

¹Kexiang Ma
^{2,*}Hui Chen
³Yi Zhang
⁴Liangjie Zhang

Research on the Development Status and Influence of Zhengzhou Primitive Celadon in the Context of Artificial Intelligence



Abstract: - In today's environment where the development of artificial intelligence is clearly accelerating, the research on traditional Chinese ceramics has also been influenced by it. Through artificial intelligence technology, we delve into exploring the developmental status and influence of Zhengzhou primitive celadon in Chinese ceramic culture, and conduct analysis and research through big data screening. At the same time, this provides a theoretical basis for the protection and inheritance of Zhengzhou primitive celadon. Zhengzhou primitive celadon. Through artificial intelligence means, we obtain relevant data from literature and archaeological discoveries related to China's primitive ceramics, and then conduct systematic research to deeply explore the cultural connotations of Zhengzhou primitive celadon. As a part of ancient Chinese ceramic culture, although the history of Zhengzhou primitive celadon can be traced back to the Shang and Zhou dynasties, due to geographical and historical reasons, its status and influence are relatively low. Under the conditions of artificial intelligence, the in-depth analysis of its unique value through big data analysis helps to better understand and inherit this unique variety of celadon, Zhengzhou primitive celadon. It provides theoretical support and guidance for the protection and inheritance of Zhengzhou primitive celadon. By utilizing artificial intelligence means to participate in the revival and development process of Zhengzhou celadon, it has positive significance for promoting the greater development of Zhengzhou primitive celadon in the field of ceramic art.

Keywords: Artificial Intelligence, Big Data, Zhengzhou Primitive Celadon, Status and Influence.

I. DEVELOPMENTAL HISTORY OF ZHENGZHOU PRIMITIVE CELADON WARE

A. *Origins and Development of Primitive Celadon Ware*

It is widely acknowledged that China is the country that invented ceramics. Archaeological discoveries have revealed the existence of a diverse array of pottery in China as early as the Neolithic era. The birth of primitive celadon was a gradual process.

In the current era of flourishing artificial intelligence development, this research will utilize big data technology to collect and compile literature and archaeological discovery data on primitive celadon. It will also employ AI methods such as literature analysis and cultural interpretation to systematically and deeply analyze the historical origins, unique value, and special status of Zhengzhou primitive celadon in Chinese ceramic culture. The aim is to reveal the cultural connotations of this ceramic variety and provide a theoretical basis for its protection and inheritance. Simultaneously, it will explore the positive role of AI in promoting the revival and development of Zhengzhou primitive celadon and promoting Chinese ceramic culture, with the goal of comprehensively achieving the excavation, research, inheritance and development of this unique ceramic type. In summary, this research comprehensively applies AI-related techniques such as big data analysis, literature mining, and cultural interpretation to thoroughly analyze the historical status and cultural value of Zhengzhou primitive celadon, and provides theoretical support for its protection, inheritance and future development [1].

The development of ancient Chinese ceramics can be divided into different stages, including primitive earthenware, primitive celadon, and mature celadon. The Shang and Zhou dynasties were part of the primitive celadon stage. Although the products of each stage differed in firing techniques and quality, they can all be categorized as ceramics. As for Zhengzhou primitive celadon, there has been little research in the ceramics industry. Based on existing archaeological data screened using AI big data, a table has been compiled showing the major primitive celadon sites and situations unearthed in the Zhengzhou area (Table 1):

The trajectory of Chinese ceramics encompasses significant development, ranging from the earliest painted pottery to ceramics. This progression can be outlined as the transition from Painted pottery to primitive porcelain, celadon porcelain, white porcelain, and later the introduction of colored glaze porcelain during the Northern Song dynasty. Subsequent breakthroughs during the Ming and Qing dynasties further elevated the craft, marking five

¹ Zhengzhou University of Aeronautics, Zhengzhou 450046, China

² Kangwon National University, Chuncheon 24341, Korea

³ Zhengzhou University, Zhengzhou 450001, China

⁴ Zhengzhou University, Zhengzhou 450001, China

*Corresponding author: Hui Chen

Copyright © JES 2024 on-line : journal.esrgroups.org

pivotal milestones in the history of Chinese ceramics. Early Chinese primitive celadon dates back to the middle of the Shang Dynasty, over 4000 years ago, during the late period of the Longshan culture. Excavations have unearthed numerous examples of celadon porcelain from this time, confirming that porcelain had already appeared in China by the middle of the Shang Dynasty. During this period, high temperature pottery appeared, characterized by a greenish-blue glaze with brown undertones and a firmer texture compared to earlier forms. These early ceramics often exhibited a grayish-white appearance akin to common green bricks. Due to the relatively rudimentary firing techniques, rough craftsmanship, and lower firing temperatures, these early ceramics displayed a primitive and transitional nature, thus earning the designations “primitive porcelain” or “primitive celadon” [2].

Table 1: The Major Archaeological Sites and Circumstances of Proto-celadon Excavated in the Zhengzhou Region

Site Name	Location	Times	The vessel shapes are typically decorated with celadon glazes, mainly for daily decorative and utilitarian ceramics.
Zhengzhou Erliqiang	Henan, Zhengzhou	Distance to today approx. 3600 years	Primitive ceramic zun (vessel), primitive ceramic zun with flared opening, with slanted shoulders, rounded bottom, vessels with celadon and yellowish glazes applied to the surface.
Xia Dynasty primitive celadon	Henan, Yenshi	Xia Dynasty	Primitive celadon long-necked flat-bottomed gui vessel, sandy grey body, celadon glaze. Relatively thick bundled neck.
Zhengzhou Xiaoduanqiao Site	Henan, Zhengzhou	Sui to Tang Dynasty	The vessel shapes include zun and weng types, mainly the zun type. They are mostly bluish-grey bodies with bluish-green or bluish-grey glazes. The glaze adhesion is relatively poor, with some even completely flaking off.
Western Side of Gongminglu Road, Zhengzhou - Shang Dynasty Tombs	Henan, Dengfeng	Shang Dynasty	Unearthed were primitive ceramic zun vessels with flared openings, with bluish-yellow glazes applied to the surface.
Xinzheng Wangjinglou	Henan, Xinzheng	Distance to today approx. 3600 years	They have a grey body with an iron rust color on the surface. There are also a small number of tiny shards. The body is hard and delicate in quality, mostly greyish-white or brownish-white in color. The vessel surfaces are decorated with olive green, bluish-green or brown glazes, with patterns of square grids and mat patterns under the glaze.

The term “primitive celadon” is also associated with “primitive porcelain”. The issue of its inception has sparked varied perspectives within the international academic community. Another viewpoint regarding the commencement of primitive celadon is primarily based on archaeological findings. Through archaeological discoveries, it is evident that during the Western Zhou period, the raw materials for pottery production transitioned from local sources to the utilization of kaolin, which contains trace amounts of Fe₂O₃, allowing for pottery firing temperatures to reach 1200°C. Primitive porcelain thus evolved from this development. By the Shang Dynasty, primitive celadon had gradually matured, featuring distinguished vessel types such as zun, weng, and dou, accompanied by diverse patterns during the latter part of the Shang Dynasty, although these designs generally exhibited a coarse and rugged quality [3].

The study of Zhengzhou's original celadon is based not only on archaeological discoveries, but also on the physical and chemical analysis of the porcelain fragments found in archaeological discoveries. Table 2 below shows the physical and chemical analysis of the chemical composition of Zhengzhou original celadon and the Longquan kiln of the Southern Song Dynasty during the peak period of celadon. It can be seen that there is not much difference in the key data between the two, and the main colorants are almost the same.

Scientific analysis has revealed that primitive celadon exhibits an uneven layer of glassy glaze on both its interior and exterior surfaces, often appearing in shades of greyish-green and yellowish-brown. Typically, yellow-green or blue-green glazes are applied to the porcelain body. This type of primitive porcelain possesses low water absorption, a pale grey-white color, and a rough texture on the body's surface [4]. Among the archaeological findings from Among the Shang Dynasty sites, primitive porcelain demonstrates refined craftsmanship, a hard

porcelain body, non-absorbent properties, and a layer of greenish glassy glaze on the surface. In the Han Dynasty, the early celadon experienced further development, with the primary production centers located in the Zhengzhou region [5]. Archaeological discoveries, such as the primitive celadon shards found in Zhengzhou Erligang, the unearthed primitive celadon zun from Zhengzhou People’s Park, and the primitive celadon zun discovered in the Minggong Road and Nanguan Shang Dynasty tombs in Zhengzhou, solidify the fact that Zhengzhou is the birthplace of primitive celadon ware, contributing to the splendid and enduring legacy of the Erligang celadon culture in Zhengzhou.

Table 2: Comparison of Physical and Chemical Properties between Shang Dynasty Proto-Celadon Shards from Erligang and Longquan Kiln Shards

specimen	chemical components(%)									Firing temperature °C	Model (3) GD
Original Erligang porcelain shards from Shang Dynasty	76.38	14.91	2.24	0.91	0.67	1.18	2.06	0.79	0.19	1180±20	9.45%
Southern Song Dynasty Longquan kiln porcelain pieces	73.93	18.36	2.43	0.39	0.31	0.67	3.16	0.22	0.15	1200±30	

Zhengzhou, as the capital city of the Shang Dynasty, served as the political and cultural center of its time. The history of ancient pottery production in Zhengzhou is long-standing and possesses its own distinctiveness and craftsmanship when compared to other regions. During the Yangshao and Longshan periods, there were over a hundred archaeological sites in the vicinity of Zhengzhou. The material evidence unearthed by the cultural relics departments in Zhengzhou and its surrounding counties and cities confirms that the city had already begun porcelain production during the Sui and Tang dynasties, which continued through the Ming Dynasty. In 1950, the discovery of primitive celadon fragments and remnants from the Erligang Shang Dynasty cultural site in Zhengzhou was recognized by the archaeological community as the earliest celadon in China. It is from this historical context that the origin of primitive celadon emerged in Zhengzhou. At the “Ancient Pottery Research Association” conference held in Beijing’s Fragrant Hills in 1977, archaeological findings unanimously confirmed that “Erligang in Zhengzhou is the birthplace of primitive celadon in China” [6].

B. The Origin and Development of Primitive Celadon Ware in Zhengzhou

Primitive celadon ware in Zhengzhou refers to early celadon pottery unearthed in the Zhengzhou area of China. It originated during the late Tang Dynasty and the Five Dynasties period, and further developed during the Northern Song, Jin, and Yuan Dynasties. This pottery holds significant cultural value and historical significance.

According to archaeological studies, the production of primitive celadon ware in Zhengzhou can be traced back to the Shang Dynasty. The surrounding areas were rich in ceramic raw materials for firing, such as the abundant high alumina clay in Xinmi and Xingyang. Throughout history, there have been numerous cultural sites related to pottery in the Zhengzhou region. Examples include Dahe Village site in the northeast, Houzhuangwang site in the northwest, Qingtai site at the border of Chenzhuang and Xingyang, Shanggangyang site in the southeast, and Xishan site on Mangshan Ridge. The Longshan pottery culture sites include Zhanmatun site in Shibalihe Township, Mazhuang site in Xushui Township, Lagawang site on Zhongyuan Road, Niuzhai site on Tongbai North Road, and Yantong site by the Jinshui River. The pottery unearthed from these sites represents the Advanced Craftsmanship and Science. The Linshanzhai kiln, through improvement and innovation, transitioned from a semi-excavated style to a vertical kiln. The vertical kiln of Linshanzhai is a model of the entire Yangshao period, and the double-linked pot shape unearthed from Dahe Village is distinctive among ancient pottery. The pottery brazier unearthed from the Qingtai site, with a diameter of 30 centimeters, has a mirror-like smooth surface and is hailed by the archaeological community as a marvel in the history of world archaeology. The hard white pottery found in Lagawang, The tire bone from the firing temperature, water absorption, porosity and other indicators have been close to the relevant standards of porcelain. laid a solid foundation for the emergence of porcelain.

Through archaeological discoveries, it has been revealed that during the early Zhou Dynasty, the Xichenzhuang site on Minggong Road in Zhengzhou already had the most advanced the incoming direct-flame kilns first of that time. By the Western Zhou period, the Luoda Temple on Zhongyuan Road in Zhengzhou had a semi-downdraft kiln known as the mantou kiln. The hard white pottery unearthed from the Lagawang site on Zhongyuan Road in Zhengzhou laid the foundation for the production of primitive celadon ware in Zhengzhou. In the late Zhou period,

ceramic production in Zhengzhou had developed on a large scale. The Jiangzhai site in Zhengzhou had dozens of ancient ceramic kiln sites and hundreds of kilns, a rarity in other regions of China. Inside the Fourteenth Middle School on Minggong Road in Zhengzhou, a small-scale kiln site was excavated, covering an area of approximately 1400 square meters. It contained 14 semi-downdraft kilns, 10 house foundations, and areas designated for kilns, drying clay, and workshops. This indicates the presence of clear division of labor and zoning during that time (Storage, billeting, drying, glazing and firing are all called workshop areas) [7].

The development of craft and technological advancements during the Shang Dynasty provided the necessary conditions for the firing of primitive celadon ware. For example, within the approximately 50 square miles of Shang Dynasty sites in Zhengzhou, there are remnants of handicraft workshops such as copper smelting sites, bone processing sites, and brewing sites. Excavated artifacts include bronze ritual vessels, tools, and more. The highly developed bronze smelting technology of the Shang Dynasty required temperatures as high as 1000-1100°C, a testament to the extraordinary productivity of the Shang Dynasty. The flourishing productivity provided ample conditions for the emergence of primitive celadon ware [8]. Furthermore, during the Shang Dynasty, there was a well-developed handicraft industry with specialized divisions of labor refined to an extreme level. In the pottery workshops discovered on the western side of Minggong Road in Zhengzhou, pottery kilns were concentrated. Apart from pottery-making tools, a large number of clay pottery fragments, such as basins, jars, and dishes, as well as **pottery specimen fragments**, were also found [9]. The advanced productivity and commercial environment of that period provided favorable conditions and environment for the birth of primitive celadon ware.

Using artificial intelligence, an overview of the stages of development of the original celadon in Zhengzhou, Zhengzhou, as well as the characteristics and features of the original celadon at different stages are as follows:

Table 3: Different Developmental Stages and Characteristics of Zhengzhou Proto-Celadon

period	With the gradual increase in firing temperature, enameling rate, mechanical strength are improved, water absorption, porosity, etc. are reduced.
Early primitive celadon stage	<p>Appeared in the early Shang Dynasty, representing the product of pottery development stage.</p> <p>Bronze culture and pottery culture fusion, opened the human ceramic art precedent. The main shapes are zun, bowls, plates, bottles and so on.</p> <p>Distributed in Zhengzhou, Henan, Anyang, - The wares basically have the characteristics of porcelain, but still with primitive, such as increased porosity, glaze color is not stable.</p>
Celadon stage	<p>Chinese porcelain goes through the development stages of primitive celadon, celadon, white porcelain and colored porcelain.</p> <p>Zhengzhou primitive celadon is differentiated from the celadon of the Eastern Han Dynasty.</p> <p>Well-made, fine decoration, into the early southern celadon ware heyday.</p> <p>Celadon ware complex shape, pattern distribution, widely used and partially replaced bronze and lacquer.</p>
Mature celadon stage	<p>The artifact production process, glaze color and decoration have reached a high level.</p> <p>Through archaeological restoration and academic research, to have a deeper understanding of Zhengzhou primitive celadon and its characteristics.</p> <p>Demonstrate the exquisite craftsmanship and colorful artistic expression of ancient Chinese ceramic craftsmanship.</p>

During the Song, Jin, and Yuan dynasties, the production of primitive celadon ware in Zhengzhou experienced further development, both in terms of quantity and quality, making it an important art form of that time. Particularly in the Song Dynasty, primitive celadon ware from Zhengzhou gained great acclaim for its unique green glaze and distinctive decorative designs, earning it the title of “The Number One Porcelain in the World”.

However, with the arrival of the Ming and Qing periods, the production of primitive celadon ware in Zhengzhou gradually declined and eventually disappeared from the stage of history. It wasn’t until the 1970s that the region began to excavate and rediscover this cultural heritage, sparking widespread attention from the domestic and international academic communities [10].

With the archaeological discovery of primitive celadon ware in Zhengzhou, other archaeological findings in the Central Plains region began to emerge. Among them: in 1957, a celadon kiln was discovered in Tiejianlu Village, Gongxian County, Henan Province; in 1959, a celadon kiln was found in Jiabi Village, Cixian County, Hebei Province; in 1974, a celadon kiln was unearthed on the southern bank of the Henghe River in Anyang, Henan Province. Subsequently, nearly ten counties and cities such as Yiyang, Hebi, and Dengzhou in Henan Province also unearthed celadon kilns. During the Later Zhou Dynasty in the Five Dynasties period, celeste glazed porcelain

had already become popular in the Ten Kingdoms in the regions south of the Yangtze River, while the roots of celadon ware originated in Zhengzhou in the northern part of China

II. THE CRAFTSMANSHIP CHARACTERISTICS AND VALUE OF PRIMITIVE CELADON WARE IN ZHENGZHOU

A. *The Craftsmanship Characteristics of Primitive Celadon Ware in Zhengzhou*

Primitive celadon ware appeared during the Western Zhou, Spring and Autumn, Warring States, and Han dynasties. It was a product of the transition from pottery to porcelain, evolving from impressed hard pottery. During the Western Zhou period, the craftsmanship of primitive celadon ware improved, and its unearthed range became more extensive. Based on current archaeological findings, the quantity and variety of primitive celadon ware unearthed in the south of the lower reaches of the Yangtze River are greater than those in the northern Yellow River Basin. During the era of the Western Zhou Dynasty, the artistry of porcelain had advanced to a point where glaze had become an indispensable component. Beyond its practical functions of creating a waterproof barrier and aiding in easy cleaning, glaze also served as a means of ornamentation, enhancing the aesthetic allure of porcelain wares. This captivating glaze, resembling a form of glass, possessed the remarkable ability to manifest an array of vibrant hues when delicately applied to the porcelain surface. Glaze is a kind of vitreous body, due to the reason that it contains the metal element iron, generally is the original celadon showing green, green color palette [11].

The book *Monochrome Glazed Porcelain of the Qing Dynasty*, published in Taiwan in 1981, describes it as follows: “Iron oxide serves as the colorant for the primitive celadon ware of ancient China during the Shang and Zhou dynasties. The varying amounts of iron oxide, combined with different temperatures and firing atmospheres, result in completely different shades, ranging from powder blue, emerald green, york yellow, amber, purple gold, oxblood red, tea foam, to black. Even the vermilion red on the glaze is caused by the presence of iron elements. By using an equal amount of iron oxide as a coloring agent, a yellow hue is created in an oxidizing atmosphere, while a green hue emerges in a reducing atmosphere. With modern techniques and terminology, it is possible to achieve shades such as aquamarine, pea green, light-bluish-green, shrimp green, rice yellow, dark red, black, and celadon. All these variations indicate that the primitive celadon ware was made using wood ash glaze.”

During the Shang Dynasty, the ceramic production process in Zhengzhou was relatively simple, resulting in coarse-textured porcelain. However, certain characteristics were already emerging during this period. For instance, such as the decoration of primitive celadon the craftsmanship continually improved, giving rise to a diverse range of vessel shapes. Moreover, this development in Zhengzhou also influenced the production of celadon in other regions.

The primitive celadon ware from Zhengzhou is one of the early representatives of celadon production in China, exhibiting several distinctive artistic features:

- 1) *Porcelain stone, grass ash, porcelain clay*: The raw materials used for the production of primitive celadon ware in Zhengzhou differ from those in other regions. It utilizes locally sourced yellow clay and kaolin clay as the main ingredients. After many times of selecting, crushing, filtering, aging, practicing clay, molding, glazing, firing and so on to make the product. The colorant used in the glaze of Shang and Zhou celadon, as well as in the glazes of celadon from the Warring States, Han, Tang, and Song dynasties, including famous kilns like Yue, Ru, Yaozhou, Guan, and Longquan kilns, is the same—iron serves as the primary colorant [12]. The large quantity of unearthed Shang and Zhou celadon ware and their widespread distribution indicate that an understanding of ceramics clay was already developed based on accumulated experience. Therefore, kaolin clay was chosen as the raw material [2]. The clay used in primitive celadon ware from Zhengzhou primarily comes from the clay deposits of Gangshan and Yandian in the Yellow River basin, employing high-temperature firing techniques. The clay in the Zhengzhou region is rich in iron and various other minerals, making the body of the primitive celadon ware stronger and more solid than other types of celadon.
- 2) *Utilization of High-Temperature Firing Techniques*: The primitive celadon ware from Zhengzhou undergoes firing at temperatures exceeding 1200°C, resulting in a Perform firing. This process significantly enhances its impact Ceramic strength and wear resistancer, while also imparting a delicate and smooth texture to the porcelain.
- 3) *Predominance of green Glaze as Main Decoration*: Zhengzhou original celadon is usually coated with prepared glazes, which exhibit a clear and transparent surface, emanating a subtle luster. The green glaze, in particular, stands out as one of the distinctive features of the primitive celadon ware from Zhengzhou, serving as an important hallmark of this type of ceramic ware. It evokes a sense of freshness and elegance, adding to its aesthetic appeal.
- 4) *Distinctive Shapes*: However, with the passage of time, the production techniques gradually improved, leading to a greater variety of vessel forms and more exquisite decorative techniques. The primitive celadon ware

from Zhengzhou showcases unique and distinctive shapes. The range of vessel forms remains relatively stable, including bowls, basins, dou (a type of vessel), plates, he (a type of vessel), gui (a type of vessel), lei (a type of vessel), weng (a type of vessel), guan (a type of vessel), and zun (a type of vessel), among others. These forms are characterized by their graceful appearance, sleek lines, and a rustic beauty that emanates a sense of natural simplicity. The discovery of similar vessel forms throughout different regions indicates a commercial aspect to their production, suggesting that the handcraft industry of the primitive celadon ware during the Shang and Zhou periods may have begun to evolve into a specialized sector.

5) *Unique Production Techniques:* The production process of the primitive celadon ware from Zhengzhou differs from that of porcelain in other regions. It involves steps such as crushing, sieving, mixing, shaping, drying, kiln loading, and firing. Among these steps, The most important of these are the two stages of shaping and firing, which determine the color and quality of porcelain. The water absorption properties of Shang and Zhou celadon ware were already comparable to those of later porcelain. Because the ratio of silica in the bodies of these celadon ware is close to that of the bodies of porcelain from famous kilns after the Tang Dynasty, both range from 59% to 76%, and aluminum oxide ranges from 15% to 20% (table 4).

Table 4: Chemical Composition of Ceramic Body Materials in Different Eras

name	Locations	era	Model (3) GD										Gross amount
			SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	TiO ₂	CaO	MgO	K ₂ O	Na ₂ O	MnO	Ignition loss	
			67.08	16.07	6.4	0.8	1.67	1.75	3	1.04	0.09	1.47	100.25
Painted pottery	Xi'an Banpo	Yangshao	63.57	15.2	5.99	0.92	2.65	2.43	2.77	1.62	0.07	5.39	100.61
Black pottery	Chengzi Cliff in Shandong Province	Longshan	59.26	16.22	6.34	1.72	5.49	2.66	2.75	1.71	0.07	3.97	100.02
Red pottery	Zhengzhou Erligang	Early Shang Dynasty	66.39	17.09	5.82	0.87	2.11	2.28	2.49	1.29	0.13	1.83	100.3
Grey pottery	Anyang Wudagou	Late Shang Dynasty	76.18	17.13	1.48	0.77	0.51	0.85	2.17	0.78	0.01	0.94	100.94
Primitive Celadon	Yin Xu	Shang Dynasty	72.36	19.32	1.64	0.83	1.03	0.45	3.75	1.04	0.07		100.42
	Xi'an Zhangjiapo	Western Zhou Dynasty	71.95	19.28	1.83	1.11	1.48	0.51	3.24	0.57	0.03		100
	Tunxi, Anhui Province		76.24	17.56	0.58	0.06	1.36	0.1	2.76	1.02	0.03		99.71
white blue	Hutian	Song dynasty	73.58	20.05	0.9		0.53	0.14	2.87	2.01			100.08
	Jingdezhen	Ming Dynasty	67.08	16.07	6.4	0.8	1.67	1.75	3	1.04	0.09	1.47	100.25

In general, the primitive celadon ware from Zhengzhou, as a type of ancient Chinese porcelain, possesses exquisite craftsmanship and a unique charm that distinguishes it from ceramics produced in other regions in terms of materials, forms, and production techniques. While retaining the essence of traditional Chinese porcelain, the primitive celadon ware from Zhengzhou exhibits a variety of craft characteristics, which not only reflect the technological advancements and aesthetic tastes of celadon production during that era but also On the other hand, it also reflects the diversity and excellence of early Chinese culture.

B. Value of the primitive celadon ware from Zhengzhou

The time frame of the Longshan Culture in Zhengzhou spans from 5000 BC to 3000 BC, predating the Nanyang Dadong Culture (4000 BC to 3000 BC) and the Longkou Dawenkou Culture (approximately 4000 BC to 3000 BC). This chronological precedence serves as substantial evidence that Zhengzhou is the birthplace of celadon, with its celadon technology directly influencing surrounding regions. The value of the primitive celadon ware from Zhengzhou can be observed in several aspects:

1) *Technological Maturity:* Zhengzhou celadon exhibits superior production techniques, such as thin and lightweight bodies, blue-green glazes, and even glaze application. These characteristics suggest extensive

technological accumulation and development over a long period of time, unlike in other regions where celadon production techniques were less mature.

2) *Quantitative Advantage*: To date, the amount of celadon found in Zhengzhou far exceeds that of other regions. Just at the Longshan site in Zhengzhou alone, nearly ten thousand pieces of celadon ware have been discovered, making it one of the largest quantities among contemporaneous sites in China and highlighting its advantage in celadon production.

3) *Transmission of Craftsmanship*: Situated in the heartland of China, Zhengzhou serves as a cultural crossroads where several major ancient Chinese cultures converge. It is highly likely that celadon technology from Zhengzhou spread to other regions through this gateway, integrating with local conditions and giving rise to distinct celadon cultures, such as in Hubei and Sichuan. This exemplifies the crucial role of Zhengzhou in the dissemination of celadon technology.

4) *Cultural Representation*: The vessel forms of Zhengzhou celadon, such as plates, dou (vessels), and ding (tripod cauldrons), as well as the decorative patterns of fish and branch motifs, have become typical representatives of China's Neolithic celadon culture. This culture is known in academic circles as the "Longshan Culture" or "Zhengzhou Culture", demonstrating the leading role of Zhengzhou celadon in the formation of this culture.

It is evident that the primitive celadon ware from Zhengzhou possesses significant advantages and representativeness in terms of time, technology, culture, quantity, and the transmission of craftsmanship. These factors provide solid evidence for its critical position in the history of ancient Chinese ceramics.

III. THE STATUS AND INFLUENCE OF PRIMITIVE CELADON WARE FROM ZHENGZHOU IN ANCIENT CHINESE CERAMIC CULTURE

A. *The Status of Primitive Celadon Ware from Zhengzhou*

The primitive celadon ware from Zhengzhou occupies a significant position and exerts a profound influence in ancient Chinese ceramic culture. Its unique production techniques, technological features, and cultural significance have played a crucial role in the development of Chinese ceramics.

Chinese porcelain traces its origins back to the primitive celadon from Zhengzhou, and it was not until the Eastern Han Dynasty that true porcelain was produced. Over a span of more than 1,300 years, encompassing the Wei-Jin, Northern and Southern Dynasties, Sui, Tang, Five Dynasties, and Ten Kingdoms periods, the development of celadon was a gradual and lengthy process.

By the time of the Northern Song Dynasty, although the ceramic industry had experienced rapid growth, celadon still reigned supreme. It can be said that celadon reached the pinnacle of its development, giving rise to the renowned "Five Great Kilns" of Chai, Ru, Guan, Ge, and Ding.

In Xu Zhiheng's *Yinliu Zhai Shuo Ci* (Discussions on Porcelain in the Yinliu Studio), it is recorded that "Qing Celadon, with its azure hue resembling the clear skies after a rain, passes on its distinguished characteristics. Dong Kiln in Bianjing (Chenliu Dong Kiln) carries on this legacy, while Ru Kiln inherits the delicate bean green from it". Xu Zhiheng believed that Zhengzhou Chai Kiln embraced the ancient heritage of Qing Celadon (dating back to the original Shang Dynasty celadon from Zhengzhou). Furthermore, Dong Kiln and Ru Kiln both inherited the mesmerizing sky-blue shades from Chai Kiln, signifying a lineage connecting Ru Kiln and Chaikiln.

It is also possible, as mentioned by Jing Zijiu, that "Craftsmen from the Chai Kiln flocked to Junzhou (Yangdi)". According to the *Atlas of Chinese History*, during the Ming Dynasty, both Zhengzhou and Yuzhou belonged to Kaifeng Prefecture. Therefore, Yuzhou was known as "Yuzhou of Bianjing", and the production area of ceramics should have been in Shenhou. However, further research is needed to determine the connection between the jun white glaze of the Jun Kiln and the Chai Kiln. The Jun Kiln was already famous during the Northern Song Dynasty. Huang Yu in *Cishi* stated, "The Song Dynasty had numerous famous kilns, approximately numbered as Rao, Ru, Guan, Ge, Jian, Xiang, Ji, Dong, Jun, Yao, and Deng, totaling twelve. Among them, the most outstanding is the Jun Kiln".

The craftsmanship and technological characteristics of the primitive celadon ware from Zhengzhou are truly unique. It employs high-temperature firing and a formula rich in alumina and silica, resulting in a delicate ceramic texture with a lustrous green glaze. Additionally, it possesses a certain seismic resistance, making it an important representative in the production of ancient Chinese celadon. Furthermore, the primitive celadon ware from Zhengzhou has achieved notable accomplishments in vessel design, and cultural inheritance, providing valuable references and inspiration for the development of Chinese ceramics.

The primitive celadon ware from Zhengzhou has played a pivotal role in advancing the field of ancient ceramics. As early as the Eastern Han Dynasty, the Zhengzhou region stood as one of China's political, economic, and cultural centers, fostering significant developments in ceramics production. With the emergence of the primitive celadon ware from Zhengzhou, ceramic manufacturing techniques underwent further refinement. Its distinct features, such as the green glaze, fine texture, simple forms, and exquisite decorations, were widely employed in the production of ancient ceramics, laying a solid foundation for the growth and prosperity of ancient Chinese ceramic culture [13].

Even in modern ceramic culture, the primitive celadon ware from Zhengzhou continues to retain its important heritage and innovative value. Its craftsmanship and technological characteristics have found extensive application and development in contemporary ceramic production, offering new avenues and directions for the innovation and advancement of Chinese ceramic culture.

In summary, the primitive celadon ware from Zhengzhou holds a significant position and exerts a profound influence within the realm of ancient Chinese ceramic culture. Its preservation and evolution bear crucial significance and value in nurturing the thriving and development of Chinese ceramic culture.

B. The Influence of the Primitive Celadon Ware from Zhengzhou

The primitive celadon ware from Zhengzhou marked the beginning of the transition from pottery to porcelain during the Shang and Zhou Dynasties. At that time, the craftsmanship and quality of the vessels were relatively crude and inferior. However, during the Spring and Autumn Period, the production of the primitive celadon ware from Zhengzhou experienced further development, becoming more refined in terms of production techniques.

During the Warring States Period, the influence of the primitive celadon ware from Zhengzhou expanded. The production of the primitive celadon ware in the south of the Yangtze River became more diversified, and began to apply green ash glaze for firing. A wide range of everyday utensils emerged during this period. In the Qin and Han Dynasties, significant differences can be observed compared to the Warring States Period. These differences mainly manifested in the clay quality and glaze material. The porosity and water absorption rate are high, presenting a gray or dark gray color. During the Warring States period, the overall glazing method was replaced with partial glazing on the mouth, shoulder, and inner bottom, improving the glazing technique [14].

During the Eastern Han Dynasty, a notable characteristic emerged as the primitive celadon ware replaced lacquerware in dining practices. The primitive celadon ware broke free from its decline during the Western Han Dynasty and experienced full development. Techniques such as fast wheel throwing, line-cutting on the base, and adhesion of the base after air-drying contributed to the formation of more regular vessel shapes. After forming, the vessels underwent further refinement and water replenishment to achieve a smooth and pristine surface without brown spots. The glazing technique transitioned from brush glazing to pouring glaze, resulting in a surface free from glaze detachment. The clay body began to utilize mineral porcelain materials exclusively, and most of the ceramics were fully covered with a relatively thin glaze layer. At this stage, the primitive celadon ware state was completely transformed, marking the beginning of celadon's journey and its entry into a mature phase. The appearance of celadon garnered favor quickly, leading to its rapid development and widespread popularity in both northern and southern China. Craftsmanship and techniques continued to improve, eventually making a global impact and contributing to human civilization.

The emergence of primitive celadon from pottery is largely attributed to overall technological advancements, particularly the increase in firing temperature. Zhengzhou area pioneered the transition from updraft kilns to downdraft kilns, primarily to mitigate temperature differentials within the kiln. Judging from the semi-downdraft kiln unearthed from the Zhengzhou Hospital of Traditional Chinese Medicine Family Compound in 1985, the kiln had already met the requirements for firing celadon. The major improvement from updraft to downdraft kilns lies in the direction of the flames.

The unearthed ancient kiln site at the Family Courtyard of Zhengzhou Traditional Chinese Medicine Hospital boasts a kiln bed area exceeding five square meters. The kiln bed area has reached over five square meters, with the kiln door, firebox, kiln bed, and chimney aligned along a single axis. This continuous increase in kiln volume, along with a scientific and reasonable layout, has enhanced ceramic production output. In the "Cultural Relics Reference Materials" of 1956, it is documented: "Within Zhengzhou's Minggong Road, on the west side of No. 14 Middle School, a small-scale kiln site from the Yin-Shang dynasty was discovered, covering approximately 1,400 square meters, with 14 semi-downdraft kilns and 10 houses". This indicates that there was already a clear division of labor and zoning at that time. The site includes areas for kilns, workshops, and clay drying. The

discovery of this kiln site further substantiates Zhengzhou's role as the origin and sacred land of primitive celadon and subsequent celadon production.

Archaeological excavations have demonstrated that more advanced semi-downdraft and downdraft kilns were developed earlier and reached a higher level of maturity in the middle and lower reaches of the Yellow River in Henan, Shaanxi, and Shanxi provinces. However, in the upstream regions of Gansu and Qinghai, as well as the downstream regions of Shandong and the middle and lower reaches of the Yangtze River, no semi-downdraft kilns similar to those found in Zhengzhou have been discovered to date.

During the turbulent period of the Five Dynasties, many skilled craftsmen proficient in the art of white porcelain migrated to the southern regions. They collaborated with local celadon artisans, utilizing the local resources and craftsmanship to spread the production of bluish white porcelain in the south. Over time, this collaboration saw remarkable development and eventually gave birth to the variety known as Jingdezhen shadowy blue ware. The discovery of bluish white specimen shards in Zhengzhou's Dongdajie Street in 2003 serves as significant proof in tracing the lineage of celadon from Chai kiln. Hence, the historical progression becomes clear: the hard white pottery of Galawang during the Yangshao period, primitive celadon ware of Zhengzhou in the Shang Dynasty, green-glazed ceramic of the Han Dynasty, and bluish white porcelain of the Tang Dynasty. This lineage has been inherited and meticulously traced. The primitive celadon ware of Zhengzhou holds a significant position with profound influence in ancient Chinese ceramic culture, notably demonstrated in the following aspects:

- 1) *The Earliest Porcelain Center in China:* The era of primitive celadon ware from Zhengzhou can be traced back to 5,000 to 3,000 years ago, preceding the appearance of porcelain in other regions of China. It served as the earliest center for porcelain production and usage, laying the foundation for the development of Chinese porcelain.
- 2) *The Origins of Celadon Development:* With its unique celadon culture, Zhengzhou influenced and promoted the emergence and development of celadon in the Central Plains and surrounding areas of China. Many regions' celadon originated from Zhengzhou but developed their own distinct characteristics.
- 3) *Inspiration for Renowned Kilns:* Many features of primitive celadon ware from Zhengzhou, such as the green glaze, Thin tires, and spiral patterns, inspired and influenced numerous famous kilns in later periods. Examples include the Nanyang Kiln in Henan, the Luoyang Kiln in Henan, the Longkou Kiln in Shandong, and the Jianghe Kiln in Hubei. These kilns inherited and developed the traits of Zhengzhou celadon.
- 4) *Ancestor of Ancient Ceramics Worldwide:* Zhengzhou was one of the earliest centers in the world for producing hard-glazed ceramics. The primitive celadon is widely recognized as the precursor of ancient glassware and porcelain., exerting a significant influence on glass and ceramics worldwide in ancient times.
- 5) *Representative of Chinese Ceramic Culture:* Primitive celadon ware from Zhengzhou bears distinct characteristics of Central Plains culture. Its vessel shapes and decorative patterns represent the aesthetics of traditional Chinese culture and serve as a microcosm and symbol of Chinese ceramic culture, reflecting the cultural heritage of the Chinese nation.

Conclusively, primitive celadon ware from Zhengzhou not only holds a central position in the history of ancient Chinese porcelain development but also exerts profound influence on glass and ceramics worldwide in ancient times. It serves as a representative of Chinese ceramic culture, symbolizing the rich cultural heritage of the Chinese nation. This substantiates the crucial role and influence of primitive celadon ware from Zhengzhou in the ancient Chinese ceramic culture.

C. *Inspiration of Zhengzhou Celadon on Subsequent Famous Kilns*

During the period of the Two Jin Dynasties and the Southern and Northern Dynasties, the era of primitive celadon ware emerged. This period was characterized by significant splits and upheavals in Chinese history. Apart from a brief period of unity during the Western Jin Dynasty, the north and south regions remained in a state of prolonged division and confrontation. However, amidst this turbulent era, the production of primitive celadon ware, closely intertwined with people's daily lives, did not stagnate. Instead, it entered a new phase of development and essentially broke away from the inherited craft tradition of late Han Dynasty, acquiring its own characteristics of the time. In terms of shaping methods, besides the improved efficiency of wheel-throwing, techniques such as paddling, impressing, carving, stacking, and mold-forming were also employed. This marked the advent of the celadon era, gradually replacing pottery, bronze ware, and lacquerware, becoming the main utensils for people's daily lives. It was extensively used in dining, study rooms, hall furnishings, and even funerary rituals.

During the Southern and Northern Dynasties, influenced by Buddhism, the carving of lotus petal motifs became popular. In the later period of the Northern Dynasties, white glazed porcelain emerged in the north, while in the south, box-shaped bowls became prevalent.

During the Sui and Tang Dynasties, a pattern of “Southern Celadon and Northern White Porcelain” emerged. However, this was actually misled by the narrative of Chinese Ceramic History. In Henan province at that time, there were more than a dozen counties and prefectures producing celadon ware, such as the “Deng Kiln” in Nanyang, the “Jun Kiln” in Yuzhou, the “Yiyang Kiln”, the “Hebi Kiln”, the “Linru Kiln”, the “Baofeng Kiln”, the “Zhengzhou Kiln”, and the “Xin’an Kiln”.

The Song Dynasty witnessed the peak of celadon production, with the emergence of six famous kilns known as the “Chai, Ru, Guan, Ge, Jun, and Ding” kilns. Except for the “Ge Kiln”, all of them were located in the northern regions.

During the late Eastern Han Dynasty, under the reign of Emperor Ling, celadon with its modern significance was finally produced. Through modern scientific testing, it has been determined that the appropriate amount of iron elements in the glaze plays a role in coloring. The firing temperature was increased to above 1200 degrees Celsius, resulting in the formation of more crystalline minerals such as mullite during the firing process. This improved the mechanical strength of the porcelain, reducing deformation and warping, and making the ceramic ware more refined. To prevent roughness in the body clay, craftsmen also made improvements in the pulverization, washing, and kneading of raw materials. Innovations were made in glaze washing and sieving, making the glaze slurry more delicate. The application of glaze was changed from brushing to dipping, enhancing the adhesion of the glaze. To ensure a smooth and polished surface of the ceramic body, additional processes such as refining, polishing, and water replenishment were carried out after the body had cooled down, eliminating the presence of impurities or defects. This process went through several hundred years of refinement, culminating in the production of porcelain during the late Eastern Han Dynasty, receiving favor from the imperial court and the nobility. People also experienced the true charm of genuine celadon. As the mineral raw materials contained iron elements, the resulting wares were mostly green in color, leading to their designation as celadon. The emergence of celadon during the late Eastern Han Dynasty marked a significant leap in ceramic craftsmanship, representing a great invention in ancient China and a remarkable contribution of the Chinese nation to the world's material civilization, with its birthplace located in Zhengzhou.

Primitive celadon encompasses the entire development process of celadon, containing rich ceramic craftsmanship and aesthetic concepts. It is an indispensable and crucial source for studying celadon. Zhengzhou's primitive celadon, as the origin of celadon, occupies a fundamental position in the study of the development of Chinese ceramic art. Only by tracing back to this origin can we fully grasp the unique contribution of celadon in ceramic history and deeply understand the essence of Chinese ceramic culture.

The primitive celadon of Zhengzhou serves as the progenitor for Yue kilns, Yaozhou kilns, Ru kilns, secret color porcelain, and Longquan porcelain, making it the cultural ancestor of various other types of Chinese ceramics. This status is determined by its ancient geographical environment and location, as well as its indirect inheritance relationship with ancient settlement culture and agricultural civilization. To a certain extent, Zhengzhou's primitive celadon marks the starting point and origin of Chinese ceramics. When studying Chinese ceramic art, one should use Zhengzhou's primitive celadon as the starting point and focal point. This is because Zhengzhou's primitive celadon stands out uniquely in the history of Chinese ceramic development, representing an outstanding example among the myriad of ceramic varieties. Zhengzhou's primitive celadon is the root of these ceramic types and an indispensable link in the development of celadon. Starting research from Zhengzhou's primitive celadon helps in comprehensively understanding the unique charm and profound connotations of celadon and even the entire Chinese ceramic culture. Through in-depth examination of primitive celadon, one can clearly reveal its technical changes and aesthetic evolution, thereby understanding the significance of celadon in ceramic history and appreciating the vastness and depth of Chinese ceramic civilization.

IV. CONCLUSION

By employing artificial intelligence techniques to comprehensively sort and deeply analyze historical literature, archaeological excavation data, and other relevant information concerning the ancient Zhengzhou proto-celadon, we have thoroughly and systematically explored its significance and impact within ancient Chinese ceramic culture. This exploration reveals several key aspects:

The primitive celadon ware of Zhengzhou holds a pivotal position within the ancient Chinese ceramic culture, serving as a crucial component. Its distinct production techniques, technological features, and cultural significance offer significant insights and inspiration for the development of Chinese ceramics throughout history.

The primitive celadon ware of Zhengzhou holds a significant position and exerts a profound influence within the history of ancient Chinese ceramics, playing a pivotal role in driving the development of this art form.

Characterized by its vibrant green glaze, delicate texture, minimalist forms, and exquisite decorations, it not only possessed a unique status and value within its contemporary ceramic craftsmanship but also maintained a lasting impact on subsequent ceramic advancements.

The primitive celadon ware of Zhengzhou continues to hold significant significance and innovative value within modern ceramic culture. Its production techniques and technological features have been extensively adopted and evolved in contemporary ceramic production, offering new insights and directions for the innovation and development of Chinese ceramic culture.

Although this study was aided by the use of artificial intelligence techniques, there are still some limitations, such as insufficient historical records and limited archaeological excavation data. These factors have inevitably influenced the research outcomes and call for further improvement and refinement in future studies.

In conclusion, the primitive celadon ware of Zhengzhou holds a significant position and influence in ancient Chinese ceramic culture. Its preservation and development bear crucial importance and value for the prosperity and advancement of Chinese ceramic culture. Therefore, it is imperative to strengthen the preservation and inheritance of primitive celadon ware from Zhengzhou, uncovering its potential cultural and economic value, and making further contributions to the innovation and development of Chinese ceramic culture.

REFERENCES

- [1] Philip Read. Ceramic Art and Artificial Intelligence. *China Ceramic Industry*, 2023(6), pp73-76.
- [2] Wen Wu. The dating of the ceramic foot of porcelain. *Financial Management t (Collection)*, 2020(8), p100.
- [3] Ding Xuhui. Application of Artificial Intelligence in the Ceramic Industry. *Ceramic Science and Art*, 2022, (02), pp64-65.
- [4] Yang Bing, Xiong Qingqing. On the development of primitive ceramics to porcelain. *Jingdezhen Ceramics*, 2016, (06), pp39-40.
- [5] Miao Yun. Outline of Classic celadon of West-Zhou Dynasty in Luoyang. *Sichuan Cultural Relics*, 2010, 3, pp35-45.
- [6] Wang Zengguang. An analysis of the dating basis for the landscape-patterned ceramic pillows from the Jin Dynasty Cizhou Kiln. *Identification and Appreciation to Cultural Relics*, 2020(19), pp66-69.
- [7] Tian Peijie. Zhengzhou Chai Kiln Site. *Financial Management (Collection)*, 2014(12), pp16-24.
- [8] Song Lili. The research on primitive ceramics of the Zhou Dynasty in Anhui region. *Anhui University*, 2010.
- [9] Li Min. The Historical Position of Shang City at Zheng Zhou in the History of Ancient Civilization. *Jiangnan Tribune*, 2004(08), pp95-98.
- [10] Wang Wei. A review and outlook on the archaeology of the Xia, Shang, and Zhou Dynasties. *A Review and Outlook on Chinese Archaeology in the New Century*. Science Press, 2000, pp42-63.
- [11] Yang Yong. A brief discussion on the history of Chinese ceramic arts and crafts. *Literature Life*, 2011(10), pp65-65.
- [12] Sun Hongyue, Gu Huimin. A new study on the aesthetic characteristics of Song Dynasty ceramics. *Art Panorama*, 2020(12), pp86-87.
- [13] Jia Bingqiang. The inheritance and development of ceramic culture in the Central Plains during historical periods. *Beauty & Times (II)*, 2017, (06), pp24-26.
- [14] Jia Bin. A study of the pottery-making techniques of the Erlitou culture at the Nanwa site in Dengfeng. *Zhengzhou University*, 2010.