

Research Status and Trend Analysis of Longquan Celadon Based on Scientific Knowledge Atlas

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Abstract: - Using the scientific knowledge atlas software CiteSpace and scientific literature counting, taking the relevant literature contained in CNKI as the data source, this paper analyzes and interprets the publishing situation, research direction, trend and hot spots in the research field of Longquan celadon through the analysis of author and organization, keyword co-occurrence, keyword clustering, timeline and bursting keywords. Through the construction of scientific atlas and visualization research, it can be seen that researchers and institutions in this field have a strong sense of cooperation, which is conducive to the deepening of related research; the research direction has shifted from the overview of Longquan celadon to the protection, inheritance and dissemination of Longquan celadon and celadon culture; in the future, Longquan celadon in Song and Yuan Dynasties and the decorative art of Longquan celadon may become a research hotspot, thereby promoting the development of other research directions in this field.

Keywords: *Atlas of Scientific Knowledge; CiteSpace; Longquan Celadon; Celadon Culture.*

I. INTRODUCTION

China has been regarded as the hometown of porcelain since ancient times. The English name of China, China, means "porcelain" after the first letter is lowercased. There are many kinds of Chinese porcelain with their own characteristics. Celadon is one of the representative varieties of Chinese porcelain. It has become the representative of Chinese traditional culture with its clear and thorough glaze color, unique refining technology and rich and diverse decorative elements. From the perspective of development, Longquan celadon originated in the Five Dynasties, flourished in the Song and Yuan Dynasties, declined in the Ming and Qing Dynasties, and has been revived in recent years. It is not only one of the core components of Chinese traditional utensil culture; As an important carrier of Chinese traditional culture, Longquan celadon has also become a witness of cultural and trade exchanges between China and foreign countries in the historical process of being sold all over the world.

In recent years, China has actively promoted the modern protection and dissemination of excellent traditional culture, and Longquan celadon firing techniques were included in the first batch of national intangible cultural heritage list in 2006. Based on the long history of development and a high degree of attention, the research results of Longquan celadon in stock are quite abundant. Systematic combing, condensing and deduction of these results can not only give better play to the value of relevant achievements, but also provide reference for subsequent research.

II. OVERVIEW OF SCIENTIFIC KNOWLEDGE ATLAS AND CITESPACE

Scientific knowledge atlas is a structured semantic knowledge base. As a branch of information

visualization, it integrates multi-disciplinary theories and methods in the form of graph, thereby presenting the "past, present and future" of the subject under study. It mainly realizes the dimensionality reduction of data through a series of potential mapping algorithms, and completes the iterative update of knowledge with a series of construction technologies such as information extraction, knowledge fusion, processing and updating [1]. At present, the main application software of scientific knowledge atlas includes CiteSpace, VOSViewer, Gephi, Ucinet, Pajek, etc. CiteSpace is a knowledge atlas software running in Java environment. Users can freely choose LLR, LSI and MI algorithms to extract information [2], and adjust the visual style of the graph according to their needs. Compared with similar softwares, CiteSpace is more operable and easier to filter data and read information.

At present, relevant scholars have applied this scientometric method to the research and analysis of cultural fields such as industrial heritage [3], museum collections [4], cultural and creative industries [5], and intangible cultural heritage [6], etc. Therefore, it is necessary to explore the field of Longquan celadon through the method of scientific knowledge atlas. This paper will use CiteSpace and scientometric method to construct and visualize the knowledge map in this field.

III. DATA SOURCES AND RESEARCH ROUTE

3.1 Data Sources

Taking CNKI periodical database as the data source, this study sets "Longquan Celadon" or "Longquan Kiln Celadon" as the subject word for retrieval. The time is set from 1980 to 2020 and the time span is 41 years. A total of 941 documents are obtained. With the help of manual removal of duplicate documents, non-research documents such as conference summaries, news reports, works and character interviews are removed, and 674 relevant documents are obtained.

3.2 Research Route

With the help of the software CiteSpace (version 5.7.R3) and scientometric method, this paper provides insight into the research status, hotspots and trends of Longquan celadon. Firstly, through the counting of literature data in different periods, we can understand the research process of Longquan celadon as a whole, and explore the general situation of papers on Longquan celadon from the analysis of author distribution, organization distribution and their correlation; Secondly, through keyword co-occurrence and keyword cluster analysis, the research status and research focus of Longquan celadon are interpreted on the basis of visual knowledge maps; Finally, with the help of Timeline view and keyword emergence analysis, this paper analyzes the research trends and related research hotspots of Longquan celadon.

IV. STATISTICAL ANALYSIS OF RESEARCH LITERATURE ON LONGQUAN CELADON

4.1 Analysis on the Number of Literatures Issued in Different Years

Quantitative analysis of the literatures was carried out by using the scientific literature count embedded in CNKI, as shown in Figure 1. On the whole, the number of research documents in the field of Longquan celadon is on the rise, and since 2004, the number of related literature results has increased significantly. This is mainly because in 2003, the former General Administration of Quality Supervision, Inspection and Quarantine approved the implementation of regional product protection for "Longquan celadon". After that, the government has also continuously introduced policies to promote the development of Longquan celadon industry and forging techniques. The support and protection of relevant policies have resulted in a significant increase in research activities and achievements in this field.

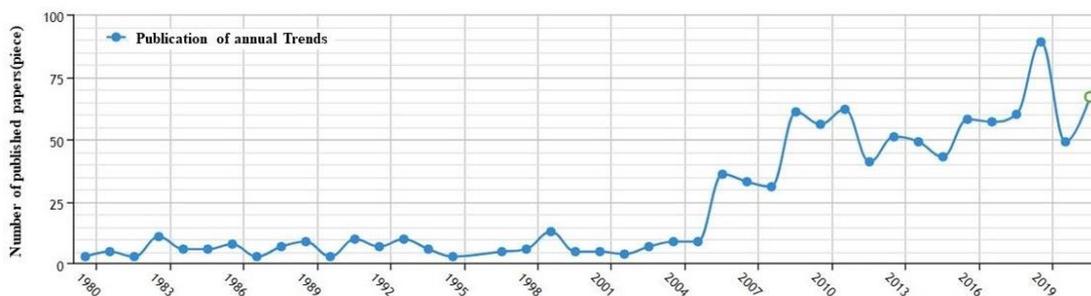


Fig.1 Distribution of publications in Longquan celadon research field from 1980 to 2020

4.2 Distribution Analysis on Author and Institution

Export the screened 674 CNKI journal documents in Refworks format, import them into CiteSpace software, and select "Author" and "Institution" for knowledge map drawing. After adjusting the thresholds, the author distribution map in the research field of Longquan celadon is obtained, as shown in the figure. 2. In the figure, the nodes are displayed in circles. The size of the circle and font represents the number of published articles. The lines connecting the nodes represent the mutual cooperation between scholars. The darker the line, the earlier the cooperation was established. On the contrary, the later the cooperation is established.

As can be seen from Figure 2, the authors Lei Guoqiang, Li Zhen and ye Hongming are the top three researchers in this field. The cooperative research network centered on Ye Hongming, Hu Zhaoxiong, Zhou Shaoda, ye Guozhen and ye Peihua is the most obvious, indicating that in the early stage of Longquan celadon research, these scholars made more contributions and have formed a stable cooperative relationship; Secondly, the cooperation network centered on Wu Junming, Li Qijiang, Wu Jun, Wu Yanfang and Zhang Maolin is also clearly visible, and its formation period is relatively late according to the color depth. In addition, there are still some small cooperation networks, such as Zhou Shaohua, Li Desheng and Xu Chaoxing, which have formed their own cooperation networks. To sum up, many cooperation networks have been formed in the field of Longquan celadon. The authors have a strong mutual relationship and a clear sense of cooperation, which effectively promotes the continuous and in-depth development of related research.

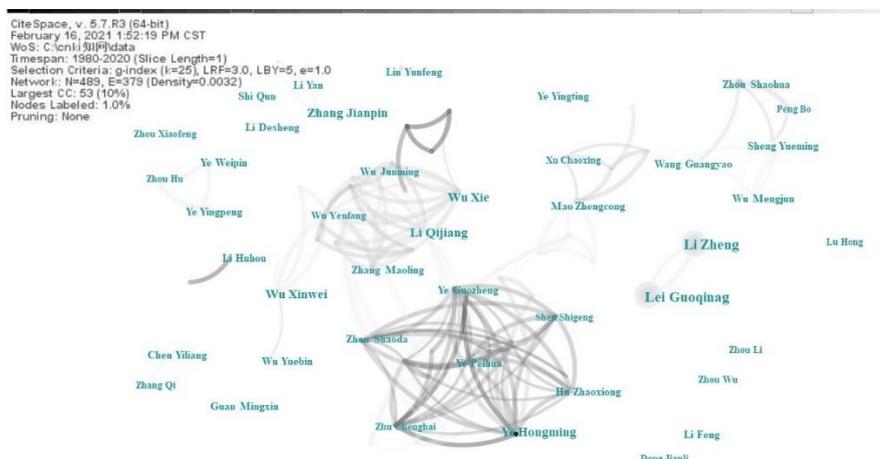


Fig.2 Distribution map of authors in Longquan celadon research field

After resetting relevant parameters and a series of calculations, the distribution map of research institutions in the field of Longquan celadon is obtained. The correlation map between the research author

and the distribution of institutions is shown in Fig. 3 and Fig. 4. According to the atlas, the research institutions of Longquan celadon are mainly concentrated in Lishui University, Jingdezhen Ceramic University, the Palace Museum and the Department of Light Industry of Zhejiang Province. Longquan celadon and Longquan kiln are one of the famous kilns with an important position in addition to the Five Famous Kilns in China. A large group of celadon kilns has been formed in Lishui, Zhejiang, so the local government, institutions and relevant scientific researchers attach great importance to them. The visual results in Figure 3 and Figure 4 verify this situation; In addition, there is a close relationship between researchers and institutions in this field. The Department of Light Industry of Zhejiang Province, the Palace Museum and Lishui University, which are respectively related to Ye Hongming, Zhou Shaohua and Wu Xinwei, are the research institutions with great influence in this field.



Fig.3 Distribution map of research institutions in Longquan celadon research field

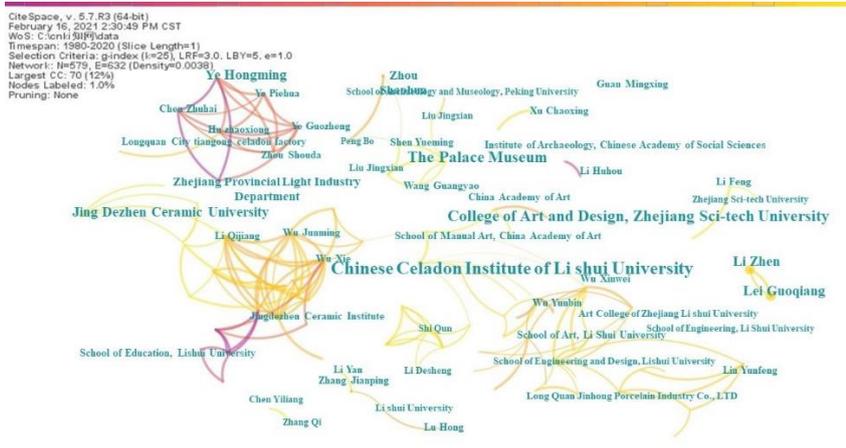


Fig.4 Correlation map of authors and institutions on Longquan celadon research

V. TREND AND HOTSPOT ANALYSIS OF LONGQUAN CELADON RESEARCH

5.1 Analysis of Research Hotspots under Keyword Co-Occurrence and Clustering

Keyword co-occurrence analysis is a quantitative analysis method that takes the frequency of keyword application, centrality, and clusters and nodes in the co-occurrence network as the analysis object, and explores its internal relationship to reveal the research framework of a certain discipline or field [7]. The map established by this method can directly convey the research hotspots in the field of Longquan celadon,

Select the clustering function in CiteSpace, and use the LLR clustering algorithm to perform keyword clustering analysis, as shown in Figure 6. According to the data at the top left, the Q value is 0.3298, which is greater than 0.3, indicating that the cluster analysis is reasonable; The S value is 0.9318, greater than 0.7, which proves the effectiveness and reliability of the clustering results. The visualization results show 11 clusters, as shown in Table 2. In this table, "Size" is the number of members in this type of group. When it is greater than 10, it means that the clustering effect is better, and in-depth analysis can be done; "Silhouette" represents the degree of closeness among members of this cluster. When it is greater than 0.7, it means that the degree of closeness is good, which verifies the feasibility of this cluster analysis.

Browsing the data of the 11 clusters presented, it is found that most of the keywords included in cluster #10 Silk Fabrics (which is still the case in the analysis below, so it is uniformly explained here) are about a certain kiln site or artifact under some archaeological results, which has low relevance with the content studied in this paper and is not included in the analysis scope. Based on the above content, cluster #0 to cluster #9 and cluster #11 are taken as the object of analysis in this paper.

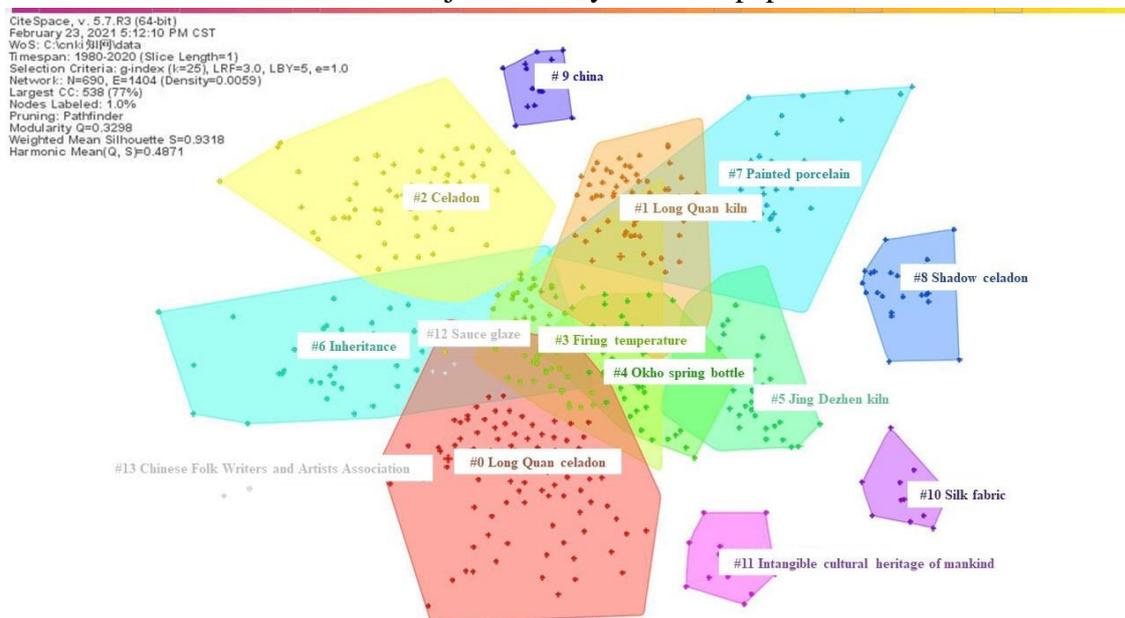


Fig.6 Keyword clustering map of Longquan celadon

Tab.2 Keywords cluster statistics of Longquan celadon from 1980 to 2020

Cluster ID	Size	Silhouette	Mean(Year)	Top terms (log-likelihood ratio, p-level)
0	93	0.97	2009	Longquan celadon
1	65	0.934	2008	Longquan kiln
2	51	0.91	2011	Celadon
3	58	0.881	1998	Firing temperature
4	48	0.882	2004	Jade spring vase
5	37	0.895	1992	Jingdezhen kiln
6	36	0.921	2012	Inheritance
7	32	0.954	1996	Painted porcelain
8	30	0.905	1995	Shadow celadon
9	15	0.991	1997	china
11	12	0.989	2009	Intangible cultural heritage of mankind

In the keyword cluster analysis, Mean (Year) indicates the average value of the year in which a keyword appears. It can be seen from the above table that the average year of appearance of Longquan celadon in cluster #0 is 2009, indicating that in recent years, relevant researchers in China still maintain a certain degree of research enthusiasm in the field of Longquan celadon and have made certain achievements, which also reflects the attention and continuity of relevant researches in a certain extent. Based on the results of keyword co-occurrence and clustering, this paper summarizes the research topics in this field from 1980 to 2020:

■ **General Research on Longquan Celadon**

The general research on Longquan celadon mainly focuses on "cluster #1 Longquan Kiln, cluster #2 Celadon, cluster #3 Firing Temperature, cluster #5 Jingdezhen Kiln". The relevant research results analyze the research status of Longquan celadon from the development trend, kiln site distribution, aesthetic characteristics, cultural representation and other aspects in different periods [8].

■ **Research on Porcelain and Specific Artifacts Related to Longquan Celadon**

On the basis of general research, there are still a large number of research results for specific artifacts, kilns, periods and so on. Such achievements are mainly based on the research topics of "cluster #4 Yuhu Spring Bottle, cluster #7 Painted Porcelain, cluster #8 Shadow Celadon and cluster #9 Chinese Porcelain", and related keywords include "The Palace Museum" "Ancient Ceramics", "Song Dynasty Porcelain", "Ceramic Shape", "Cultural Communication" and so on. Moreover, the historical period covered by such research is mainly the Song Dynasty, which has important relationship that Chinese porcelain making reached its peak in the Song Dynasty. Scholars such as Lei Guoqiang, Ye Hongming, Du Juan, etc. explored the Longquan celadon in the Song Dynasty from the perspective of utensils, glaze, modeling, and decorative style [9-10].

■ **Research on Longquan Celadon Culture and Its Inheritance.**

Relevant researches mainly focus on "cluster #6 Inheritance and cluster #11 Intangible Cultural Heritage". The keywords of the former mainly include "innovation", "firing skills", "inheritance", etc.; the keywords of the latter mainly include "Lishui College", "Calligraphy Art", "Chinese Dream" and so on.

On the one hand, the two clusters explore the follow-up inheritance of Arts and crafts from the intangible cultural heritage firing technology of Longquan celadon. Among them, Zeng Lingke, Wang Hui and others took celadon as an example to analyze the relationship between its manufacturing process, materials and decorative effect [11]. And by comparing and analyzing the protection objects and methods of traditional and modern refining techniques, Xu Huaying summarized three inheritance methods and their respective characteristics, such as workshop type, popularization type and production type [12].

On the other hand, the two clusters take the decorative characteristics of Longquan celadon as the starting point, analyze its artistic connotation and cultural heritage, and think that this can be an important perspective for the modern dissemination of Longquan celadon culture. Among them, Zhang Jianping systematically sorted out the inscriptions and auspicious words in the calligraphy decoration in Longquan celadon, discussed its decorative function and aesthetic value, and proposed that calligraphy decoration can be the focus of revival of celadon culture [13]. An yang, Lin Yunfeng and others summarized 8 kinds of innovative techniques in Longquan celadon decoration, and pointed out that the future development of Longquan celadon needs to continuously absorb and learn from other excellent

techniques from the perspective of artistic innovation, so as to ensure the leading position of Longquan celadon industry and culture [14].

5.2 Research Trend Analysis under Keyword Timeline View

The timeline view of CiteSpace shows the specific research contents involved in each knowledge group from the time dimension and reflects its evolution process. Compared with the time zone diagram, the time line diagram focuses on the interrelationship and influence among various knowledge groups, and weakens the relationship between keywords within the clusters. The keyword timeline knowledge map of Longquan celadon is shown in Figure 7. It can be obtained from the frequency of key words, that the relevant researches of Longquan celadon were mainly produced on the period from 2004 to 2016, and then the popularity of researching in this field declined. The keyword "inheritance" first appeared around 2003 and has continued to recent years, and the relevant research contents are becoming more and more diverse. In general, the information presented in the time line diagram is basically consistent with the cluster diagram, both revealing that in the research of Longquan celadon, the academic circle has shifted the research focus from the simple research on history, textual research, and characteristics to the protection and inheritance of Longquan celadon, and put forward insights and paths to realize related propositions from their respective perspectives.

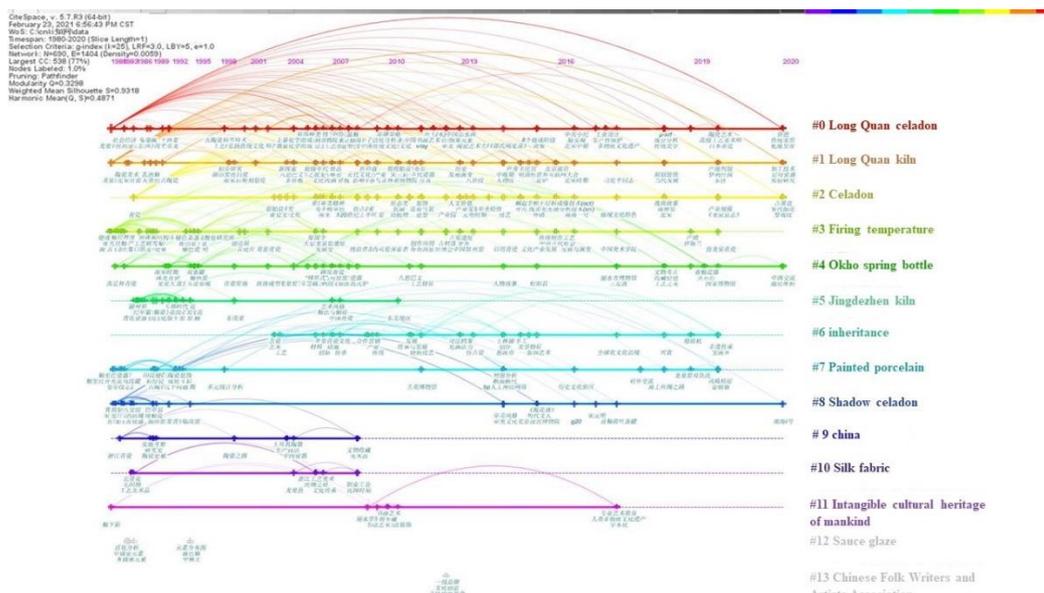


Fig.7 Timeline map of Longquan celadon keywords

5.3 Hot Spots and Trend Analysis on Citation Bursts of Keywords

Using the burst function of CiteSpace, set the value of parameters γ to 0.5, and keep other parameters unchanged. A total of 30 keywords with the strongest citation bursts are displayed, as shown in Figure 8. According to the figure, firstly, " Longquan kiln celadon" has the highest strength of citation burst, with a value of 6.95. The strength of citation bursts of "celadon glaze", "Jingdezhen", "celadon white porcelain", "Jingdezhen kiln", "celadon" and other keywords closely related to Longquan celadon are all greater than 4; Secondly, among the keywords shown in the figure, the life cycle of the word "Zijintu" lasted the longest, from 1983 to 2006, got the value about 23a. The keyword "celadon culture" appeared in 2003 and lasted until 2016, indicating that there is a certain research heat in the research of Longquan celadon culture during this period. In addition, through the display of this figure, we can also intuitively find that "calligraphy art",

"innovation", "process characteristics" and "Song and Yuan Dynasties" are bursting words that appeared in recent years., which represent the current research hotspot in the research field of Longquan celadon to a certain extent.

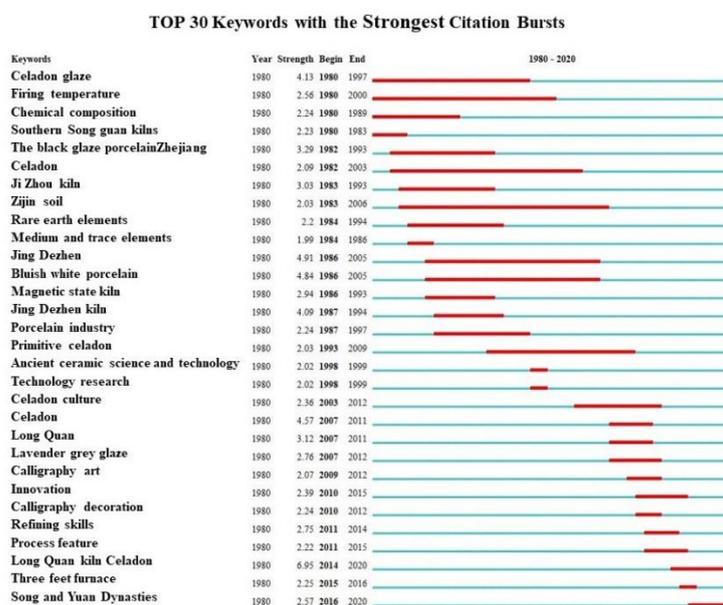


Fig.8 Keyword with the strongest citation bursts in researches on Longquan celadon

VI. CONCLUSION

With the help of scientific knowledge atlas and scientific literature measurement, this paper analyzes the research trend and hot spots through the research literatures of Longquan celadon which were built from 1980 to 2020, and draws the following conclusions:

- **First**, judging from the situation of publications, domestic researchers have a certain sense of cooperation and have formed a relatively stable research group, which will certainly help to expand the breadth and depth of research. Researchers and research institutions are mostly concentrated in the location of kilns related to Longquan celadon. Although this is helpful for the in-depth excavation of regional culture, it has a certain restrictive effect on the wider dissemination of related culture to a certain extent. In the future, researchers or groups can try to break through the limitations of space and use cross-regional cooperation to explore new ways to interpret, inherit and develop Longquan celadon culture.
- **Second**, from the perspective of research direction, the coverage of related research on Longquan celadon is expanding day by day. Starting from the initial analysis of the basic characteristics of processing technology, composition, chemical properties, etc., or comparison with other celadons such as Goryeo celadon and Yue kiln celadon, it has gradually developed into a multi-level and multi-perspective analysis of its decorative arts, modern manufacturing, and industrial development. And on this basis, a variety of ideas and methods to promote the protection, continuation and dissemination of Longquan celadon culture are put forward.
- **Third**, from the perspective of research trends and hot spots, since the Longquan celadon in Song and Yuan Dynasties has developed to the peak in both artistic achievements and firing technology,

combined with the above knowledge atlas information, it can be predicted that the research of Longquan celadon in Song and Yuan Dynasties will be one of the research priorities in the future. At the same time, the research on Longquan celadon decorative art also shows an increasing trend, but the research perspective will be more diverse. Possible research perspectives include the artistic features and cultural value mining of calligraphy elements, opera elements and character story elements in the decorative elements of Longquan celadon; it also includes the subjective and objective analysis of relevant decorative elements using Kansei Engineering, as well as the innovative methods of modern Longquan celadon based on this.

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