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Progress of domestic and foreign research on urban ecological restoration of mine landscapes based on citespace

Abstract

The bibliometric method was used to comprehensively analyze the progress of mine landscape ecological restoration at domestic and abroad, so as to expand the new ideas for the ecological restoration and landscape planning of mine wasteland in China from simplification to diversification, give full play to the comprehensive functions of regions and cities, integrate regional culture, and expand the transformation of mine wasteland. From 2000 to 2022, 152 articles in CNKI database and 292 articles in WOS core collection were classified and counted, the articles were compared from perspectives such as the publication number, co-keywords and high-frequency keywords. The results showed that in terms of the number of published papers, the research of mine landscape had been highly valued at domestic and foreign, but the foreign research started early, and the domestic research hotspots continued to increase; from the point of research hotspots, the foreign research hotspots focus on "Ecological restoration", "Evolution" and "Heavy metal" etc., while the domestic research hotspots were "ecological restoration", "geological environment" and "landscape" etc., indicating that the research hotspots at domestic and foreign are different. Foreign countries paid more attention to the development of disciplines, and domestic countries paid more attention to social needs.

Keywords: mine landscape, ecological restoration, urban renovation, citespace

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Introduction

With its vast territory and rich mineral resources, China is the world's largest country in terms of the number of mineral resources and the amount of minerals it possesses. However, for a long time, while large-scale and high-intensity mineral development and mining prosperity have provided guarantee for economic development, at the same time, the notion of MORE DEVELOPMENT LESS PROTECTION (Pay more attention on economic development and less focusing on ecological protection), had been causing the irrational development and utilization of many abandoned mines, bringing a series of ecological and environmental problems, such as the mountain fragmentation, bare mountain rocks, and vegetation destruction. Europe and the United States began ecological restoration research on these abandoned mines at the beginning of the 20th century, initially focusing on vegetation restoration.[1,2] Since the 1980s, in order to solve the problems of the aggravation of the degradation of various ecosystems worldwide and the further development of landscape ecology, the research on the ecological restoration of abandoned mines had paid more attention to the internal relationship between ecological restoration and landscape planning. Furthermore, the ecological system, interrelationship of human being and land, Social and cultural, and others had been integrateing into the restoration and remediation of abandoned mines following the Time's development.[3]

The China Knowledge Network Infrastructure (CNKI) and the Core Database of Science Citation Index (WOS) were taken as the basis of the literature in this paper, and utilized Excel and the literature analysis software, CiteSpace, to carry out a visual analysis in terms of the number of publications, keyword co-occurrences, keyword clustering, and keyword time plotting, to arrive at the current status of the research at home and abroad in the evolution of hotspots in the landscape planning of the mines.

Data sources and methods

Data sources: In this study, the China Knowledge Network Infrastructure (CNKI) and the Core Database of Science Citation Index (WOS) were used as the search source, and the search time range was 2000-2022, in which CNKI uses "mine" + "abandonment" + "landscape" as the search keyword, "abandoned mine" + "landscape" were set as the searching subject term inWOS Database, then the search results were checked and sorted out, and finally 152 Chinese literature and 292 English literature were selected.

Analysis methods: Firstly, Excel software was used to analyze the number of literature issuance, which resulted in the distribution map of the number of literatures, and then CiteSpace visual analysis software was used to analyze the research hotspots and co-occurrence analysis of the retrieved literature, and to draw the co-occurrence mapping of keywords in the literature with 1 year as the time partition, so as to analyze the high-frequency supplying words.

Results and Analysis

Analysis of the articles published on mine landscape: According to the statistics of the literature in Figure 1, the number of papers published in the field of mine landscape had been steadily increasing. Due to the earlier industrialization and urbanization process in foreign countries, the research on mine ecological restoration and landscape also started earlier, and the number of foreign research articles on mine landscape were higher than that in China, and the number of literature in foreign countries from 2000 to 2019 was exceeded two-folds than China, indicating that the domestic research on mine landscape is still in its infancy stage. With the widespread of CHINESE SUSTAINABLE DEVELOPMENT, the combination of multidisciplinary integration and advanced technology has expanded and continued the research on ecological restoration and landscape planning of mines. and the

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number of research articles published has increased significantly since 2013, got the peak point in 2020 (34 articles) in foreign countries, and reached the summit (30 articles) in China in 2021, then the number declined, which may be that China's urbanization process is shorter and more concentrated, and the urban ecological problems are more prominent, coupled with the "Beautiful China" and "Lucid Waters and Lush Mountains are Invaluable Assets" and the proposal of the policy of "Urban Double R"(Ecological Restoration and Urban Renovation) in recent years, which has a certain driving role in the study of mine landscape.

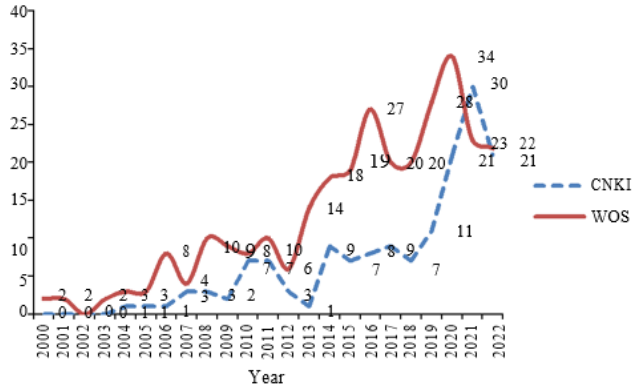

Figure 1 The distribution of the number of mine landscape literature at home and abroad.

Analysis of hotspots in mine landscape research: Keywords are high-level summaries and summaries of the content of a document, and hot keywords can reflect the research hotspots of a field to a certain extent.[4] Hot keywords are mainly determined by two indicators: co-occurrence frequency and centrality, the co-occurrence frequency focuses on the number of occurrences of keywords, and the centrality focuses on the importance and core position of keywords in the co-occurrence network. Table 2 was obtained by statistically stating the co-occurrence frequency and centrality of the top 5 keywords in the keyword co-occurrence network map of mine landscape research (Figure 2 & 3).

The co-occurrence frequency of keywords is not positively correlated with centrality, that is, the co-occurrence frequency is high, and the centrality is not necessarily high (Table 1 & 2). For example, the co-occurrence frequency of the keyword "heavy metal" ranks first in foreign literature, but centrality ranks third, indicating that although "heavy metal" is mentioned many times in literature, but it might be nothing important point in some articles. Among the keywords in the domestic literature, the centrality was greater than or equal to 0.1 (key node) and the co-occurrence frequency was greater than 14: "abandoned mine" and "ecological restoration" (ecological restoration and ecological restoration are synonymous, so only one is displayed). Among the keywords in foreign literature, words of the centrality was higher than or equal to 0.1 (key node) and the co-occurrence frequency was higher than 14 were listed as below, "abandoned mine", "heavy mental", "soil", "impact" and "landscape". Considering the two indicators of intermediary centrality and co-occurrence frequency, it was shown that in the past 20 years, the research hotspots in the field of mine landscape research mainly involved "abandoned mines", "ecological restoration", "heavy metal pollution", "soil improvement" and "landscape planning".

Figure 2 Keyword co-occurrence network map of domestic mine landscape literature.

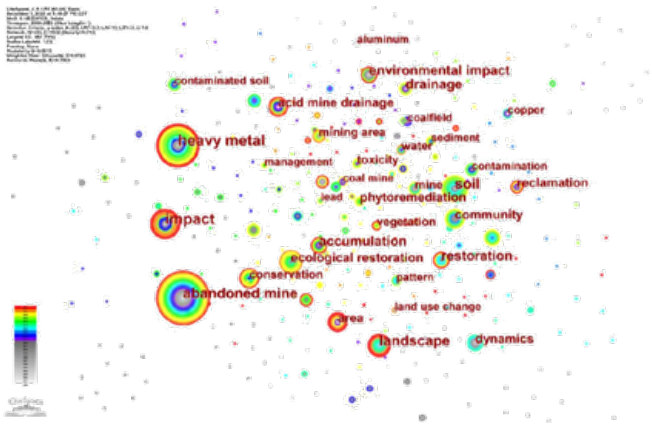

Figure 3 Keyword co-occurrence network map of foreign mine landscape literature.

Table 1 Top 10 high-frequency keywords

Chinese key word	Frequency	Centrality	English key word	Frequency	Centrality
Abandoned mines	47	0.8	Abandoned mine	26	0.2
Ecological restoration	35	0.52	Impact	17	0.2
Ecological restoration	14	0.14	Heavy metal	30	0.16
Geological setting	11	0.11	Landscape	14	0.16
Mine Park	8	0.1	Conservation	10	0.13
Landscape design	8	0.09	Soil	16	0.11

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Table 1 Continued....

Chinese key word	Frequency	Centrality	English key word	Frequency	Centrality
Ecological environment	8	0.09	Dynamics	8	0.11
Landscape	6	0.09	Drainage	8	0.09
Mode	3	0.06	Community	7	0.09
Landscape reconstruction	2	0.06	Copper	3	0.09

Table 2 Top 5 keywords with the strongest citation bursts in domestic literature

Keywords	Year	Strength	Begin	End	2004 - 2022
Wasteland	2005	3.08	**2005**	2012	
Abandoned mining areas	2007	1.65	**2007**	2010	
Mine Park	2008	1.61	**2008**	2014	
Landscape planning	2009	2.24	**2009**	2012	
Landscaping2011		1.97	**2011**	2017	

Mining landscape research frontiers and keyword evolution: Emergent keywords refer to keywords whose co-occurrence frequency changes greatly in a relatively short period of time, which can reflect the research frontier of this period.[5] Through the keyword emergent analysis of domestic and foreign literature (Table 2 & 3), it was concluded that the top five emergent keywords in the domestic literature were: "abandoned land", "abandoned mining area", "mine park", "landscape planning" and "landscape construction", after synonym merge, the prominent keywords mainly include "abandoned mining area", "mine park" and "landscape planning". From the analysis of the emergent time period of emergent keywords, these three aspects have been the focus of attention in past research. From 2017 to 2022, there were no emerging keywords.

Table 3 Top 5 keywords with the strongest citation bursts in foreign literature

Keywords	Year	Strength	Begin	End	2000 - 2022
coalfield	2011	2.59	**2011**	2014	
evolution	2015	2.93	**2015**	2016	
landscape	2006	2.94	**2016**	2017	
ecological restoration	2011	3.7	**2017**	2022	
heavy metal	2005	3.34	**2018**	2019	

Frontiers of mine landscape research in China: The reason for the sudden appearance of "mine park" and "landscape planning" was influenced by the specific Country policy, the Ministry of Land and Resources issued the "Notice on Declaring National Mine Parks" in 2004, which put forward the concept of mine parks for the first time, and various localities also began to declare and build national mine parks. For example, the first batch of national mining parks in the country has been built - Huangshi Mine Park, on the world's highest steep slope with a drop of 444 meters left by the open-pit stope, the largest hard rock greening and reclamation base in Asia with an area of 2.47 million square meters has been built, and the damaged mine environment has been repaired. In addition, during this period, land art, bionic design, tourism development, etc. gradually emerged, so that the management of mine waste land was more integrated into landscape design, humanities, sightseeing, tourism and other contents on the basis of ecological restoration. By dredging the landscape corridor, enhancing the node function of the patches, establishing a sufficient patch and corridor system,[6] Fan Jinshuan[7] put forward a preliminary plan for the improvement of the landscape restoration of the mining area from the perspective of landscape ecology, guided the landscape transformation of the abandoned land in the mining area, and provided a certain reference for the landscape restoration and transformation of the abandoned land. However, according to the current situation of landscape planning for the transformation of mine-waste-land in China, what had been seen and the popular perception by people was that non-ecological design guides the unsustainable landscapes, ignoring the functional replacement of heterogeneous landscapes, the cultural inheritance of landscapes, and the importance of natural work in biodiversity restoration, whether it is the early mine reclamation planning or the landscape planning and construction of national mine parks.[8]

In short, the research on mine landscape in China had made some progress, but it still needs to be strengthened in theory and methodology. According to the latest National New-type Urbanization Plan (2021-2035) released in 2022, China's urbanization development has entered the middle and late stages, and urban development has changed from "extension expansion" to "connotative development", and "tapping the potential of stocks" will become a new path for sustainable urban development in the new era. Under the guidance of the concept of Ecological restoration and urban renovation, it is an important research direction of urban renewal and development to solve the problems of urban ecology, social culture, and human-land relationship with the help of the restoration of urban ecosystem and the weaving of urban culture.

Frontiers of foreign mine landscape research: The top 5 key words in foreign literature were: "coal field", "evolution", "landscape", "ecological restoration" and "heavy metal". This is because as early as 1863, in the Parc de la Petchaumt in the 19th arrondissement of Paris, France, Napoleon III built an artificial lake in a low-lying area by retaining the original topography and building an artificial lake in a low-lying area, supplemented by natural plants. Quilted, with all kinds of bridges, trails, and the surrounding landscape roads are connected, ingenious, integrated, completed and opened in 1967, is the pioneer of the transformation of abandoned mines, thus opening the prelude to the transformation of abandoned mine park.

After the 1970s, with the decline of traditional industries, the strengthening of environmental awareness and the rise of environmental protection, the ecological restoration of industrial waste land has received more and more attention. Countries around the world have taken measures to carry out ecological restoration of abandoned mining areas, and the early restoration mainly focuses on vegetation restoration and reducing the damage to the natural environment. With the development of landscape science and ecology, in the 1990s, designers began to use landscape design techniques to deal with the transformation of abandoned mining areas. For example, the "Eden Project"in Cornwall, England, pruned the abandoned porcelain clay pit into a botanical garden with the world's largest greenhouse.[9] the French Deis Entertainment Base was transformed from a sand and gravel yard for highway mining, and the Emscher Landscape Park in the Ruhr area of Germany created a "green corridor" integrating open space, landscape restoration, and environmental ecology improvement on the abandoned site of a century-old steel mill. In the landscape design of the renovation of Seattle Gas Plant Park,[10] the designer adopted the techniques of preservation and reuse, preservation and artistic processing, respected the current situation of the site, and optimized the urban ecological environment, which was an international model of ecological landscape design reflecting the urban context and saving resources.

Through these cases, it had proved that foreign countries respect nature in the landscape design of mine transformation, following the characteristics of the site, retained the traces of human transformation of nature on the basis of ecological restoration, reorganized and utilized the scattered and different heterogeneous landscapes, stabilized the destructiveness, and used the principle of ecological design to increase the self-recovery ability of the landscape ecosystem itself and improved the productivity of the ecosystem (Figure 4 & 5)

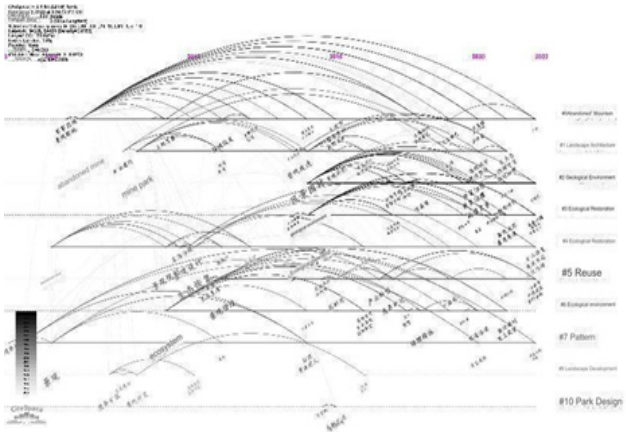

Figure 4 Timeline map of keywords in domestic mine landscape literature.

Figure 5 Timeline of keywords in foreign mine landscape literature.

Conclusion

In summary, it was objectively analyzed in this paper that the number of publications, research hotspots and distribution characteristics of research frontiers in the field of mine landscape at domestic and foreign by using Excel and CiteSpace literature visualization analysis software, which provides an important reference for accurately grasping the research status and development trend of mine landscape. The scale of mine waste land in China is huge, and the transformation design of mine waste land in ecological, engineering, aesthetic, landscape, economic and social aspects, and the research on the landscape planning theory of mine waste land are helpful to promote the development of mine landscape in China's landscape planning and design. With the deepening of the concept of sustainable development and the concept of Urban Dual R, it is necessary to integrate the concepts of ecology and landscape science in future research, to establish a complete planning theory system, to further guide mine landscape planning, to get the natural process with everyone's daily life, and to explore a new path of mine landscape planning.

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Conflicts of interest

The authors declare no conflicts of interest regarding the publication of this paper.

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