

A Brief Analysis of the Conservation Status and Prospect of Grotto Temples in China

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Abstract

Grotto temples constitute the richest collection of cultural relics in China, with the most defined inheritance history, the closest interrelationship, and the most complete system. They have the best-preserved authenticity and integrity; yet they are also the most fragile heritage sites in the country. Their conservation is tightly related to their geological, geographical and climatic conditions. Ever since 1949, the conservation work of the grotto temples has undergone three stages: environmental cleaning and hazard elimination, integrated protection based on multidisciplinary cooperation, and preventive protection and large-scale restoration. Currently, a basic consensus has formed over how the temples should be preserved. In addition, the temple consolidation techniques have been maturing over time, while the basic technical standards have been gradually established. Despite the new achievements in the research and development of protective materials and water disaster control, the grotto temples are still under the threat of water disasters, weathering and other harms. As a result, a series of issues arise, including the imbalance in their overall development, the restoration and protection initiatives in their infancy, and the controversy surrounding the actual practices in site conservation. In the future, basic research should

be reinforced to transform the thought process and methods currently in use and shift the focus to the conservation and preventive protection of cultural relics. Active research and demonstration projects regarding the conservation of the eaves of the grotto temples should be carried out.

Keywords: conservation of grotto temples, water disaster, weathering, preventive protection, status and prospect

Introduction

Buddhism was introduced to China around the 1st century. The construction history of grotto temples dates back to the 3rd century AD in Xinjiang. Grotto temples are cultural landscapes that combine architectural structures and natural geology. According to archaeological statistics, there are more than 10,000 grotto temple sites in China. The historical development of these grotto temples is clear and continuous, and contains rich cultural and artistic content.

From 1949 to the present, the protection of grotto temples has been a key area of China's cultural heritage protection practice, and its achievements basically represent the status quo of China's protection work.

History of grotto temple protection

1940's: Preliminary investigation of the distribution and situation of grotto temples.

From 1941 to 1943, the famous painter Zhang Daqian went to Mogao Grottoes in Dunhuang to investigate the grottos and copy the murals and held exhibitions for publicity. The "National Dunhuang Art Research Institute" was established in 1944, which was the first cultural relics protection institution established in China for the grotto temples. In 1940 and 1947, two groups of scholars investigated the Dazu Rock Carvings in Chongqing, respectively (Fig. 1). In 1941, scholars visited the Maijishan Grottoes in Gansu and compiled the "Journal of Maijishan Grottoes". In the autumn of 1943, the inspection team photographed and established archives for the Maijishan Grottoes for the first time (Fig. 2).

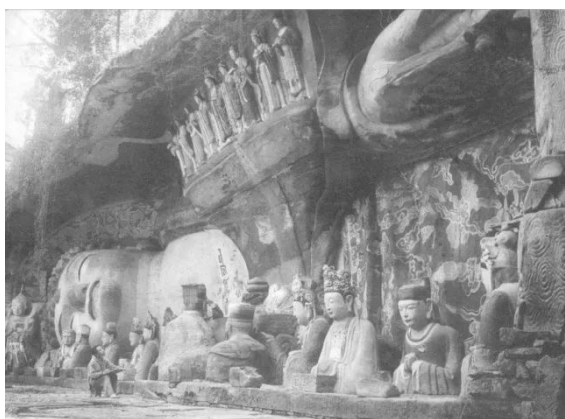


Figure 1: Stone carvings of Dazu Baoding Mountain, taken by China Building Society in 1940. Source: Dazu Rock Carving Research Institute.

1950s: urgent works in difficult situations.

At that time, China was in a difficult period, but the country still attached great importance to the protection of cultural heritage. Some important grotto temples established special protection management institutions. For examples, the Dunhuang Cultural Relic Research Institute was established in 1950. In 1951, the "Longmen Forest Heritage Preservation Committee" was established, and in 1953 it was renamed "Longmen Cultural Relics Depository". In 1952, "Stone Carving Store of Dazu County, Sichuan Province" was established. In 1953, the "Datong City Historical Relics Maintenance Center" was established, and in 1958 it was renamed "Shanxi Yungang Cultural Relics Management Office". In September 1953, the "Maijishan Grotto Cultural Relics Management Office" was established.

Because most of the grotto temples have been deserted in the past few hundred years, many rock masses are in danger of collapse. The first principle at that time was to ensure the safety of the grotto temples. The key work was to support and strengthen the cracked and deformed rock mass, remove the danger, and carry out scientific experimental research on the grotto temples of great value. For example, from 1956 to 1958, Mogao Grottoes built a 60-meter-long wooden plank road and carried out stone pillar reinforcement tests. This was the first large-scale reinforcement project in the history of the protection of Chinese grotto temples.

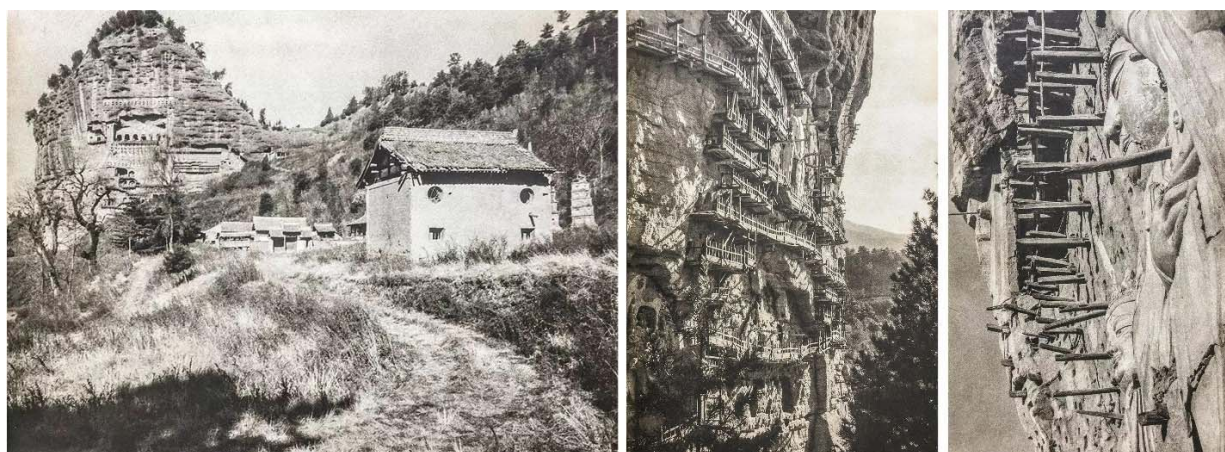


Figure 2: The breathtaking wooden plank way at Maijishan Grottoes. Source: Maijishan Grotto Art Institute.

1960s to 1970s: The past two decades have witnessed a substantial change in the protection of Chinese grotto temples. In the early 1960s, the Institute of Ancient Building Protection cooperated with the Institute of Chemistry of the Chinese Academy of Sciences to carry out research on the application of methyl methacrylate in the grouting and surface sealing in No.1 and No.2 grottos of the Yungang Grottoes, thus opening up a precedent for the protection of cultural relics in China using modern science and technology. Based on this research, breakthroughs were made in the research of epoxy resin materials used to strengthen rock fractures from 1961 to 1966, and they were widely used in the protection projects of Chinese grotto temples. A number of major projects were implemented during this period. For example, from 1963 to 1966, in order to reinforce the 576-meter-long rock wall and 354 grottos in the Mogao Grottoes, gravity retaining walls, beams, and dangerous rock removal engineering measures were adopted (Fig. 3). This is the first engineering major project in the history of the protection of Chinese grotto temples to combine geotechnical engineering and civil engineering.



Figure 3: (Left) In 1964, the reinforcement project of external rock wall in Mogao Grottoes was underway. (Right) After the repair, the reinforcement effect of the retaining wall is still effective today. Source: Dunhuang Research Institute.

The National Ten-Year Scientific Plan from 1963 to 1972 includes the first major national R & D plan in the field of grotto temple protection in China. It has set up ten research projects and achieved breakthroughs in the technical fields such as grouting materials, anchoring technology and weathering stone statue reinforcement materials. From 1971 to 1974, the research results of epoxy resin grouting materials were applied to the grouting project of Fengxian Temple in Longmen Grottoes (Fig. 4) and achieved remarkable results, the reinforcement effect is intact so far (Fig. 5).

Since then, the reinforcement technology based on epoxy-type grouting materials has supported the scientific and technological development of the protection work for decades.



Figure 4: Longmen Grottoes panorama. It is 1 kilometer long from north to south, and there are 2,345 grottos and more than 100,000 statues. Source: Longmen Grottoes Research Institute.

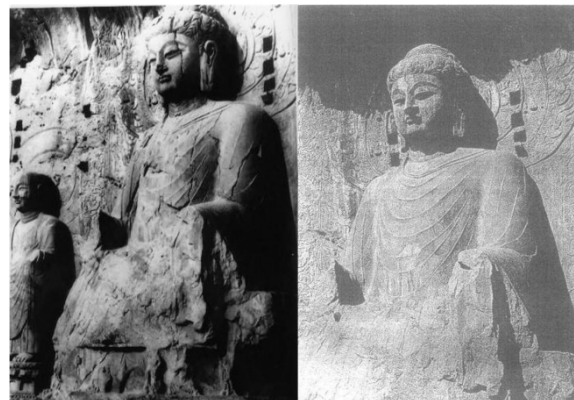


Figure 5: Comparison before (left) and after (right) the restoration of the Luchena Buddha in Fengxian Temple, Longmen Grottoes. Source: Longmen Grottoes Research Institute.

1980s to early 21st century: Protection technology and system are basically mature. In the late 1980s, rescue protection work was fully launched. From 1972 to 1984, the technology of "spraying, anchoring, sticking and supporting" was used to strengthen the Maijishan Grottoes as a whole (Fig. 6). The project has a total spray area of 9,100 square meters, a total length of 12,500 meters with 2,300 anchors installed and a new 1,000-meter reinforced concrete plank road. This is the largest and longest project in the history of the protection of Chinese grotto temples. It is a representative project using contemporary science and technology and multidisciplinary cooperation. The strengthening work and its achievements have had a significant impact on the subsequent protection of Chinese grotto temples. So far, China has

formed an integrated and mature anchoring technology system.

In the following two decades, the strengthening work of Grotto temple was carried out in full swing. In 1984, the Mogao Grottoes in Dunhuang strengthened the cliff faces with a length of 172 meters for 26 grottos. From 1984 to 1987, the cliff faces with a length of 174 meters were strengthened in the Xiqianfo Grottos. From 1986 to 1992, the five-year comprehensive protection project of Longmen Grottoes finished.

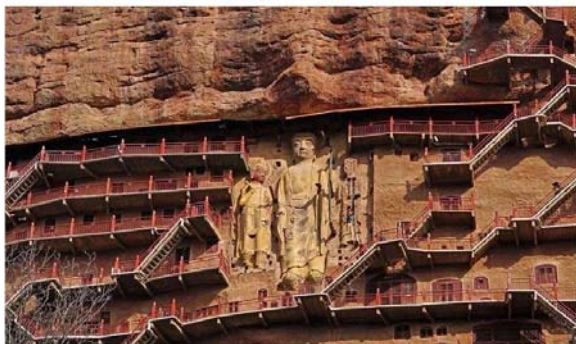
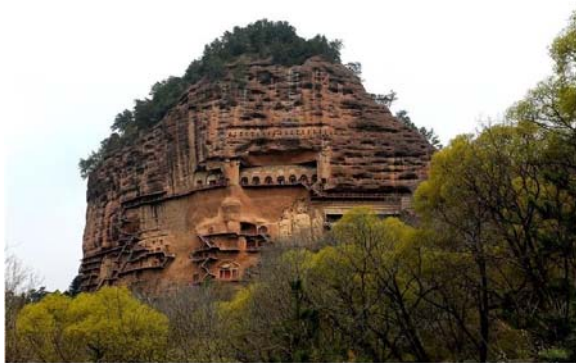


Figure 6: The Maijishan Grottoes, which have been strengthened as a whole, took 12 years to complete. Source: Maijishan Grotto Art Institute.

Since the 1980s, comprehensive protection work to get rid of various diseases in the Grottoes temples has been valued. From 1989 to 1999, the Dunhuang Grottoes explored a comprehensive scientific governance work of engineering sand control, biological sand control, and chemical sand control to prevent sand damage at the top of the grotto. From the mid-1980s, the Dunhuang Mogao Grottoes made a breakthrough in mural painting restoration technology. From 1989 to 1993, Dunhuang Research Institute cooperated with Getty Conservation Institute in the United States to protect 85 grottos of Mogao Grottoes. From 1981 to 1984, the experimental research of using grouting materials in grottoes under humid

environment was successfully used in Dazu Rock Carved Beishan Grotto 136. From 1984 to 1984, the drainage of the Beishan Grottoes tunnel at Dazu Rock Carving and the seepage prevention drainage works at the top of the grotto were completed. From 1993 to 2002, the Dunhuang Research Institute, together with various universities and other research apartments, began research on digital mural technology, which lay the foundation for digital Dunhuang.

From the beginning of the 21st century to now:

The protection work is more standardized and has shifted to preventive protection. China has formulated and supplemented a series of laws, regulations and policies concerning the protection of cultural relics. In 2000, the National Cultural Heritage Administration of China cooperated with the Getty Conservation Institute and the Australian Heritage Commission to compile and release the Guidelines for the Protection of Chinese Cultural Relics and Historic Sites. Its revised version was released in 2015, becoming the guideline for the protection of immovable cultural relics in China.

The "Key Technology Research on the Protection of Stone Cultural Relics", which was included in the "Eleventh Five-Year" National Science and Technology Support Plan in 2008, is the second major national science and technology research plan in the field of grotto temple. It set up 6 research projects, which played important roles in promoting the comprehensive scientific and technological level of Grotto temple protection.

Since the 21st century, there have been several major projects for the protection of cultural relics.

From 2004 to 2014, the Guangxi Huashan Petroglyph Restoration and Protection Project, which lasted for ten years (Fig. 7), achieved breakthrough results in the research and promotion of natural hydraulic lime composite materials. From 2008 to 2015, the water damage treatment project of Qianxi Temple Grottoes in Longmen Grottoes was completed. From 2014 to 2017, the Dazu Rock Carving Water Pollution Control Project was completed.

Maintenance status and main issues of Chinese grotto temples

The potential threat of rock deformation caused by fracture cutting still remains. Various types of cracks often occur on the surface, causing diseases such as collapse, overturning and landslides, which seriously threaten the safety of geotechnical relics. Therefore, the instability of the rock mass in the grotto temple is still a key issue for protection.

Water erosion is still very serious and difficult to get controlled. The grotto temple is connected with the natural mountain body, which leads to the fact that the rainwater, surface water, fissure seepage, capillary water, condensation and other water will cause erosion and damage to the rock mass and stone statue of the grotto temple, especially the grout seepage disease (Fig. 8). Because the causes of various water damages are very complicated, the protection work is strictly restricted. For example, the back wall of the Yungang Grottoes has serious water seepage and its stone carvings have almost been weathered and damaged.

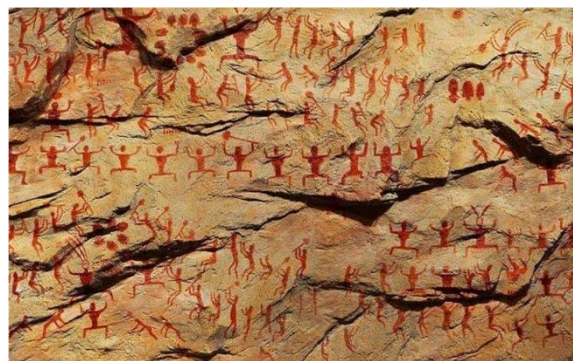


Figure 7: Natural hydraulic lime is used in Huashan rock painting restoration project. These more than 8,000 square meters of rock art show the vivid and rich social life of people 2000 years ago. Source: Jinhua Wang.

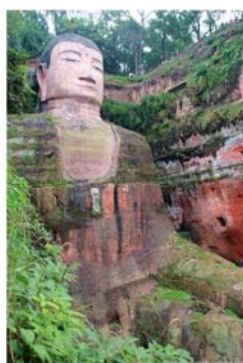


Figure 8: (Left) Due to heavy rainfall and humid climate, the water damage problem of Leshan Giant Buddha is very serious, including seepage, precipitation, condensate and groundwater. (Middle + Left) The seepage disease of Dazu Rock Carving is also very serious. The picture shows the reclining Buddha at Baoding Mountain, with water seepage points on the head, face and chest. Source: Jinhua Wang.

The detection and evaluation of various kinds of weathering damage diseases is very difficult. Due to differences in climatic conditions, geological conditions, lithological structures and weathering damage capacity, there are serious problems in standardization of the classification techniques and assessment indicators.

The development of protective materials is still a bottleneck in the protection of grotto temples. Protective material technology plays an important role in the protection of grotto temples, including the polyacrylate materials in Yungang Grottoes in the 1960s, the epoxy materials in Yungang

Grottoes and Longmen Grottoes in the 1960s and 1970s, the Epoxy resin materials in wet environments in the mid-1990s, the potassium silicate series materials in the early 1990s, the natural hydraulic lime materials since the new century, and some new inorganic silicate gelling materials, etc. In recent years, China has carried out exploratory research work on inorganic silicate materials, organic and inorganic composite materials in the grout grouting reinforcement materials for grottoes, restoration materials for stone statues, and consolidation materials for deteriorated stone statues. It pays more attention to

the matching and safety of the reinforcement material and the rock mass.

Future work of China's Grotto Temple Protection

- 1) Continue to focus on basic research work. The basic research on the protection of Chinese grotto temples is still very weak, especially the investigation and evaluation systems. First, we need to complete the construction of the basic database of Chinese grotto temples. Then, the preservation status assessment and strategies need to be established. Third, some basic research on protection technology needs to be carried out.
- 2) Pay extra attention to the protection of the grotto temple entity. The protection work of grotto temples is turning to the treatment of ontological diseases. Diseases such as grotto murals, statues, statues, damage, pollution, and weathering of statues are being repaired and strengthened. Moreover, the environment of the grotto temple is being improved.
- 3) Improve the technological capabilities on developing new protection material for the grotto temples. The focus of developing new protection materials mainly includes two aspects: the scientific evaluation and standardization of the traditional protection materials. The material should be researched with priority on inorganic materials, supplemented by organic materials. It should preferentially choose inorganic materials, supplemented by organic materials. Attention needs to be paid to the matching between the solidified material and the cultural relics, as well as the material safety and permanence.
- 4) Carry out a demonstration project for the protection of grotto temples. The protection system should be dominated by architecture and unite with the disciplines of archaeology, fine arts, landscape science, and environmental monitoring. It needs to start from the two following aspects. The investigation and evaluation of the historical background and current status should be carried out. Besides, select representative grottoes for demonstration projects.

Acknowledgements

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