



The Deterioration Mechanism study for sandstone of Avalokitesvara Sculptures on the Dazu Rock Carvings

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Abstract:

The paper presents the scientific analysis for deterioration of Avalokitesvara Sculptures on the Dazu Rock Carvings which is located in ChongQing, one of the Municipalities in south-west China. Dazu Rock Carvings is the general name of over 60,000 carved figures of religion in 74 different places within Dazu and was published as a cultural heritage on the World Heritage List by the UNESCO.

Avalokitesvara Sculpture, one of the most elegant Cliff Stone Sculptures, has near 800 hands holding different Buddhist instruments. The area of sculpture caved on cliff is about 88 square meters. Most area was gilt and covered with overlapped gold leaf, except instruments part is painted with pigments.

The Sculpture has been seriously decayed in the past 800 years. Now it is in very dangerous condition. Because better understanding of the deterioration processes and mechanism could help to make preventive measures and remedial treatments, investigation and survey has been done since 2002. Micro-environment monitoring was also carried out in 2006. The main types of sandstone deterioration and its distribution were studied. The main deterioration is powdering which occurs not only on the surface but also inside the sandstone. It is found that the sandstone is less decayed on the area covered by gold leaf than that painted with pigments and the deterioration condition of the lower part and the upper part is different on the cliff.

The samples of sandstone were analyzed to understand the structure and minerals composition of sandstone by using XRD, SEM-EDX and polarizing microscope. And structure and composition of multi-layer gilt were studied.

Gypsum is found in the sample of deteriorated sandstone powders. It is supposed that gypsum is the products of deterioration reaction between calcite and sulfuric acid which comes from acid deposition. Another discovery is a great amount of clay minerals in the sandstone. Hydraulic swelling of clay minerals could cause powdering and deconstruction of sandstone. FTIR results showed that traditional gold size used to attach gold leaf on stone is Chinese Lacquer. It could prevent water and moisture penetrating into sandstone.

The distribution and the mechanism of deterioration were explained based on the environment monitoring data. High humidity could accelerate the deterioration process, and gilt layer could protect the sandstone from water penetration, so water could affect the area without gilt layer directly. Furthermore, serious acid rain that occurred frequently in the past 50 years could explain the source of sulfuric acid.

Preventive measures that could control low and even humidity around the cliff Sculpture were proposed. Also, consolidation of powdered sandstone to protect the Sculpture must be done as soon as possible.