The degradation state of the Wareishi Rock Cliff Sculpture based on the multi-view stereo.

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The Wareishi Rock Cliff Sculpture, carved on a core stone of granite in A.D. 1300, designated as an important cultural property of the Hiroshima Prefecture, is located near a shoreline of the Sagi Island, Mihara City, Japan. The core stone appears above the sea level during the ebb, whereas a part or all sinks below the sea level during the high tide. The lower part of the core stone is now dark colored probably covered with algae. It is often pointed out that the Sculpture seems to have recently been degraded rapidly due to the direct influence of tidal ebb and flow. In this study, the present condition of the Sculpture will be argued based on a precise measurement and an appropriate direction of conservation ways will be discussed.

The present shape of the Sculpture was measured in order to estimate the degradation state exactly. The same measurement was also applied on a replica of the Sculpture made in 1986 and exhibited in the Hiroshima Prefectural History Museum. The difference between the present shapes of the Sculpture and the replica can be regarded basically as the degradation of the Sculpture during these 30 years.

The measurement is required to be simple without electricity because people can approach the Sculpture only during the ebb. For this reason, the multi-view stereo technique was examined in this study. This technique measures the unevenness information of targets through taking photographs from various viewpoints and matching the photos. This method provides 3D information as well as color information at the same time quite simply and quickly. Fifty seven photographs (ca. 70 cm wide for each) were taken on the Sculpture and 43 photographs (ca. 120 cm wide) on the replica using a digital camera “PowerShot G7X” of Canon Company. The measurement was carried out basically by one person and took ca. 6 minutes for the Sculpture and ca. 4 minutes for the replica.

As a result, the difference between the shapes of the Sculpture and the replica was detected mainly on the middle part of the core stone constituting a horizontal belt of ca. 20 cm parallel to the sea level. The total area of the places where more than 3 mm difference was detected constitutes ca. 0.56 % of the whole measured area.

The upper surface of the beltlike deteriorated area almost concurs with that of the darkened area of the present Sculpture, whereas the lower surface of the deteriorated belt with the upper surface of the darkened area of the replica. In other word, the degradation of the Sculpture during these 30 years is detected mainly on the belt between the uppermost lines of algae on the Sculpture at present and at 30 years ago.

Because the luxuriant growth of algae is normally influenced by water, it is likely that the uppermost line is related to the average sea level during the high tide here. If so, the rising of the line may be related to the rising of the sea level. This hypothesis suggests that the recent degradation of the Sculpture occurred through the participation of the rising of the sea level. In fact, the lower part of the Sculpture, where the displacement is not obvious, does not retain the original surface of the Sculpture, indicating that the degradation occurred in the past when the sea level was lower. Accordingly, the detected degraded-area during these 30 years, 0.56 % of the whole, cannot be regarded so much large compared with the total degradation of the Sculpture during ca. 700 years.

As a conclusion, the degradation of the Wareishi Rock Cliff Sculpture does not seem to be recently accelerated so much but to be progressing at not so different pace as the history of the Sculpture. However, if the sea level rises up more in the future, it is possible that the degradation occurs on the

essential part for the Sculpture, e.g. on the face. In such a case, some conservation measures may be discussed such as establishing a transparent barricade keeping the Sculpture from the direct wave erosion.

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