

3D Recording Process of the Underwater Excavation Site in Waters of Sinchang-ri, Jeju

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ABSTRACT

The paper fits in session 2, as focusing on the survey of underwater cultural heritage at Jeju-do in Korea.

The underwater site of Shinchang-ri, Jeju-do was reported by Haenyeo¹ for golden artifacts in 1980s, and, further survey recovered Chinese celadon printed with ‘河濱遺范’, ‘金玉滿堂’ in 1990s. However, it was not until 2018 that consistent investigations were begun by the National Research Institute of Maritime Cultural Heritage. Exploration is to search artifacts exposed on the bottom surface without any dredging, which is necessary for understanding distribution of artifacts under the surface. With targeting the area which could include as many artifacts as possible to be dredged, actual excavations were conducted for three seasons from 2019 to 2021. The objective of underwater investigation is to find the area of intensive distribution of artifacts and understand their contents. Then, how the environment of underwater sites can be documented by areas?

Waters off Shinchang-ri, Jeju-do have relatively fine visibility, comparing to other sites in Korea. Thus, for the first time, attempts to document the targeted area in the 3D model with pictures, which is assumed to suggest more accurate timelines and coordinates than plans, were conducted. Recording process is begun with taking pictures which is also the starting point of traditional investigation. Accuracy is the most emphasized. Methashape of Agisoft is used. Not only are topography of underwater but exact coordinates of hundreds of artifacts identified. Environment limitation for underwater excavation in Western coasts in Korea exists, such as strong currents and bad visibility. 3D documentation should be consistently tried, however, as one of the most important things in archaeological excavation is to locate the shipwrecks and artifacts and document them.

Keywords: Jeju Island, Metashape, recording

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ENVIRONMENT OF WATERS OF SINCHANG-RI AND OVERVIEW OF THE INVESTIGATION

The underwater remains in Sinchang-ri, Jeju, are located in the western part of Jeju-si and are a coastal area near the beach. In March 1983, haenyeos collecting seaweed found a golden artifact in the form of a headpiece, and the remains were unveiled. Based on the discovery report, the Cultural Heritage Administration at the time conducted an underwater investigation for 10 days from April 13 to 22 and confirmed two additional golden artifacts. As the seabed in the Sinchang-ri is composed of sand and basaltic bedrock, the investigation could not have kept continuing. Later, in December 1996, in an underwater investigation conducted by Jeju Island and Jeju National University Museum to produce video materials related to marine trades in the Jeju area, Chinese celadons with imprinted phrases, ‘河濱遺范’ and ‘金玉滿堂’ were found.

The National Research Institute of Maritime Cultural Heritage (NRIMCH) explored waters of Sinchang-ri from August 29 to September 4, 2018. As a result of the exploration in 1997, about 500 pottery pieces were found, including celadons with the phrases ‘河濱遺范’ and ‘金玉滿堂’. It was judged that detailed excavations were required because of the large number of artifacts being discovered, and the underwater excavations were conducted from April to June 2019 (first) and from May to July 2020 (second). The artifacts excavated through the exploration and excavations include many potteries from the Southern Song Dynasty in China with the phrases ‘河濱遺范’ and ‘金玉滿堂’ which allow us to understand the era of the remains, celadon comb-patterned dish, celadon floral-patterned bowl, etc. Waves, etc., damaged most of the excavated potteries, and only the thick bases

¹ Female divers

remained. Only a few of them had complete shapes. Also, two seals, one seal box, one anchor stone, four coins, etc., were found.

CONTENTS OF INVESTIGATION IN WATERS OF SINCHANG-RI

The underwater investigation aims to find the points where artifacts scattered on the seabed are intensively buried and to understand the nature of the remains clearly. In the previous investigation of the Sinchang-ri and the exploration in 2018, only the artifacts exposed to the seabed were checked without removing the soil on the seabed. Therefore, the need to identify the distribution pattern of artifacts under the seabed through an investigation after removing soil was raised and the excavations were conducted three times from 2019 to 2021 by setting the area around the spot where relatively many artifacts were found during the exploration as the section of investigation with soil removal.

The following introduces the exploration in 2018 and excavations from 2019 to 2021 conducted by the NRIMCH:

Exploration in 2018: The offshore of Sinchang-ri has an underwater visibility of higher than 10 m and a depth of around 2-5m, therefore, it is significantly affected by surge caused by wave soil. Also, reefs are located everywhere, so Nurian (290 tons) and Sea Muse (18 tons), dedicated underwater excavation ships, cannot approach. Therefore, small boats were used to approach the point, which was conducted in parallel with the underwater exploration through diving and the metal detector investigation.

Most artifacts exposed on the seabed were found as fragments of bases and some parts of bodies. An unmanned submersible was used to identify the area where it is estimated that an old ship was sunk (50 m deep), but nothing was found.

The first excavation in 2019: The underwater excavation aimed to find where artifacts scattered on the seabed were intensively buried and identify the nature of the remains. The purpose of the investigation in 2019 was to re-explore the area where artifacts were discovered in the exploration in 2018, remove soil from the spots where exposed artifacts are concentrated, confirm the underwater topography, and find spots where artifacts were intensively buried and traces of the sinking of an old ship.

The investigation area with soil removal was about 500 m west of Sinchang-ri Port and about 430 m northwest of Mariyeo Lighthouse. A grid was installed in the investigation area at a distance of 30 m from north to south and 10 m from east to west using a 5 mm thick rope. Inside the grid, relatively large stones and sand were mixed, and the artifacts exposed on the seabed were found to be stuck between rocks. The soil removal for the sand was about 10-30 cm, which was not so deep. Underneath, basaltic bedrock was found, along with many pottery pieces.

As mentioned above, recovered artifacts were found in rock crevices and under the sand. Among them were about 400 pieces of celadons, accounting for the largest number. For the celadons, the celadon bowl inscribed with ‘河濱遺苑’ and ‘金玉滿堂’ which were found in the exploration in 2018, were confirmed as identical, and potteries that appeared to have been produced at the same time with them were found.

Also, two wooden seals and a piece of metal box were found during the soil removal. One wooden seal was square-shaped embossed with letters of the seal script, and the traces of the stamping ink remained. Another was also square-shaped seal embossed with letters that stand for happiness. Around the seals, pieces of seal boxes were found.

Notably, in the first excavation, after taking several pictures inside the grid, the location of the artifacts and the underwater topography were recorded in drawings using a 3D program.

The second excavation in 2020: In the second underwater excavation, the east of the area of the first investigation with soil removal was set as the investigation area. The investigation was based on soil

removal and conducted by installing a 10 x 10 m grid in the north-south direction to the east of the area of the first investigation with soil removal. The average depth of soil removal was about 70-80 cm, and brownish basaltic bedrock was found under the sand.

Recovered artifacts were 200 pieces, including Chinese celadons found in the previous exploration and excavation, coins, and an anchor stone split into two pieces. The total length of the anchor stone was 3.1 m. It had a shape of a trimmed Chinese-style anchor stone with a thick middle and thin both ends.

The third excavation in 2021: The third investigation of the waters of Sinchang-ri in Jeju aimed to identify the nature of the Sinchang-ri underwater remains as an extension of the first and second excavations. The investigation was conducted six times for 60 days, each for ten days, and the investigation with soil removal was conducted by installing 10 x 10 m grids to the west and north of the point where the anchor stone was found in the second excavation in 2020. The seabed is composed of sand and basaltic bedrock, and in the last sixth investigation, a trench survey was also conducted on the sandy seabed around the sections of the previous first to third excavation investigations.

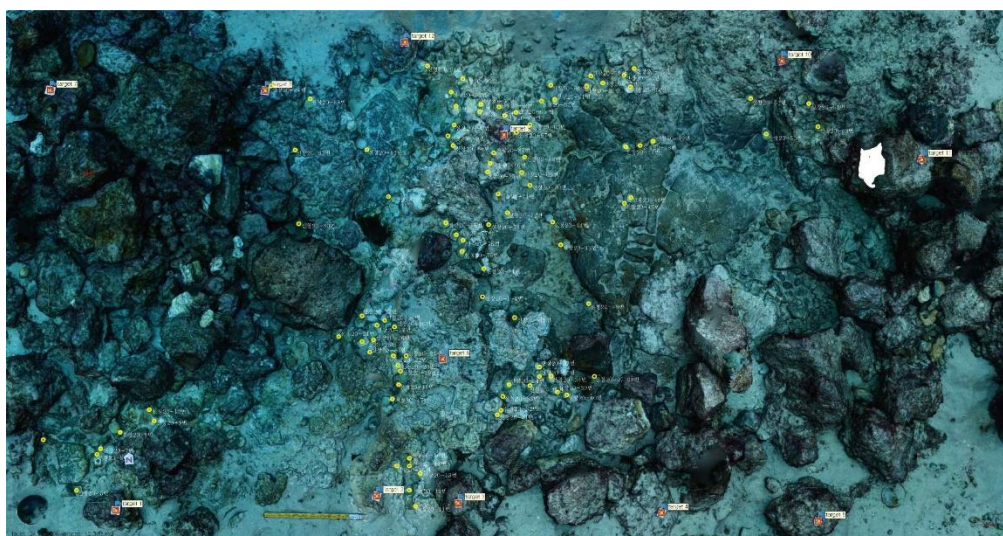


Figure 1. Indication of the locations of the excavated artifacts after soil removal (3D mapping used)

For the recording and handling of the artifacts, the investigation team attempted to clarify the location of the artifacts underwater using the 3D mapping introduced in the first investigation. At this time, a marker with a diameter of 3.5 cm was made, placed next to an artifact, and photographed so that the position of the artifact could be identified on the photograph. The result was printed on transparent tracing paper, carried underwater, and given an artifact number.

In the third investigation, 600 artifacts were found, most of which were pottery. Among them, 500 pieces were celadons, which were the most. Celadon bowls with the phrases ‘河濱遺范’ and ‘金玉滿堂’ which were found in the previous investigations, were found again in this time, revealing that the artifacts include celadons from the Southern Song Dynasty in China. In addition, potteries that seemed to have been produced simultaneously, such as the Celadon Lily-patterned Bowl and the White Porcelain Box Lid Embossed with Phoenix Patterns, were found.

3D RECORDING OF INVESTIAGED AREA IN THE WATERS OF SINCHANG-RI

Unlike other underwater remains, waters of Sinchang-ri in Jeju had clear underwater visibility. Therefore, the investigation area could be recorded in 3D model for the first time. The recording process will be introduced. The investigation was conducted in the following steps. First, a 10 x 10m grid was installed with a disc weight and a rope. Next, photographs were taken to record the underwater view before soil removal. The photography's most focused part was capturing the underwater topography and scattered artifacts as clearly as possible. As a result of trying various

methods, Agisoft's Metashape was used. The program recommends using a standard lens with a focal length of about 50 mm with less distortion.

In the waters of Shinchang-ri, a lens with a 16 mm focal length was used based on a full-frame-sized sensor. Photography was done by walking around, not swimming, to get close to the subject. In this case, the distance to the subject was approximately 0.5-1 m. In the waters of Shinchang-ri, the image had to be created considering the curves, so the photos were taken in a slightly inclined diagonal line. At a point where many rocks were piled up, about 900 photos were created.

After taking photographs, the artifacts exposed on the seabed before the soil removal were handled, and then soil removal was started. As mentioned earlier in the investigation contents, most of the artifacts were found during the investigation process with soil removal. Thus, after the final soil removal, the sand was removed, the changed underwater topography and artifacts could be photographed, and the artifacts could be handled.

To record in 3D in earnest, Metashape was used. It proceeds in the steps of Photograph Alignment → Dense Point Group Generation → Mesh Generation → Texture Expression.

The step of photograph alignment starts from the 'Key Point' extraction. Check the same key point in multiple photos to create connection points. For the waters of Sinchang-ri, photos taken in 5 x 5 m units were each aligned.

Dense point group generation extracts points based on the camera's location. The quality of the generated data can be chosen. If set to 'High', a memory shortage problem occurs, so the points were extracted by setting it to 'Medium'.

The next step, mesh generation, is a process of making 3D data based on the generation of a dense point group. This process is essential to obtain a 3D image. After that, the texture expression is a step to add texture to the data created in the previous step and make a photo-like effect.

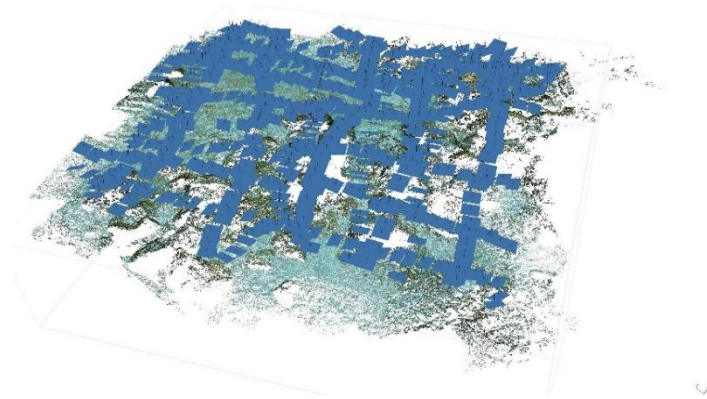


Figure 4. Grid photograph alignment (Metashape)

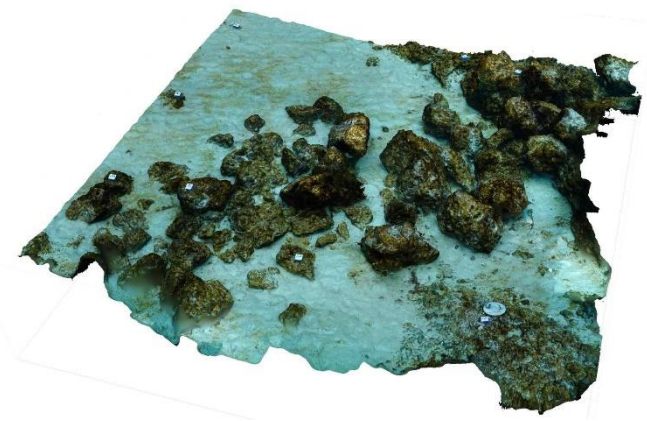


Figure 3. Grid mesh generation (Metashape)



Figure 2. Taking photographs

Recording the locations of discovered artifacts clearly is very important in archaeological excavations. However, it is not easy to record the locations of many artifacts when there are no actual survey drawings. In Metashape, orthophotographs can be easily created. It plays the same role as a floor plan, which greatly helped to handle the artifacts. First, orthophotographs or 3D results were printed on transparent tracing papers, which do not get wet in water, and images that only indicate the artifact locations were also printed. Then, the artifacts were handled by referring to the printouts of orthophotographs or 3D results printouts underwater. At the same time, the artifact numbers were written on transparent tracing paper, which indicated the artifact locations. The precise locations of hundreds of artifacts could be recorded using this method.

CONCLUSIONS

The report will be concluded by briefly summarizing the meaning and achievements of the exploration and underwater excavation conducted at Sinchang-ri.

In the exploration in 2018, the investigations using submergence and geophysical exploration equipment allowed us to see the underwater topography of the area and handle potteries from Southern Song Dynasty, which were stuck in rock crevices. Therefore, the time of the remains could be identified, and the core point and the distribution range of the scattered artifacts could be found. In the first to third excavation investigations conducted after that, 10 x 10 m grids were installed centering on the concentrated distribution point of the artifacts, and the investigations were conducted by expanding the range. By removing soil, a large amount of Chinese pottery pieces was found, as well as two wooden seals, a seal box, and coins.

Excavated Chinese celadons are estimated to be produced in Longquanyao (龍泉窯) in China in the late twelfth century during the Southern Song Dynasty. The pottery artifacts discovered in Sinchang-ri remains were also discovered in Dazaifu in Fukuoka and Kurakizaki in Kagoshima in Japan. The same potteries from the Southern Song Dynasty found in Sinchang-ri remains, and Japan has examples that reveal the maritime trade in the past, along with the anchor mentioned above the stone. Especially the Chinese-style anchor stone, a ship accessory found in the second excavation investigation, allowed us to secure important data in estimating the nature of the Sinchang-ri underwater remains. A wide area of Sinchang-ri underwater remains is covered with sand, and the area where the soil removal investigations were done is only a small part of the remains. Therefore, continuous excavation investigations will be required in the future.

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