

Searching for the evidence of disaster from the sunken village of Lake Hibara, Japan

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ABSTRACT

In 1888, the eruption of Mount Bandai in the Fukushima prefecture of northern Japan created a dammed lake, resulting in the submergence of the entire village of Hibara. A multi-disciplinary research team has been organized to extract both archaeological and historical information as well as environmental information. The focus of the research is not only on the material culture, but also on topics such as the process of submergence and how people's lives were affected. The study of the submerged village of Hibara is a unique opportunity to gain a deeper understanding of the impact of natural disasters on human settlements. To locate the periphery of the site, the team is using remote sensing technology including Side Scan Sonar, Sub-bottom Profiler, and underwater drones. Additionally, soil coring is being used to study the event sequence and the environment, and archaeological techniques are being used to record the material culture. This is one of the first studies of its kind conducted in Japan, and the team aims to develop methodologies for investigating submerged sites. Ultimately, this research will contribute to the study of local history and enhance our understanding of cultural heritage.

List of Abbreviations

SSS Side Scan Sonar

JpGU Japan Geoscience Union

Keywords: Japan, Fukushima, Submerged Landscape, Natural Disaster

INTRODUCTION

This article discusses the scientific potential of studying disaster sites located on an inland lake. So-called disaster archaeology at submerged archaeological sites is not a well-known topic of research in Japan. In 2022, to promote the study of underwater disaster archaeology at inland lakes, researchers from various fields came together to conduct an archaeological expedition. This paper focuses on a research project led by Senior Researcher Wataru Tanikawa, being conducted at the submerged site of Hibara Village in Fukushima Prefecture. The village was submerged by the formation of a dammed lake following the 1888 eruption of Mt. Bandai (Central Disaster Management Council 2005, 1). The site records the tangible heritage of village life, the mechanisms of a disaster, and how people reacted to the disaster. The project is a joint effort by archaeologists and natural scientists to extract records of disasters by investigating historical records, archaeological remains, as well as acquired data from remote sensing technologies and soil science technologies.

The importance of understanding past disaster sites is apparent because such studies not only provide an understanding of our past but also contribute to today's policy-making in better disaster prevention. Disasters, such as volcanic eruptions, change the landscape drastically and the lives of people. The study of submerged landscapes and the material culture left behind underwater due to a disaster can provide insight into our past interaction with the environment. Research in this sub-field has been challenging because of the small number of investigated sites, the lack of uniting themes, and how to glean information through available scientific methodologies. The team hopes to create momentum for further research on disaster archaeology at submerged sites by providing possible themes and research methods to be followed. This paper discusses the history of Hibara Village, how the research came about, results from the 2022 season, and as a conclusion, a plan for future research. The preliminary results of the 2023 fieldwork will be discussed in the presentation.

HISTORY OF HIBARA VILLAGE

Hibara village is strategically located along an East-West path in a mountainous region of northern Japan. The major development came during the Edo period (1603-1867 CE) when the village was designated as a post town or *Shukuba-Machi*, on the Aizu-Yonezawa Highway. The village has little farmland, but it flourished as an “inn” for merchants and travelers. However, in the Meiji era (1868-1912 CE), when the highway system was abolished, the town declined in its importance. Despite losing its function as a station, the village was a well-known spot along the highway for rest (Kita-Shiobara Village Board of Education 2018, 1-2).

On 15 July 1888, the sudden eruption of Mt. Bandai changed the course of the village forever. This was the first major disaster that received international attention in the Meiji period. A part of the mountain collapsed and the avalanche buried several villages, killing close to 500 people (Sato 2021, 49-50). Hibara village first appeared to have been saved from the devastation, as the debris from the collapsed mountain did not reach the village. However, the debris from the mountain dammed the existing streams creating lakes. The water level began to rise slowly, and after several months, the government ordered the villagers to evacuate and the village was relocated to a higher ground. The newly formed Hibara Lake eventually swallowed the entire village (Kita-Shiobara Village Board of Education 2022, 36).

The location of the village was not forgotten. The focal point for the villagers then and now is the shrine, located at the ridge of a hill, above the current water-level. The passageway, or the approach to the shrine, is marked by rows of trees. After the submergence, these trees were cut down, leaving the tree stumps behind partially submerged. These stumps can be seen today along the two Torii gates, leading up toward the shrine. One Torii gate is standing close to the current shoreline and another Torii is in the lake. The water level of the lake is controlled, and seasonal fluctuation is high due to the heavy snowfall in the area. Usually, the water-level is kept low during winter. During summer seasons, one of the Torii is completely below water, but when the water level is low, one can walk beyond this Torii on dry land.

The submerged section of the village has been designated as a known site by the local municipality (Kita-Shiobara Village Board of Education 2022, 35). In 2000, Hosei University carried out a preliminary diving survey around the village and found several ceramic fragments. Hosei University organized further research in 2002, and they recorded some features, including rock foundations and raised ground. The work was done by the university's Explorer Club and not by trained archaeologists (Tanikawa 2021). The video and the drawings they made, however, provided clues about what to look for during research. In addition to these underwater expeditions, the Kita-shiobara village conducted an in-depth walking survey during a historic low tide in 2016; they found gravestones and other stone-built structures, as well as some artifacts including ceramics and iron objects (Kita-Shiobara Village Board of Education, 2022).

HOW THE RESEARCH CAME ABOUT

For years, Tanikawa had a vague idea of studying past disasters and their impacts on human society by combining natural and social sciences. Between 2015-2019, Tanikawa investigated "Kuroda-gori," a village in Kochi Prefecture that is believed to have been submerged by the Hakuho Earthquake of 684 (Tanikawa *et al.* 2016, 17-18). Based on historical documents and sedimentation history, several areas in Kochi Prefecture were surveyed, finding underwater remains, such as blocks of stones and stone pillars (Tanikawa *et al.* 2019). However, it was not possible to identify direct links between the features, sedimentology data, and written records. Tanikawa realized the need for collaborative research, especially from the archaeological community. Randall Sasaki, hearing the story of Tanikawa's research, offered help. To discuss the possible collaboration of research, a session titled 'Natural hazard and human activity recorded in underwater geoarchaeological structure' was organized at the Japan Geoscience Union and American Geophysical Union joint meeting held at

Makuhari, Japan (JpGU Session H-QR05, 2020). At this session, the need to investigate a known submerged site as joint research was proposed, and Hibara village was selected as a case study. The research team, mainly from three different fields, was formed. Besides the archaeological team, one team focuses on remote sensing surveys to gather an overall image of the site, and another team conducts scientific analysis including the soil profile. The Lake Hibara underwater site is a suitable location for research for several reasons. Written records of the disaster are available and the reason for the submergence is known. The location of the site is certain and the local municipality is eager to support the project.



Figure 1. A Historic Map (Azaippitsukagirichizuchou, Hibara-Mura) of Hibara Village, displayed at the Local Museum (Photographed by the research team)

In 2021, the team gathered at Hibara Lake for a preliminary investigation; a sonar survey, snorkel survey, and underwater monitoring by a drone were conducted. The sonar survey revealed rows of tree stumps along the approach and showed some strong reflections. The snorkel survey identified rows of trees and some building blocks. The underwater drone survey revealed stone structures, and possible locations of a temple by the presence of gravestones. The main source for identifying the general plan of the village is the land allocation map (Azaippitsukagirichizuchou, Hibara-Mura) from the early Meiji period (Aizu -Yonezawa Kaido Main Road, Hibara Historical Museum). It depicts streets, canals, housing blocks, and important buildings including a shrine, a temple, and administrative buildings (Figure 1). The results from the 2021 season appeared to correspond well with the allocation map. A meeting with the local municipal office was held, sharing the results and discussing the research plan. Based on the results, the team was able to draw a research plan. The team applied for a research grant and was approved, starting a four-year project in 2022 (Grant-in-Aid for Scientific Research (A) - Clarification of underwater ruins of Lake Hibara and the volcanic disaster that caused the submergence of the lake).

THE 2022 SEASON

This was the first main season of the research and was focused on gleaning information from various methods to see the overall picture of the site and fine-tune the research plan for the coming seasons. The team conducted various remote sensing surveys and diving investigations. Soil samples and wood samples were also collected for analysis.

Remote Sensing Survey

The success of underwater archaeology is all about knowing where to look, and this study is to know the general distribution or the plan of the village. The above-mentioned allocation map is an important source; the map contains information on the length/size of the village blocks. Remote sensing was planned to orient and adjust the map to be used for archaeological surveys (Figure 2).



Figure 2 A Photo of the Lake, the Torii Gate, and the Team Conducting a Survey (Photographed by the research team).

Sonar surveys were conducted on several occasions using Side Scan Sonar (SSS) (Imagenex Model 872 YellowFin: 800 kHz). The images showed reflections from the submerged Torii, rows of trees, stone walls and foundations, intersecting roads, and some other unknown features. Approximately an area of 0.2km² was surveyed, and a mosaic image was generated. The SSS image appears to correspond well with the land allocation map, showing some of the building blocks with sharp corners. A general land formation and small streams can be vaguely seen but require a visual inspection to identify (Figure 3).

A Sub-bottom Profiler survey (SyQwest Bathy 2010-PC: 3.5 kHz) was conducted to investigate the features buried below the lake sediment. The survey focused on the proposed village area; transect lines were made from both north-south and east-west directions. The result showed that the site was covered by about 20-30 cm thick soft lacustrine sediment. The land slopes downwards towards west-northwest directions and appears to show a greater change in elevation at the edge of the village, which is also seen in the SSS data. All water sources run from west to east, following the natural land formation. The irrigation channel made at the village followed this natural drainage direction.



**Figure 3 A Side Scan Sonar Mosaic Image overlayed;
Showing the Outlines of the Village in Reflections (image provided by the research team)**

A magnetometer survey (OH Marine Magnetics SeaSpy2) was also conducted. Around the supposed village, 12 magnetic anomalies were found, mainly concentrated in the northern part of the survey area. These anomalies could potentially be associated with iron artifacts discarded by villagers when leaving.

Archaeological Investigation

The underwater investigation was conducted to see if the SSS data corresponded with the map and the accuracy of the map. If the team can “learn” how underwater features appear, it may be able to reconstruct the village by looking at the SSS data, and also be able to pinpoint the location to dive.

Silt accumulation is the main problem for an archaeological diving survey. The visibility becomes close to zero, if divers are not careful to disturb the bottom surface. The datum was set at the submerged Torii, and a 100 m line was established extending out from the approach. Since this survey was a preliminary expedition, this is a temporary datum and a fixed datum point will be established in the following season. The submerged Torii is about 71 m offshore. The resident informed the team that these Torii gates were constructed about 40 or 50 years ago, close to the original locations.

Stacked Stone Wall

The diving survey revealed the remains of a two-story stacked stone structure with an L-shaped plan, located 120 meters offshore (about 50 m from the datum). This is thought to be the junction of the approach and the main highway. The structure was composed of rectangular stones measuring roughly 70 cm x 30 cm. The feature is partially buried, especially showing heavy accumulation towards the west. The wall was at least two stones high, 18 stones lined north-south (along the approach), and at least five stones east-west (along the main highway). This wall can be seen clearly on the SSS image.

Rock Accumulation

A wide area of gravel accumulation was discovered approximately 15 meters from the datum. The exact extension is unknown, and the size and the shapes are irregular. Several stones were cut to make into shapes, and a circular hole was drilled in at least one of the stones, which is broken in half. It is

considered to be the foundation of the Torii. The feature appears as cloudy reflections in the SSS image.

Earthen Embankment

An elongated earthen embankment was discovered parallel to the east of the approach road, extending approximately 25 m in length. The embankment was made primarily of sand mixed with gravel. The embankment measures four meters wide and has a low rise of two meters. To the north of this feature is an area with scattered rocks and the remains of building foundations. Based on the land allocation map, a temple was located at the northern end of the embankment. The embankment may be an access road to the temple. The feature is shown as a mix of spotted strong and weak reflections in the SSS image.

Landform

The SSS image shows an abrupt change in color at several locations, and these correspond well with the elevation change. A slanted S-shaped change in landform seen in the image can also be seen in the land allocation map. The abrupt change in the elevation was confirmed during the diving survey as well. The houses, or village blocks were built along this ridge. The main highway runs along the lower edge of this ridge. Some houses, a shrine, and a temple were built on the upper ridge and the rest of the town below.

Core Samples Wood Species analysis

The core samples were taken at four locations, two samples each (Samples A and B), counting eight cores in total. Samples A were subjected to destructive analysis while Samples B were only used for non-destructive analysis. The baseline for collecting samples was set along the approach to the shrine, establishing the zero point at the submerged Torii. The core sample was collected at 30m (Core I), 52m (Core II), 70m (Core III), and 100 m (Core IV) from the zero point. Core samples were collected by divers pounding polycarbonate pipes directly into the lake bottom. Samples up to 35 cm in length/depth were collected. Nondestructive observations of internal structure in lake sediments were made using X-ray computed tomography. Density and magnetic susceptibility measurements were made using a nondestructive multi-sensor core logger, density and porosity measurements were made using the nitrogen gas displacement method, grain size analysis using laser diffraction, and mineral identification using powder X-ray diffraction.

All cores had fine-grain sediments in the shallow/top layer (Layer I) and mixed sediment with some angular gravel in deeper layers (Layer II). Layer I had a lower bulk density, magnetic susceptibility, percentage of grains larger than 1 mm in diameter, and dispersion of grain size distribution. In terms of bulk density, a clear physical property gap was observed between the layers. Layer I showed a larger proportion of diatoms and volcanic glass and a smaller proportion of quartz than Layer II. In addition, no illite or chlorite, both of which are andesitic origin, was found in Layer II. The results indicate that Layer I is a soil layer deposited after the formation of Hibara Lake.

To our surprise, pottery fragments were found in Core IV. These pottery sherds had engraved stripes on the interior, suggesting that it is a fragment of mortar for grinding, which is a typical artifact found in a site dating to the Early Modern period or later. Core IV showed higher porosity, indicating heavy land use. Perhaps, this area was used as farmland or trash pits existed nearby. Core III, which is located near the intersection of the approach and the main highway, showed compacted soil.

Rows of trees along the approach create the key scenes of the site. To identify the species and to date the tree, core samples were drilled into several trees. The species were identified as cedar. The trees date to around the mid-19th century from the radiocarbon dating. The date confirms that the growth of trees stopped soon after submerging.

CONCLUSIONS AND 2023 SEASON PLAN

Interdisciplinary investigation of the Lake Hibara underwater site is a challenging and complex endeavor, but the first season shows promising results. The research team hopes to obtain a comprehensive understanding of natural disaster mechanisms as well as the people's interaction with the event. With the data and knowledge gathered in the first season, the research team is well-positioned to find out more about the complex dynamics of the underwater site, and the wider implications of natural disasters.

During the 2023 season, small-scale excavations both on land and underwater are being planned. This may provide an insight to the changes in material culture before and after the village was relocated. The detailed season plan has not been finalized at this point of writing, but the season's preliminary results will be introduced at the conference.

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BIBLIOGRAPHY

Aizu -Yonezawa Kaido Main Road, Hibara Historical Museum “Azaippitsukagirichizuchou, Hibara-Mura” A photo-copy of Historical Map 字一筆限地図帳 第四大区七小区 岩代國耶麻郡 檜原村, Author not recorded, Date Unknown, (Photographed by the research team)

Central Disaster Management Council. *1888 Mt.Bandai Eruption Report*, Tokyo:Central Disaster Management Council, 2005.

Kita-Shiobara Village Board of Education. *Kita-Shiobara Village Excavation Report, No. 5*, Fukushima: Kita-Shiobara Village Board of Education, 2022.

Kita-Shiobara Village Board of Education. *Historic Road, Aizu-Yonezawa Highway - Hibara History Trail*, Fukushima: Kita-Shiobara Village Board of Education, 2018.

Sato, Hiroshi. “Eruption of Mount Bandai in 1888 and Recovery from Disaster.” *Water Science* 65, no. 3 (2021): 45-69.

Tanikawa, Wataru. *Collaborative Research and Meeting of Natural Hazard Science and Archaeology for Submerged Ruins*. Disaster Prevention Research Institute Kyoto University, Kyoto: Kyoto University, 2021.

Tanikawa, Wataru., Go-ichiro Uramoto, Yohei Hamada, Masafumi Murayama, Yuhji Yamamoto, Takehiro Hirose, Osamu Tada, Kouki Tanaka, Hiromasa Ozaki, Minoru Yoneda, and Hidekazu Tokuyama. “Provenance of submerged stone pillars in an earthquake and typhoon hazard zone, coastal Tosashimizu, southwest Japan: A multidisciplinary geological approach.” *Marine Geology* 415 (2019) 105962.

Tanikawa, Wataru., Go-Ichiro Uramoto, Hidekazu Tokuyama, Masafumi Murayama, and Yuhji Yamamoto. “A Review on Estimation of Subsidence Records of Nankai Earthquakes from the Tradition of the Submerged Village Kuroda-gori.” *Rekishi Jishin* 31 (2016):17-26.