

# **Introduction**

In recent decades, greater access to underwater cultural heritage—all traces of human existence of historical or cultural significance that lies or once lay under water—has been made possible due to the rapid development of underwater archaeology and exploration techniques. These advances have resulted in a better understanding of our world's underwater cultural heritage, however increased traffic under water has also made these objects more susceptible to damage due to such issues as looting, vandalism and marine construction works.

Recognising these challenges and the importance of protecting and preserving underwater cultural heritage, archaeologists have increasingly brought attention to the value of the conservation of ship wrecks and submerged ruins in situ, in their original location, through dive trails and underwater museums. An important example of this movement towards in situ conservation is the Baiheliang Underwater Museum—the first complete underwater museum, constructed in the Yangtze River around the Baiheliang Stone inscriptions in Fuling, Chongqing, China. The museum is the first of its kind, displaying some of the most ancient hydrological inscriptions in the world, recording 1, 200 years of changes to the water level of the Yangtze River. The structure of the museum, an arch-shaped water pressure-free container, required meeting numerous engineering and technical challenges, with the end result a leading international example of in situ conservation.

With the aim of sharing experiences gained through the construction of the Baiheliang Underwater Museum, the "International Meeting on the Protection, Presentation and Valorization of Underwater Cultural Heritage" was held from 24 to 26 November 2010, in Chongqing, China. The meeting, jointly organised by the Chinese Academy of Cultural Heritage, the Chongqing Administration of Cultural Heritage and UNESCO was attended by over 80 scholars, experts and representatives from China and across the world. A key focus of the meeting was the exchange of ideas between Chinese and international experts in the fields of underwater cultural heritage conservation, underwater archaeology and presentation techniques of underwater cultural heritage, with a focus on underwater museums.

The meeting proved to be immensely successful, which is exemplified in the resulting recommendations jointly drafted by participants concerning current international underwater cultural heritage issues—“Chongqing Recommendations on Strengthening the Preservation of Underwater Cultural Heritage.” The recommendations outline suggestions for underwater cultural heritage preservation, including intensifying preservation, improving capacity building, encouraging in situ preservation, raising awareness, emphasizing international cooperation and furthering knowledge of the 2001 UNESCO Convention on the Protection of the Underwater Cul-

tural Heritage.

In addition to the recommendations, this publication documents the speeches presented during the three sessions, which includes the key note speeches by Shan Jixiang, Ulrike Guerin and Wang Chuanping; issues faced in underwater archaeology; presentations of underwater cultural heritage and technical issues; and, conservation practices for underwater cultural heritage. It is anticipated that the meeting, the corresponding recommendations and the current publication will serve to contribute to the promotion of underwater cultural heritage conservation in China and to increase communication and cooperation amongst international groups involved in underwater cultural heritage preservation and conservation; and thus, the safeguarding of underwater cultural heritage for the benefit of humanity.

# **Keynote Speeches**

# From Underwater Archaeology to Underwater Cultural Heritage Protection: Speech for the International Meeting on the Protection, Presentation and Valorization of Underwater Cultural Heritage

Shan Jixiang

Director State Administration of Cultural Heritage

Distinguished guests and dear friends:

Good morning! Today, almost all specialists in this field, including the young and the old, have arrived. Experts from all over the world are gathered here in Chongqing, a mountain city by the Changjiang River, to focus on the topic of the “protection, presentation and valorization of underwater cultural heritage,” which is of extraordinary significance. My path is full of petals-I have swept it for no others. My gate has been closed-but now opens for you. Although the protection work of underwater cultural heritage in China is still not mature, we would like to open our minds, freely exchange and make discussion with all of you, and seek and promote the common development of underwater cultural heritage protection in China and around the world. Now, I will discuss a few of points regarding the protection work of underwater cultural heritage in China.

## **1. Actively Explore the Path of Underwater Cultural Heritage Protection with Chinese Characteristics**

China is a large maritime country and has a coastline of more than 18, 400 kilometers and territorial waters and waters under jurisdiction of more than 3 million square kilometers. During its history of several thousand years, China has not only developed farming culture based on loess culture, but has also developed ocean culture, such as Dong Yi culture, Bai Yue culture

and so on, and the “Marine Silk Road” is especially remarkable. This long navigation history has left rich underwater cultural heritage, which are located mostly in territorial waters, internal waters and waters under Chinese jurisdiction. According to incomplete statistics, there are at least 2000 sunken wrecks in China’s territorial waters. In order to protect these precious underwater cultural resources, China has established professional teams and carried out underwater archaeology work since the 1980s. With exploration and development for more than twenty years, China’s underwater archaeology work is currently in a crucial transition period from single underwater archaeology to all-round underwater cultural heritage protection. With leadership from the state, support from local entities, and coordination and cooperation of all relevant departments, the management system of underwater cultural heritage protection has been established.

“Leadership from the state” means the Chinese government provides all-round supporting measures including regulation, organization and funding support. The UNESCO *Convention on the Protection of the Underwater Cultural Heritage* specifies that underwater cultural heritage is an important part of the cultural heritage of mankind and all countries should bear the responsibility of underwater cultural heritage protection. As a major country with underwater cultural heritage, China has been committed to building a legal system for underwater cultural heritage. Early in 1989, China formally disseminated the *Regulations of the People’s Republic of China Concerning the Administration of the Work for the Protection of Underwater Cultural Relics* and became one of the countries that made early legislation for underwater cultural protection. The *Regulations* specify that underwater cultural relics are property of the state and the state exercises jurisdiction over these cultural relics and legally protects underwater sites from destruction.

At the same time as improving the legal system, Chinese underwater cultural heritage protection institutions continually advanced. In 1987, the underwater archaeology coordination group was jointly established by the State Administration of Cultural Heritage, the Ministry of Communications and the State Oceanic Administration. In September 2009, in order to further integrate resources, the State Administration of Cultural Heritage set up the “National Underwater Cultural Heritage Protection Center,” which is responsible for organizing, coordinating, exchanging, training, planning and implementing the protection work of underwater cultural heritage. In the meantime, funds spent in underwater cultural heritage protection are being increased year by year. Since 2006, the central budget has allocated protection funds for underwater cultural heritage of more than RMB 20 million per year.

“Support from local entities” means that in addition to professional national organizations,

coastal provinces and cities have set up professional underwater archaeology institutes and underwater cultural relics repair and protection organizations and established teams of intellectual. Following the Yangjiang base in Guangdong province, the Ningbo base in Zhejiang province and Qingdao base in Shandong province, the national underwater cultural heritage protection Chongqing base was formally established this morning and is another professional underwater cultural heritage protection institute. Some places also established specific underwater cultural heritage protection museums, for example, the Nanhai No. 1 Museum in Yangjiang Guangdong, Baiheliang Underwater Museum in Chongqing and Quanzhou Maritime Museum in Fujian. In addition, some provinces raised funds for the exploration and protection of major projects in their regions, for example, Guangdong province allocated tens of millions of funds to support the integral salvaging project of Nanhai No. 1. Indeed, support from local entities has greatly enhanced China's ability and level to protect underwater cultural heritage.

The "coordination and cooperation of all relevant departments" means that different departments and organizations of different fields work together to provide all-round protection of underwater cultural heritage. This is a group photo of underwater staff at the exploration site of Nan'ao No. 1 in Guangdong; the staff come from different cities, organizations, and professional fields, such as project planning, underwater exploration, site protection, post-protection of underwater cultural relics and so on. This is an epitome of protection work of Chinese underwater cultural heritage, and also a common work mode. At the level of project work, once the State Administration of Cultural Heritage decides to carry out the excavation of a large site, the project group will mobilize professionals from all over the country to take part in and provide joint protection. At the level of the state, in case an important site requires investigation and protection, the Ministry of Finance, the State Oceanic Administration, the Ministry of Communications, the Ministry of Public Security and so on will establish a working group to realize cross-sectoral, interdisciplinary and cross-industry cooperation. Similarly, cross-sectoral cooperation has actively contained such criminal acts as the illegal salvaging and smuggling of underwater cultural relics, and the public security and the frontier defense departments of Hainan, Guangdong, Fujian, etc. have solved many relevant cases. This year, in order to provide well-founded experiences for underwater cultural heritage monitoring, we set up synchronous experimental units for safety monitoring of underwater cultural heritage at offshore and open sea fields. It can be said that the work mode with coordination and cooperation of all relevant departments benefits the implementation of the protection work of underwater cultural heritage.

## 2. Make Bold Innovations and Practice the Heritage Protection Concept of “In-situ and All-Round Protection”

The UNESCO *Convention on the Protection of the Underwater Cultural Heritage* aims at ensuring and enhancing the protection work of underwater cultural heritage. To make the public learn about, appreciate and protect underwater cultural heritage, we should encourage people to visit underwater cultural heritage sites in a responsible and non-intrusive manner, so as to carry out investigations and establish archival data. However, such activities shall not prejudice the protection and management of underwater cultural heritage or be used for commercial development of underwater cultural heritage. In China, underwater cultural heritage protection is still a young science and requires the spirit of innovation. In addition, the protection concept of the Convention puts forward higher requirements on China's underwater archaeology. China has established the idea of all-round protection and received valuable experiences based on long-term exploration. Now, I will introduce three representative examples.

The first example is the Baiheliang Underwater Museum that experts present at this meeting will visit tomorrow. It is a key protection project of the cultural relics of the Three Gorges. Early in 2001 when the building was proposed, the all-round protection concept of in-situ construction, original environmental protection and original state presentation was established. Based on this concept, after eight years of practice and overcoming many technical difficulties of integrating the construction of the museum ashore and embankment work, this underwater site museum was completed. It is a representative example of China's cultural relics work that has transferred from the preservation of cultural relics to the protection of cultural heritage. Experts can take the in-situ view of the carving on Baiheliang and study the hydrology, and regional and global climate changes of the Changjiang River. The construction idea of this museum is in full accordance with the concept emphasized in the Convention to “make the public learn about, appreciate and protect underwater cultural heritage and encourage people to visit underwater cultural heritage sites in a responsible and non-intrusive manner, so as to carry out investigations and establish archival data.”

The second example is the well-known protection project of Nanhai No. 1 sunken wreck of Guangdong. This photo shows the moment at which the whole Nanhai No. 1 sunken wreck was salvaged from the water. According to the preservation state of the sunken wreck and the burial environmental characteristics, we learnt from the method of integral moving on land and adopted an overall salvage technique to protect the sunken wreck. Today, our archaeologists can ex-



plore, preserve and present the underwater cultural heritage in a manually-controlled environment. Its successful salvage is not only a beneficial attempt to comprehensively employ underwater archaeology, cultural relics protection and ocean engineering technology, but also a powerful witness of cross-industry and cross-sectoral cooperation to protect underwater cultural heritage, and even an explanation and scientific development of UNESCO's "authenticity and integrity" principle of cultural heritage.

The third example is the third national cultural relics survey that is currently being conducted. Combined with this survey, we organized and carried out underwater cultural relics surveys at coastal waters of 11 coastal provinces and cities, the Xisha Islands and interior provinces, including Anhui, Jiangxi and so on. Through the survey, we discovered numerous evidences of underwater cultural relics, confirmed over 70 sunken wreck sites, and thus provided abundant first-hand information for the understanding of distribution laws and the preservation state of Chinese underwater cultural heritage. More importantly, we provided basic data for further active and all-round protection of underwater cultural heritage for all mankind. This survey work is the best practice to actively bear the protection responsibility as specified in the Convention.

In addition, we enhanced the promotion of underwater cultural relics protection by means of various media to create a new situation of "public participation and joint protection." From the exploration of the Qing Dynasty's (1644-1911) sunken wreck in Fujian in 2005, to the salvage of the Southern Song Dynasty's (1127-1279) sunken wreck in Guangdong in 2007, to the opening of the Baiheliang Underwater Museum in 2009, and to the exploration of the Ming Dynasty's (1368-1644) Nan'ao No. 1 sunken wreck this year, many media in China have given much attention to the subject and played an important role in raising public awareness of the protection of underwater cultural heritage.

### **3. Cooperate to Jointly Promote the Protection of Underwater Cultural Heritage around the World**

Over the past twenty years, China has maintained good interactions with international counterparts regarding underwater cultural heritage protection and benefited greatly from these interactions. For example, this meeting provides a good chance for learning and exchange. In fact, from establishment to development, China's underwater archaeology has always involved international exchange and cooperation. From the first two trainees sent by the State Adminis-

tration of Cultural Heritage to the Netherlands to learn and participate in underwater archaeology in 1988 to its investigation of underwater ship construction work in Korea this year, over the past two decades, China has sent relevant personnel to Japan, Australia, the USA, France, Indonesia and so on for cooperation and exchange of underwater cultural heritage protection. And just at this moment, one of our underwater archaeological teams, together with Kenyan counterparts, are carrying out an investigation and exploration work of an underwater sunken wreck site in the surrounding waters of Lamu Island in Kenya. We hope that we can make due contribution to the protection work of the world underwater cultural heritage.

The next purpose of the protection work of underwater cultural heritage in China is to further enhance the work platform. The protection of underwater cultural heritage has specificity and faces various limits, such as personnel, funds, technology and equipment limits and so on. Thus in the past, the major working areas of China's underwater archaeology have mostly been concentrated in coastal waters. In recent years, as the national investment and support measures have increased, the idea, technology, staff supplies, logistics systems and other aspects of underwater cultural heritage protection in China have made great improvements and the work areas are continually expanded. At present, we are making a demonstration for the construction of the first specific ship work for underwater cultural heritage protection in China. This ship will further improve our ability to protect underwater cultural heritage. Currently, the objects of underwater cultural heritage protection are increasingly various, the working field is expanding and becoming more and more concerned with relevant departments and industries, and our work is no longer limited to the investigation of underwater cultural relics and rescue explorations of important sunken wreck sites. Supported by the National Underwater Cultural Heritage Protection Center, today's State Administration of Cultural Heritage will build an open work platform, fully integrate existing resources, gather effective strength and focus on a number of significant protection projects of underwater cultural heritage as examples. For instance, the building of a monitoring system of underwater cultural heritage protection, the establishment of work bases of underwater cultural heritage protection, the enhancement of research and the development of protection technology of explored cultural relics, the declaration of the Maritime Silk Road as world cultural heritage, and the investigation of ancient coastal defense engineering. These major projects and tasks may serve to promote the theory and technical research of underwater cultural heritage protection, foster and train professionals, improve the application level of high technology and further the comprehensive development of underwater cultural heritage protection.

Here, I declare again that China is a strong supporter of the UNESCO *Convention on the Protection of the Underwater Cultural Heritage*; at the 31<sup>st</sup> UNESCO Conference in 2001, China voted in favor. In practice, China has carried out lots of protection work of underwater cultural heritage and actively contained such acts as looting and destruction of underwater cultural heritage. Facing new situations and problems to the protection of underwater cultural heritage, China will further enhance the contact and cooperation with relevant national and international organizations and professional institutes, as the Convention specifies, “contracting states work together, make exchange and training about the preservation technology of underwater archaeology and underwater cultural heritage, carry out technical transfers concerning the research and protection of underwater cultural heritage based on agreed conditions.” China will absorb and learn the advanced protection ideas, experience and technology from international counterparts, and actively take part in relevant international cooperation.

China has an old saying, “water has no waves, but can ripple when meeting each other; stones are dark, but produce spark when hitting each other.” The exchange and collision of different academic ideologies and different scientific fields will certainly lead to more advanced protection ideas, methods and results of underwater cultural heritage, and promote all-round progress. Looking back, China’s protection work of underwater cultural heritage has had a good beginning and stable development; looking ahead, China’s protection work of underwater cultural heritage has a bright future and a long way to go. I believe this international meeting on underwater cultural heritage will be a good chance for and greatly promote the international exchange and cooperation of underwater cultural heritage. It is not only beneficial for the all-round development of China’s protection work of underwater cultural heritage, but also for the permanent preservation and utilization of the precious cultural heritage of mankind, and for the harmonious development of the world social economy and culture!

At last, please allow me to give my best regards to all the attendees. I wish you happiness during the meeting! I wish the meeting success!

Thank you!

# The UNESCO Convention on the Protection of the Underwater Cultural Heritage and the development of underwater museums

Ulrike Guerin

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Underwater Cultural Heritage (2001)  
UNESCO

Two major museums recently constructed in China, the *Baiheliang* underwater museum and the *Nanhai No 1* wreck museum, are certainly among the most important exploits of underwater archaeology worldwide: The *Baiheliang* museum as the first example for the respectful preservation of heritage and its context *in situ*, showing the feasibility of its presentation to a large audience in the original location. The *Nanhai* museum as the result of one of the largest wreck recovery projects, bringing the presentation of underwater cultural heritage a major step forward in presenting the relic in an environment similar to the original one, under water in an aquarium.



Both projects are of great interest for the international scientific community and the public. In the UNESCO Convention on the Protection of the Underwater Cultural Heritage ( “the

2001 Convention”) the international community took a clear stand in favour of the preservation of the authenticity and the historical context of submerged heritage. This Convention is the major international instrument regulating the protection of submerged heritage. It recommends considering the preservation *in situ*, i. e., in the original location of a site first, before recovery, and sets clear scientific standards for intrusive activities, like excavations, should these be undertaken. It also encourages strongly the access of the public to submerged heritage.

This does not mean that no recovery should be undertaken any more, but it means that the destruction of the original site should be well balanced to the reasons for it and that the possibility of preserving site-integrity should be thought about, justly because the developments like the construction of true underwater museums become a real option.

## 1. The UNESCO Convention and its Stand towards Preserving Heritage in its Original Location

The United Nations Educational, Scientific and Cultural Organization (UNESCO) is a specialized agency of the United Nations. Among others it works to improve the protection of cultural heritage on a global level. Its 2001 Convention seeks to improve legal and operational protection of submerged heritage. It is an international treaty, responding to the increasing looting and destruction of such heritage, setting international protection standards. The Convention protects as “underwater cultural heritage” all traces of human existence having a cultural, historical or archaeological character, which have been under water for at least 100 years. This includes a large variety of sites, like ancient shipwrecks, submerged structures and buildings, human remains or traces in submerged caves or sunken prehistoric landscapes and villages.



*Preserving the context and beauty of a submerged site-comparing a submerged to a recovered anchor*

The Convention sets out basic principles for the protection of this heritage, provides a detailed State cooperation system and widely recognized scientific rules for the treatment and research of submerged sites. It does not regulate the ownership of sites nor does it change maritime zones. Among the main principles of the Convention, in addition to heritage preservation and the refusal of commercial exploitation, is the recommendation to consider first the preservation of submerged sites *in situ*. The recovery of objects may, however, be authorized for the purpose of making a significant contribution to the protection of, or knowledge about, underwater cultural heritage.

This recommendation to consider as first option the preservation of submerged sites *in situ* is especially regulated in the first sentence of Rule 1 of the Annex of the Convention. It means that *in situ* preservation shall be considered as the first choice and that in authorizing any activity, this possibility should be considered first. ‘First option’ does however not mean ‘only option’ or ‘preferred option’. Partial or total excavation may be preferable in a number of occasions depending on the specific situation. While the Convention indicates the negative impact of an artefact displacement, as it destroys the link between site, relic and the surrounding community, it is nevertheless clear about the fact that objects may be recovered for a good cause, so it does not categorically prohibit recuperation.

Valid reasons for recovery may be for instance the threat of looting, a major scientific interest or the desire to make important heritage accessible for the public, as was the case for the *Nanhai No. 1* wreck. Development projects, for which sites need to make way, may also be compulsory reasons. Sometimes an instable environment, like soil movements or changed currents may furthermore speak for an excavation, when for instance stabilizing an endangered site would be so exorbitantly costly that *in situ* preservation is not the best option. However, the Convention makes it clear that none of these reasons should prevent from considering *in situ* preservation first.

The desire for and the appreciation of the authenticity of a heritage site is a fundamental reason for the consideration to preserve *in situ*, versus the decision to excavate. Especially wreck sites, but also any other submerged historical site, like the *Baiheliang* stone inscriptions, illustrate events that took place at a certain place. The importance given by the Convention to *in situ* preservation reflects the significance of this historical context of the cultural object and its scientific meaning. It also takes into account that new developments in the presentation of sites will soon make them accessible to the public at large, what is now admirably demonstrated by the *Baiheliang* museum at Fuling, China.



*Figures displaced from the Parthenon and exhibited in the British Museum, being object of a restitution request of Greece © Andrew Dunn*

Among the reasons for the opinion expressed by the drafters of the 2001 Convention in favour of the preservation *in situ* is certainly also the consideration that the displacement of large objects from under water might on a long-term have an equally undesirable effect as the displacement of major terrestrial heritage objects at the beginning of the 19th century had. While certainly the displacement of Egyptian obelisks, Greek temple artefacts and Jordanian palace facades to European museums have contributed to making this heritage known all over the world, the gap they left at their original location is now regretted and in some instances even restitution is claimed.

Another aspectspeaking for *in situ* preservation of submerged sites is that heritage is not an inexhaustible resource. Archaeological remains are limited, and as research develops, it is important to preserve authentic sites for the future.

## **2. The Challenge of Building a Museum Under Water**

Since many years experts in many countries worldwide have sought ways to present submerged heritage to the public. Many projects for the construction of submerged museums ‘wrecked’ however due to problems with the purification of the water, site visibility, water pressure, security or simply funding. While over the years a partial solution was found and many sites have been made accessible to divers by the means of cage-protected sites, replica sites, dive trails or ROV visits there remained always a strong interest to make the whole of the public audience profit from the enjoyment of underwater cultural heritage.

The recovery of wrecks and their dry exhibition in museums, most spectacularly done with



*Project design for the Alexandria underwater museum © J. Rougerie Architects*

the *Mary Rose* wreck in the UK and the *Vasa* wreck in Sweden, did much to make submerged heritage known and their display excited a large public. It was however always felt that the water that surrounds a wreck or submerged ruin and the context of the historical site were assets that were important for the full appreciation of a submerged relic.

The challenge of the construction of a true submerged museum remained therefore on the agenda of underwater archaeologists worldwide. A UNESCO meeting recommended for instance in 2006 the construction of a submerged museum in the harbour of Alexandria to present the famous lighthouse and the submerged remains of the Ptolemaic palace to the public in their original emplacement. The feasibility study for this museum should start soon.

Nevertheless, the issues to be taken into consideration for the creation of an underwater museum constitute a very long and challenging list. They range from general to architectural and technical issues.

General questions to be solved are for example issues of site authenticity and archaeological considerations concerning the choice of the emplacement of the museum building. They encompass also questions of the presentation of the heritage and the overall conservation and protection of the site and its cultural objects. A construction should for instance neither damage the original site nor disfigure it. It does however equally not make much sense to build an aquarium under water in which artefacts, or even worse replica, are only placed in an artificial manner, creating a mock-museum, while not sharing with the visitor the so-much desired authentic experience.



Architectural and technical issues encompass on the other hand questions like the structural approach to be chosen under water, as there are issues to be considered like the up-floating caused by the water, the pressure of currents, tides and storms, or the stability of the soil. Many ruin sites have for instance been submerged due to the emergence or subsidence of the soil or by earthquakes. It would evidently be perilous to ignore these factors in a museum construction.

To be added to this list are issues of water quality and visibility under water. Most submerged sites are originally covered by silt, sand or mud because the water displaces such material easily. It creates however a real problem in the presentation (and conservation) of a heritage site if it would need cleaning every day or even hour in order to be visible. Mostly free floating water is also not completely pure and transparent, therewith negatively influencing the visitor experience, while confined water develops algae, which need to be eliminated.

Other challenges are security issues, like the possibility of an intrusive event from the inside (explosion) or outside (water pressure, impact of a passing ship) that might flood the building or make it collapse therewith endangering visitors and relics.

In comparison to the above matters design issues, like the museology and the choice of presentation to the visitor, and the consideration of the creation of training and research facilities seem minor. However, it has proven that these may be as crucial as any of the above mentioned technical challenges. A museum can on the long term only become a success if it appeals to its addressees, i. e. . the public at large.

While the above issues concern the museum construction as such, it may be stressed and added that a major concern in the first instances of the museum planning should also be the integration of the structure into urban planning, to ensure the harmonious interplay of site, museum and city or landscape. This is valid for both directions-the museum needs to complete the city, but also the city the museum. The non-consideration of the preservation of the urban and natural environment of a museum may have a deadly effect on future success and underwater sites need for instance to consider the impact on the local fishing industry, on port activities, tourism and navigation.

Important are also the consideration of typical visitor routes, the environmental impact of the construction on the concerned site and on other archaeological sites. The fact that serious obstacles exist for visitors to come to visit a site, like for instance the locked security zone that hinders visitors to visit the location of the Oranjemund wreck in Namibia, can be as well terminating factors for museum plans as technical issues.

### 3. The International Importance of the Baiheliang and Nanhai Museums

The many challenges and constraints might create hesitations for the construction of a submerged museum, like the *Baiheliang* museum or even an only half-submerged museum like the *Nanhai* museum. The creation of both of them in a record-breaking time is therefore a success in itself worth celebrating. Adding to this and moreover both museums have however also won the laurels of the ‘world-first’ of their kind.

The *Baiheliang*, literally the White Crane Ridge, is an archaeological site in Fuling, China, now submerged under the waters of the newly built Three Gorges Dam. It displays some of the world’s oldest hydrological inscriptions. Planned since 1994, begun in 2002, the construction of the underwater museum has cost some 28 million US Dollars. This museum construction permitted to preserve as much as possible the access and appreciation of a site that would have otherwise been lost due to the rising waters of the river. It is a fabulous first-world-wide example of the presentation of underwater cultural heritage *in situ* accessible for the non-diving visitor. Locally it has also the importance of having preserved a cultural link of the population to a stream, which has caused the destruction of the homes of many million persons as well as of a precious natural environment through the Three Gorges Dam. The effects of the dislocation and cultural disconnection of many millions of people cannot yet be evaluated, but it is important that at least some heritage remains to bind the community to its roots.



*Diver inside the underwater container of the Baiheliang Museum © Huang Dejian, Baiheliang Museum*

The wreck of the *Nanhai No. 1* is in comparison an 800-year-old vessel, 25 meters long and weighing 3, 800-tons, which sank during the Song Dynasty (960 ~ 1279). It has been



Interior of the Nanhai No. 1 Wreck museum © U. Guerin/UNESCO

raised in its entirety including the surrounding silt, on the south coast of China in the Guangdong province. The *Nanhai No. 1* wreck is now displayed in a new museum on spectacular Silver Beach on Hailing Island near Yangjiang, a three-hour drive from Guangdong. It is surrounded by a tourist development area and is therewith cultural center point of a very much developing holiday-zone. The museum features an aquarium with the same water quality, temperature and environment as the spot in which the wreck was discovered. Archaeologists will now excavate the vessel, which is currently still enclosed in the surrounding silt and the recovery container inside the aquarium, thereby enabling visitors to observe underwater archaeological work in a museum environment. The *Nanhai No. 1* museum is to become certainly one of the most important museums of underwater cultural heritage worldwide, due to the underwater setting of the main relic, the wreck, and the possibility for visitors to gain a first hand view of underwater archaeology.

Both museums, the *Baiheliang* and the *Nanhai* museums, do currently still face problems that had to be expected in this kind of undertaking, mainly concerning water purity and visibility, museology and conservation. A solution to these problems is sought and will certainly be found. Both museums will therewith certainly guide scientific advancement and give the international scientific community a first-hand example of the possibility to realize such a museum construction exploit. They will be able to offer long-thought solutions to known problems.

For the public they are more than that however-they are beautiful experiences of the historical mysteries lying still under water and magnificent illustrations of the promise of underwater archaeology.

# Preservation of Cultural Relics in the Three Gorges and the Establishment of the Three Gorges Museum Complex

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China Three Gorges Museum

China

The Yangtze River is the third largest river in the world, the largest in both Asia and China. The Yangtze, along with the Yellow River, are the mother rivers of the Chinese nation. The Three Gorges is symbolic of the Yangtze River and is an essential part of Yangtze River culture. In March 1992, the Chinese government committed to the construction of a hydro-junction project in the Three Gorges, which attracted worldwide attention to the rescuing and preservation of cultural relics in the region. On the 26<sup>th</sup> of October 2010, the water level at the front of the Three Gorges Reservoir reached 175 meters above sea level, symbolizing an end to the construction phase of the Three Gorges Project and indicating a general end to the rescue and preservation of cultural relics in that phase. The preservation of cultural relics in the Three Gorges, along with the construction of the Three Gorges Project and the Three Gorges Migration Project, has moved phases from “Pre-Three-Gorges” to “Post-Three-Gorges”. From the last two decades of the last century to the beginning of the current century, preservers of Chinese cultural relics have made every endeavor to create conditions, to make every minute count while enduring criticisms, to unite, to innovate, to make selfless devotion, and to record the rescue of cultural relics in the Three Gorges region.

## 1. Major Contents of the Rescue of Cultural Relics of the Three Gorges

### 1.1 Preservation of Underground Cultural Relics

- Archeological exploration and excavation conducted at 722 locations, of which 528 are situated in Chongqing.
- 12.198 million m<sup>2</sup> of land employed for archeological exploration, of which 10.212 million m<sup>2</sup> is situated in the Chongqing reservoir area.
- 1,862 thousand m<sup>2</sup> of land employed for archeological excavation, of which 1,302 thousand m<sup>2</sup> is situated in the Chongqing reservoir area.
- Approximately 250,000 cultural relics unearthed with 140,000 pieces in Chongqing (182 items are currently under repair, and thus have not yet been analyzed).

### 1.2 Preservation of Above Ground Cultural Relics

- 365 locations for the preservation of cultural relics with 246 located in Chongqing.
- 169 locations for collected documents with 98 located in Chongqing.
- 60 locations for on-site preservation with 55 located in Chongqing.
- 132 locations for relocation for reconstruction and replication with 92 located in Chongqing (including one in the Dragon Back Stone).

### 1.3 Large-scale Special Preservation Projects

- Relocation and Preservation Project for Zhanghenghou Temple in Yunyang County, Chongqing.
- In-situ Preservation Project for Shibao Stockaded Village in Zhong County, Chongqing.
- Underwater In-situ Preservation Project for Baiheliang in Fuling, Chongqing.
- Reconstruction Project for Qu Yuan Temple in Hubei.

### 1.4 Research and Published Items Concerning Cultural Relics in the Three Gorges

- Brief reports on the excavation and subjective archeological reports of 30 million Chinese characters have been published (15 million characters regarding Chongqing).
- Research papers and monographs of 15 million characters published.

- Over 200, 000 volumes and pieces have been collected, including 4, 771 papers, 26, 642 books, 29, 513 photograph slides, 103, 954 photographs, 3, 474 digital disks, and 383 video tapes in the Chongqing reservoir area, as well as texts and cartographic records of over 800, 000 characters; over 3, 000 mapping design drawings of historic buildings, over 50, 000 black-and-white photographs and films, over 2, 000 disks, and over 200 soft disks in the Hubei reservoir area, all of which have laid a foundation for systematic management and comprehensive research in the future.

- The archeological research of 40 million characters and 90 research subjects are planned to be published, and will be pushed forward during the “Post-Three-Gorges” phase.

### 1.5 Museum Construction Project

- The Three Gorges Museum, the Baiheliang Underwater Museum, and nine other locations for cultural relics open to the public have been constructed in the Chongqing reservoir area.

- There are an additional 10 museums currently under construction and 15 in planning stages, which will be pushed forward during the “Post-Three-Gorges” phase.

## 2. Main Methods for the Large-scale Rescue of Cultural Relics in the Three Gorges

2.1 Funds for the Three Gorges Project were received from the Construction Commission of the State Council in coordination with the State Cultural Relic Bureau; leadership and management of governments in both Chongqing and Hubei

2.2 *A Planning Report Concerning the Preservation of Cultural Relics in Inundated Areas and Relocation Areas in the Three Gorges Project* was completed by top-ranking archeologists in China, 30 cultural organizations, and over 300 experts from universities under the leadership of the State Cultural Relic Bureau. Yu Weichao, Curator of the National Museum of Chinese History, served as the leader of the planning group. Main experts in the planning group served as members in the counsel group of the experts for the preservation of cultural relics in the Three Gorges led by Mr. Yu, to ensure the execution of the planning.

2.3 *Collaboration of nationwide workers for the preservation of cultural relics.* Nationwide large-scale cooperation and rescue with Chinese characteristics is one of the favorable traditions in the field of cultural relics in China. Under the collaboration of the State Administration of

Cultural Heritage, workers from over 120 institutions of higher education and cultural organizations nationwide participated in the rescue of cultural relics with 110 organizations from the Chongqing reservoir area. There are 210 organizations in total with organizations outside the field counted, 182 of which are in the Chongqing reservoir area.

2.4 *The innovation and devotion of workers for the preservation of cultural relics in both Hubei and Chongqing*. For almost 20 years, the workers for the preservation of cultural relics in both provinces have made every effort to assist the rising of the water level in the Three Gorges. They established a leading group for the preservation of cultural relics in the Three Gorges at provincial and municipal levels, overcame difficulties and strived to be innovative. During the period when China's planned economy shifted to a market economy, the system of project legal persons, contract systems, supervising systems (including supervision for underground archeology), quality tenure systems, and auditing systems, and executed disciplinary inspection systems were introduced. These processes served to ensure the success of the preservation activities and the security of the funds for the preservation.

### **3. Major Values of the Great Rescue of Cultural Relics in the Three Gorges**

3.1 The establishment of the sequence of the Paleolithic and the Neolithic culture in the Three Gorges, and the preparation of invaluable data for research concerning the East-West transmission between the Neolithic culture in the Jiangnan Plain in the middle reaches of the Yangtze River; the Poyang Lake Plain and the culture in the Chengdu Plain in the upstream of the Yangtze River in the New Period; and, the mutual cultural transmission between the mountainous regions and the plains. It offers new archeological materials for the Ba culture in the Copper Age and the cultural relations among the Bachu, Bashu and Baqin people, and provides new physical evidence of unique social, historical and cultural developments in the Three Gorges and research concerning the ancient environment, disasters, etc. in the region. Furthermore, the concept of "Civilization of the Yangtze River" that was seldom mentioned by experts in the past has since been popularized.

3.2 The preservation of nonrenewable and irreplaceable cultural resources for sustainable development in the Three Gorges, the preservation of culture valued for international tourism in the area, and maintained context and basic conditions in order to shape the Three Gorges to become a spiritual home for millions of immigrants.

3.3 The preservation of cultural relics in the Three Gorges has received greater attention from national and overseas media. During this process, the supervision of the media was accepted, and the *Law of the People's Republic of China on the Protection of Cultural Relics* was promoted as well as the preservation principles of “reasonable application and strengthened management with preservation and rescue as the priority” and the knowledge of cultural relics and preservation concepts.

3.4 Training was given to relevant groups involved in the preservation of cultural relics. Immediately following the founding of China, workers for the preservation of cultural relics of “Huangpu Yiqi” were trained in the preservation of the Sanmenxia Project of the Yellow River. The preservation of cultural relics in the Yangtze River was conducted under the “Reform and Open Up” policy during a period when China transformed from a planned economy to a market economy. The workers for the preservation, the “Huangpu Yiqi” in the new age, went through complicated trials, dared to undertake responsibilities, endured difficulties, solved one difficulty after another, and conquered major strategic parts of the area, such as Zhang Fei Temple, the Shibao Stockaded Village, Baiheliang, and the construction of the Underwater Museum of Baiheliang. The museum, a preservation project and display concerning lithical cultural relics under the inland river, achieved success with no former experience, no experiments, and no failure allowed, which paved the way for the preservation of cultural relics of this kind.

3.5 The rescue of cultural relics in the Three Gorges is a preservation activity with the largest engineering volume, the largest scale, and the most participants, and is a pioneering work. The activity has met water storage requirements at 135m, 156m and 175m successively, and has ensured smooth processes for the Three Gorges Project. Meanwhile, the result of the preservation itself indicates that the Three Gorges Project is a project for the people as well as a model in the effective preservation and reasonable application of cultural relics in large-scale capital construction.

## **4. Establishment of the Three Gorges Museum Complex**

The Three Gorges Project, the Three Gorges Migration Project, and the preservation of cultural relics in the Three Gorges paved the way for the establishment of the Three Gorges Museum Complex. The Complex is a necessary follow-up and consolidation of the three aforementioned projects.



In total, there are 45 ~ 50 museums in the Museum Complex of the Three Gorges that will stand out in the international tourism for the Three Gorges.

The Three Gorges Museum Complex refers to an aggregation of museums that either focus on the Three Gorges or are situated within the Three Gorges. Firstly, the Museum Complex consists of the China Three Gorges Museum (established), the Three Gorges Migrants Memorial (Wanzhou District, Chongqing, under construction), and the Memorial for the Three Gorges of the Yangtze River (in Yichang, Hubei, prepared to be built). Secondly, the Complex consists of locations constructed by the preservation of the ground cultural relics in the Three Gorges, such as Baiheliang, Shibao Stockaded Village, Zhang Fei Temple, Dachang Ancient Town, Qu Yuan Temple, the Yunyang Three Gorges Cultural Relics Park, the ancient architectural complex in Fengdu, the ancient architectural complex in Jiangdu Temple in Hubei, etc., and 5 relic parks planned for the “Post-Three-Gorges”, with 20 locations in total. Thirdly, the Complex also consists of 25 established and newly established museums in 22 districts, counties and cities in the Three Gorges reservoir area (including private museums) that display items, conduct research and collect unearthed cultural relics in the Three Gorges and its related local culture.

# **Session 1 Underwater Archeology**

# The Origins and Creation of China's Underwater Archeology

Zhang Wei

China's National Museum

## 1. Introduction

China is an ancient country with five thousand years of civilization and rich cultural heritage. Notably, China has a long sea coastline stretching more than 18,400 km, a territorial sea of more than 3 million square meters, and numerous rivers and lakes. China has enjoyed a long history of sea voyage, with its world-renowned Maritime Silk Road. Our ancestors created a prosperous civilization of the waters, leaving a rich legacy for future generations of underwater cultural heritage, which are preconditions for China's underwater archeological work. The enhancement of such work and the effective protection of underwater cultural heritage are important subjects for archeology in China.

## 2. The Origins of China's Underwater Archeology

Underwater archeology is an extension from the field of archeology, and adopts the theories and research methods of archeology to investigate, explore, excavate and research underwater cultural heritage. Also, as a periphery subject, underwater archeology requires technical support from other related subjects, including marine exploration technology and diving technologies.

Due to historical reasons, Chinese underwater archeology did not take shape until the 1980s. In 1985, when Englishman Michael Hatcher salvaged blue and white porcelain made during the Kangxi Period, Qing Dynasty from the South China Sea, he never would have anticipated that his discovery would lead to the birth of underwater archeology in China. Early in

1986, he took these treasures to Amsterdam, the Netherlands, for auction, which triggered strong dissatisfactions on the part of the international archeological and museum circles, and also raised concerns from the Chinese government and cultural departments. As an immediate response, the Chinese government decided to launch its own underwater archeological work.

In September 1986, the Chinese government finalized its decisions. In March 1987, a “National Underwater Archeological Coordination Team”, including the Ministry of Transportation, State Scientific and Technological Commission, National Sea Bureau, Headquarters of the General Staff, the Navy, the Ministry of Foreign Affairs, China’s History Museum (now China’s National Museum) and the Archeological Research Institute of the Chinese Academy of Social Science, was founded, approved by the State Council and led by the State Cultural Relics Bureau and China’s History Museum at the national level. With no capacity, expert knowledge, or capital, the China’s History Museum, led by Mr. Yu Weichao, head of the museum and archeologist, took this historical opportunity and shouldered the responsibility of launching China’s underwater archeological work. Therefore, Mr. Yu is considered the founding father of China’s underwater archeology. In September 1987, China’s History Museum created China’s only underwater archeological institution—the Underwater Archeological Research Institute—and was responsible for archeological work under the guidance of the National Cultural Relics Bureau. With combined efforts of various departments, China’s underwater archeology has grown from weak to strong with great progress achieved and blanks in this field of work have gradually been filled.

### **3. The Creation of China’s Underwater Archeology**

#### **3.1 The Development of Underwater Archeological Specialists**

The development of underwater archeological specialists represents the beginning of the Chinese underwater archeological enterprise. Practices show that an underwater archeological team was effectively built through training courses in diving and underwater archeological knowledge aimed at cultivating specialists.

With no existing underwater archeological experts, the National Cultural Relics Bureau sent people to study diving and underwater archeological technologies in Holland, Japan and the U. S. from 1987 to 1989, laying the foundation for the development of Chinese underwater archeological specialists.

From 1989 to 1990, China’s History Museum and the Southeastern Asian Ceramics Re-

search Center of the University of Adelaide, Australia, cooperated to organize the first training class to train underwater archeological specialists. The National Cultural Relics Bureau then commissioned China's History Museum to organize four training classes in 1998, 2004, 2007 and 2009 respectively, developing a group of underwater archeological experts and promoting Chinese underwater archeology.

Through the five training courses, 87 underwater archeological specialists gained qualification certificates from the National Cultural Relics Bureau, which ensured that an archeological team of roughly 60 persons could be established to implement practical work. Around the world, few countries could match China in terms of maintaining a national underwater archeological team.

In recent years, China has aimed to design higher-level diving technology training and on the basis of existing training courses, selected outstanding specialists to participate in high-tech diving training with the water depth reaching 60 ~ 80 m, and special training programs of sunken vessel diving and totally-enclosed diving with respirator. Now, more than ten specialists have the ability to dive 60 m under water, which correspondingly extends and expands the archeological working area.

### 3.2 Investigation and Uncovering of Underwater Archeology

The fundamental approach to develop Chinese underwater archeology is through practice. Since the establishment of the Chinese archeological team, investigations and uncovering work of sunken vessels and other underwater relics in Bohai, Yellow Sea, the East Sea and the South Sea have been carried out, of which the following achievements stand out:

#### 3.2.1 Investigation and Uncovering of the Wreck of No. 1 Nanhai, Guangdong

The wreck of No. 1 Nanhai is located off the coast of Shangxiachuan Island, Guangdong Province, which is outside the mouth of the Pearl River and 20 nautical miles from land. The largest water depth in the relic area is approximately 24m, and the seabed is dusty and of poor visibility.

In August 1987, the Guangzhou Bureau of Salvage of the Ministry of Transportation and the British Maritime Exploration Corporation cooperated in investigation work off the coast of Shangxiachuan Island, Taishan County, Guangdong Province, and salvaged more than 200 objects of porcelain, silver bullions, and copper cash. Knowing that these might be from a sunken ship, they halted the salvage work, and reported their findings to the National Cultural Relics Bureau. Having had no experiences in underwater archeological work before, the Chi-

nese government decided to cooperate with foreign academic institutions to investigate and uncover the wreck. After one year's preparation, China's History Museum and the Japanese "underwater archeological institutions" co-organized an "Underwater Archeological Investigation Team for China's South Sea Sunken Ship" and conducted its first underwater investigation 15 ~ 20 November 1989, naming the ship No. 1 Nanhai. From nine underwater investigations, the team collected a piece of white porcelain of Dehua ware, which resembled the white porcelain bowl salvaged in August 1987. This finding served to prove the location of the wreck and also marked the first transnational cooperation since the opening up of China's economy.

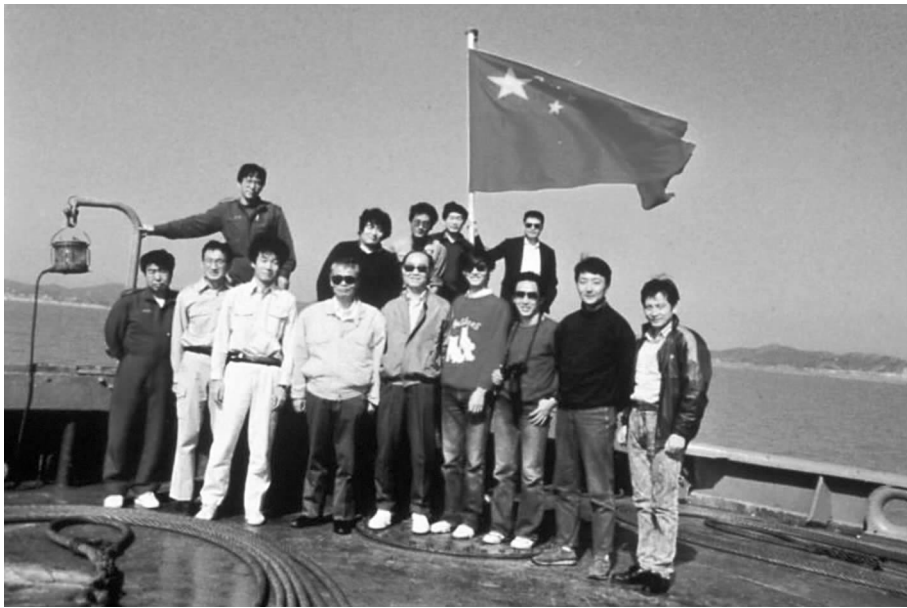


Figure 1 Sino-Japan Underwater Archeological Investigation Team

Based on the analysis of the objects salvaged in 1987, the shipload of cargo mainly included porcelain, gold and silver objects, silver bullions and copper cash. Porcelain made up the bulk of the cargo, including porcelains for daily usages from four wares during the Song and Yuan Dynasty: blue and white glaze porcelain from Jingdezhen, Jiangxi; blue porcelain from Longquan, Zhejiang; white glaze porcelain from Dehua ware, Fujian; and, black glaze porcelain from Cizao, Fujian. Some porcelains have marks at the bottom, such as "Zheng Zhike", while others are green glaze pottery, flower-painted basins, and bow string patterned pots. Besides these, objects also included tin water-jet, a dozen silver bullions, and several copper cash of "Zhenghe Tongbao" and "Shaoxing Tongbao". The also included a 170cm-long gold-decorated belt, with its form and emblazonry pattern different from Chinese characteristics.

In April 2001, with generous support from the Hong Kong China Underwater Archeology Research and Exploration Association, the Underwater Archeology Research Center of China's History Museum led 12 underwater specialists from Guangdong, Qingdao, Fuzhou, and also Hong Kong diving volunteers, and professional divers from Guangzhou Salvage Bureau, to form a "No. 1 Nanhai Sunken Ship" underwater archeological team, to rediscover the ship according to the positioning of 1989. After one month of hard work, the team identified the location of the wreck and in October 2001, the archeological team reconfirmed the location of the relics with great accuracy.

With approval from the National Culture Relics Bureau, the Underwater Archeology Research Center of China's History Museum led the "No. 1 Nanhai Underwater Archeological Team" on four large-scale investigations and uncovering work in spring and fall of 2002, spring of 2003 and spring of 2004, which further accurately defined the location (latitude and longitude), features (commercial vessel), age (Southern Song Dynasty (1127 ~ 1279)), and figures of the ship's length, width and height. This served as a foundation for the comprehensive salvage plan for the future.

### 3.2.2 Sunken Ship of the Yuan Dynasty (1271 ~ 1368) at Sandaogang, Suizhong, Liaoning

The sunken ship of the Yuan Dynasty (1271 ~ 1368) at Sandaogang, Suizhong, Liaoning, is located at the sea area of Sandaogang, southwest of Suizhong County, with a water depth of 13 ~ 15m and a visibility of 0 ~ 20cm. Since the underwater working conditions were very poor, the investigation and uncovering work was time-consuming, and required intensive labor and resource work. Finally it achieved magnificent academic results.

After locating the relic site in 1991, the Underwater Archeology Research Center of China's History Museum organized a working team with members from many departments including the Cultural Relics Research Institute of Guangdong, and made a comprehensive investigation and uncovering of the sunken ship. The wreck is a commercial ship of the Yuan Dynasty with cargo of Porcelain of Cizhou ware and objects made of steel. It is 21m in length and 7m in width and its body has disintegrated due to wave damage and decomposition by sea creatures; only several pieces of the ship board remain. Carbon 14 showed that the ship dates back to  $740 \pm 80$  years ago. The uncovered objects were mainly porcelains, coming from the Cizhou ware of Northern China, and also a number of large jars featuring white glaze, black flower patterns and pictures of a baby playing, and also a large jar featuring white glaze, black flowers and patterns of dragons and phoenixes. The steel objects are mainly ploughshares and pots.

The discovery of the sunken ship at Sandaogang, Suizhong, provides valuable resources for studying the export history of Cizhou wares as well as Chinese ancient sailing and shipbuilding history. This discovery was rated as one of the top 10 new archeological discoveries of 1993. It was the first large-scale salvage work independently finished by a Chinese underwater archeological team. The report that followed, “Yuan Dynasty Sunken Ship of Sandaogang, Suizhong,” was also the first themed underwater archeological report in Chinese history.



*Figure 2 Porcelain evacuated from sunken ship at Sandaogang*

### 3. 2. 3 Salvage of Underwater Relics: Xisha Islands

The salvage of the underwater relics of Xisha Islands in 1998 ~ 99 was one of the “Archeological Projects of the South Sea Islands” planned by the National Cultural Relics Bureau. Under the direct guidance of the National Cultural Relics Bureau and led by the Underwater Archeological Research Institution (now the Underwater Archeological Research Center of China’s History Museum), a group of underwater archeologists worked on the sea for 39 days from December 1998 to January 1999. This investigation team chose the north island of Xisha Islands as the main work site and also carried out salvage work at Huaguang Island and Yinyu, with rich outcomes achieved. The team discovered 13 underwater cultural relic sites of five dynasties, Song (960 ~ 1279), Yuan, Ming (1368 ~ 1644) and Qing (1644 ~ 1911) Dynasties as well as a site of the modern ages.



This archeological investigation uncovered more than 1500 objects (including samples), most of which are porcelains, as well as steel objects, ivory and ship decks. The porcelains have diverse varieties, including blue porcelain, blue and white porcelain and white porcelain of the Song and Yuan Dynasties, and also the blue-and-white porcelain of the Ming and Qing Dynasties. The objects also include a bowl, plate, powder box, bottle, pot, large jar, small jar and cylinder. These porcelains were mainly produced in Fujian, Guangdong and Jiangxi. One point worth mentioning is that two ivory objects were uncovered at the No. IV. site of the north island, one of which is approximately 1.20m in length and 0.20-m root in diameter. It is suggested that the ivory objects might come from Africa and a basic analysis implies that it may originate from the Song and Yuan dynasties. Four dole stones were also discovered at the No. 3 wreck relics at the north island, and the one selectively salvaged is 3.2m in length and 500 kg in weight.

The great accomplishments of this work show that as the transportation center of the ancient Maritime Silk Road, the South Sea features a very rich collection of underwater cultural relics, which are great testimony to the Chinese people's inhabitants and exploration at local islands in history. In addition, these accomplishments provide very valuable and academically useful data for the study of Chinese sailing, foreign trade, porcelain exporting and ship construction history.

#### 3.2.4 Investigation and Salvage of Wanjiao No.1 Sunken Ship of the Qing Dynasty (1644 ~ 1911) at Pingtan, Fujian

The Wanjiao No. 1 sunken ship relic at Pingtan, East Sea, was an important archeological discovery in 2005, and raised wide concerns for uncovering exported porcelains produced in Jingdezhen during the Kangxi Period of the Qing Dynasty (1644 ~ 1911). This relic is located near Wanjiao, the center of Wuzhouquanjiao at the north of Yutou, Pingtan County, Fuzhou. The water depth of the relics area is about 13 ~ 16m, with the seabed consisting of dust and silt. The visibility under water is about 0.1 ~ 0.5m. The 34 underwater archeological specialists from various areas of Fujian Province were organized by the underwater archeological research center of Chinas' History Museum to form the "Wanjiao No. 1" underwater archeological team and to implement the salvage work of "Wanjiao No. 1 Pingtan, East Sea". The salvaging work was carried out in two stages; firstly, the team uncovered and cleared the cargo and areas around the relic; secondly, the team measured the ship body and completed protection work of the cultural relics. The uncovered area was approximately 150 m<sup>2</sup>, and rich outcomes were achieved during and following the uncovering.



*Figure 3 Archeological investigation at Xisha Islands*

Investigations indicated that the ship wreck is 13.5m in length, 3m in width and 1m in depth. It stretches from east to west, with its fore facing east. The ship body is a little sloped to the south, forming an angle of 41 degrees. The ship wreck still has 16 berths, and most compartments have been destroyed.

The shipload cargo consists primarily of more than 17,000 porcelains produced in Jingdezhen, during the mid-Kangxi Period of the Qing Dynasty. The porcelain products include different varieties, such as blue and white and five colored porcelain, and a range of shapes including bowls, plates, trays, cups, jars, goblets, bottles, and boxes. The patterns also vary, featuring flower patterns, animal patterns, human stories, mountain and water images. The team also discovered a stone ink-slab, copper cash and bronze lock, which have high historical, scientific and artistic value.

“Wanjiao No. 1” sunken ship relic is located on the ancient Maritime Silk Road, which ranges from the Changjiang River and ports in the north, to the trade ports of Quanzhou and Guangzhou, and as south as Southeast Asia. As a trade route linking north and south, the Maritime Silk Road allowed ships with 5000 t loads to pass. The archeological work of the sunken ship relics is very significant to promote research on the ancient Maritime Silk Road, shipbuilding history, and porcelain history.



Figure 4 Blue and white porcelain salvaged from “Wanjiao No. 1” sunken ship

### 3.2.5 The Uncovering of South Song “Huanguangjiao No. 1” Sunken Ship at the Xisha Islands

Huanguangjiao is located around the Xisha Islands, Hainan Province. The Huanguangjiao No. 1 sunken ship relic is situated at the northwestern periphery of Huanguangjiao and was discovered by fishermen in 1996. It was illegally explored in 1997 and suffered great damages. In 1998 China's History Museum and the Cultural Relics Departments of Hainan Province made preliminary investigations and recovered nearly 1800 objects, most of which are blue and white porcelains. Some of the porcelains found have brown and white glazes. The porcelain was produced in southern Fujian during the Southern Song period (1127 ~ 1279).

The uncovering project of Huanguangjiao No. 1 sunken ship relics recommenced in 2007 and was completed in 2008. It covered two stages: the first stage was March-May, 2007, with the main task of uncovering the sunken ship relics, collecting remains of the ship and measuring the ship body; the second stage was November-December 2008, with the main task of uncovering the ship body, measuring the ship structure and components, and delivering these objects back to the Hainan Museum for desalinization and dehydration.

The sunken ship is 18.4m in length, 9m in width, with its fore forming a 320-degree angle. The sunken ship is sloped to the west, with 10 remaining compartments and a depth of 1.1 ~ 1.5m. The lateral plates of the ship have 6 layers, while the rest plates have 5 layers and a thin outer flank. The recovered objects include porcelain, steel, bronze mirror and copper cash. The porcelain includes those of blue-and-white glaze, blue glaze, white glaze and dark brown glaze. The production areas mainly include Jingdezhen, Dehua, Cizao, Mingqing, Nan'an and Songxi, which date back to the Southern Song period.

The discovery of Huaguangjiao No. 1 sunken ship is the first open sea archeological work and has achieved great results, providing valuable resources for studying shipbuilding technology history, foreign trade history, and export history during the Song and Yuan Dynasty. This salvage work strictly followed regulations and principles of international underwater archeology. It also has significance for creation of the discipline of underwater archeology in China.



*Figure 5 Porcelains in Huaguangjiao No. 1 sunken ship at Xisha Islands*

### 3.3 Construction of Underwater Archeological Research and Training Base

The construction of scientific research, a training base and related information systems are required in order to develop underwater archeology as an academic subject. This idea was raised in 1992 and included in the “China Underwater Archeology ‘Ninth Five-year’ Scientific and Technological Development Plan”. This project was then started in 2002 under the ap-

proval of the National Cultural Relics Bureau and was put into operation in 2003.

The Underwater Archeological Research and Training Base is located in Yangjiang, Guangdong, with a construction area of more than 5, 000 m<sup>2</sup> and consists of one main building and side buildings. The base features a library, a special equipment depot, an on-line information highway, a video conference room, a computer center, a classified computer room, an exhibition hall for archeological results and ancient ship models. It also features comprehensive facilities, including an underwater archeological scientific and research center, a training center, an information center, and an international communication center.

After the base was put into operation, it has met all preliminary expectations and played an important role. It has hosted three training courses for national underwater archeologists, has successfully held many academic research and discussion forums and underwater archeology working conferences, and has also finished typological arrangements of all recovered objects from the wreck of Xisha Islands Huaguangjiao No. 1 sunken ship, and related drawings, photography and protection work.

### 3.4 Application of Related Science and Technologies

To solve problems faced during underwater archeological investigations, uncovering, recording and cultural relic salvaging, and also protection of these objects, various specialized technologies, including archeological diving techniques, underwater investigation and uncovering techniques, and techniques for the protection of cultural relics, are required. These techniques relate to many subjects of the natural sciences and engineering, such as diving physics, diving physiology and medicine, maritime physical exploration, remote sensing techniques and space technology.

Through years of accumulation, the Chinese underwater archeological team has been equipped with many high-end technology facilities and systems, including high accurate GPS, side-looking sonar, multi-beam sonar, shallow stratum section plotter, magnetometer, underwater baseline positioning system, underwater communication system, underwater photography and video recording devices, ROV, high-oxygen diving technology devices, and regular diving devices. These equipments have played an important role in the Chinese underwater archeological investigations.

### 3.5 Concluding Thoughts

Over the past two decades, China's underwater archeological work has been progressing

through practice and exploration, laying a solid foundation for the protection of underwater cultural relics. The basic successful experiences can be summarized as follows:

3.5.1 Under the leadership of the National Cultural Relics Bureau, relevant groups cooperated together and agreed on the right direction for development. The development of underwater archeological specialist training, and also investigations and salvaging work along the coast would have been impossible without the great support from leaders of the National Cultural Relics Bureau. Relevant groups have also made full use of the geological advantages of cultural relics units along the coast to create good conditions for developing various works.

3.5.2 Relevant groups are dedicated to training professional abilities and creating a group of underwater archeological workers with great bravery and a sense of teamwork. Aptitude and talent forms the basis of implementing work and since introducing the underwater archeology, China has given special importance to training underwater archeological talents. We have sent people abroad to study underwater archeological theories and techniques, worked with foreign institutions and also carried out self-training. We have experienced an accumulation from internal to external, and gradually worked out the training methods and experiences with distinct Chinese characteristics that deserve great promotions.

3.5.3 Relevant groups have carried out a series of underwater archeological practices to train the team, accumulate experiences, expand outcomes and constantly raise working abilities and scientific research capacities. Since the 1980s, China's underwater archeology has started and developed from nothing, and carried out a great number of underwater investigation and salvage work along the Chinese coast and in inland waters, having achieved great accomplishments. Until now, we have made great breakthroughs in scientific practices, including research methods and uncovering techniques, and also establishing underwater archeological theoretical frameworks. These are the most important accomplishments of China's underwater archeology during the past two decades.

# DRASSM 1966 ~ 2008 : An Overview of the Accomplishments and Future of French Underwater Archaeology

Michel L'Hour

DRASSM

## 1. Introduction

In France, the development of the field of underwater archaeology began in 1943 when Jacques-Yves Cousteau and Émile Gagnan created the aqualung, thus enabling easy access to the “Silent World.” This invention led to the discovery of a large number of wrecks along the Mediterranean coasts of France and Italy. Not surprisingly, at the beginning of the 1950s, a number of divers and some archaeologists also became interested in this submerged heritage.



Salvage work conducted by the Italian Nino Lamboglia on the Albenga wreck in 1950 and the excavation of the ancient wrecks of Grand-Congloué in the Bay of Marseille between 1952 and 1957 were the two first underwater archaeological excavations in the world. In Marseille, archaeologist Fernand Benoit directed all the operations from the beginning of the project, but was not trained to dive on the site. Excavation was undertaken by Cousteau's dive team. Faced with a number of scientific and technical problems, it soon became clear that the excavation needed an archaeologist who was able to control the work directly. This meant that the archaeologists needed to learn to dive. For this reason, André Malraux, then French Minister of Culture, created the Department of Underwater Archaeological Researches (DRASSM) in 1966. Born out of the experience of Benoît and Cousteau in the Mediterranean, the new research center was established in Marseille. To support its work, DRASSM was equipped with a purpose-built 30 m long research vessel, *L'Archéonaute*, in 1967.

The creation of DRASSM was an ambitious project. Its responsibilities were to manage, develop, and protect all submerged heritage in French Public Maritime Domain. Thus, its mission included not only the Mediterranean but also all French territorial waters around the world. Notably, France possesses the second largest Exclusive Economic Zone in the world, covering 11 millions km<sup>2</sup>, and containing 10% of the planet's coral reefs and 20% of its coral atolls.





## 2. Legal Context

French legislation relating to shipwrecks is very old. Since the creation of DRASSM, underwater archaeologists in France have compiled a whole series of legal texts, some very ancient and others very recent, that lend legal support to their work on shipwrecks (L'Hour 2006).

French law derives from Roman law, which does not consider the process of wrecking as severing ownership of a vessel. The owners of the floating vessel and its cargo remain the owners after the wrecking. While French wreck law has evolved considerably over the centuries, with the most recent changes made in 2004, the fundamental principles established by the Roman code have never changed. Under French law, there are only two possible owners of a shipwreck: the original owner, if one can be identified, or the French state.

In accordance with this principle, France recognizes the ownership rights of flag states over wrecked state vessels and aircrafts located in its territorial waters. Thus, in 1989, France recognized the ownership rights of the United States over the wreck of USS *Alabama*, which sank in 1864, near Cherbourg in Normandy. By virtue of the same principles, France claimed from the United States its rights over the wreck of *La Belle*, lost in 1686 in Matagorda Bay, Texas. These rights were formally recognized in 2001.



For all others wrecks, when a legitimate owner cannot be identified or it has no heirs, French law stipulates that the wreck belongs to the state and is considered state property. Wrecks cannot be sold, and with rare exceptions, they cannot be subject to commercial concession. Conversely, if an unidentified wreck is discovered, the discoverer is obliged to declare the find, and has no right to ownership of the wreck. French law only provides financial compensation. This sum is fixed according to the scientific, not the commercial value, of the wreck. The typical amount is modest, between US \$ 15, 000 and US \$ 42, 000.

As a whole, these laws ensure that French underwater archaeological heritage is effectively protected.

### 3. Wreck Inventory

In 1966, when DRASSM was founded, the government services responsible for listing historic wrecks had only registered 49 shipwrecks in French territorial waters. This number quickly increased to the point where today there are more than 5, 000 registered wrecks in French territorial waters. This total will continue to rise, as it is estimated that between 15, 000 and 20, 000 wrecks remain to be found in French waters.

In addition, it is estimated that between 150, 000 and 200, 000 wrecks lie in France's Exclusive Economic Zone. While approximate, these figures indicate the increasing volume of work of recording and study that underwater archaeologists will have to complete in future cen-



turies. Of course, DRASSM is not waiting. This work has already started.

Over the last 42 years, more than 1, 500 wrecks or underwater sites of different types and periods have been excavated or studied by archaeologists from DRASSM. During this time, French archaeologists have excavated a range of sites, including marine sites; sites in lakes and rivers; sites that were previously terrestrial, but are now submerged (for example, the Roman Gaulish necropolis at Fos-sur-Mer); sites that were previously maritime, but are now buried (for example, wrecks buried in sandbanks); and sites that were and remain land, but that can now only be accessed by diving (for example, the Cosquer cave (28000 BP) near Marseille, whose original entrance is now 115 ft. below sea level).



The diversity of sites covers a large range of time periods. Until the beginning of the 1980s, French underwater archaeologists concentrated primarily on wrecks from the Greek and Roman periods of antiquity. Since the early 1980s, there has been more work undertaken on wrecks that are much more recent. Since 1995, many studies have focused on wrecks from the 18th to the 20th centuries. DRASSM aims to ensure that no aspect of France's maritime history is neglected. For this reason, in recent years, the team has reexamined wrecks from the First and Second World War. Long neglected by archaeologists, these wrecks are now at the heart of a new perspective, which has led to important conferences in France. DRASSM has enhanced protection for these wrecks, which are among those most threatened by looting.

The wrecks studied by DRASSM have also revealed a wide range of cargos, fittings, and personal items, leading to diverse studies of subjects, from raw materials, such as lead, zinc and tin, to everyday utilitarian objects, up to fine works of art. These shipwrecks have also provided the opportunity for numerous studies of ship construction, which have led to researchers relearning techniques in order to understand the evolution of tools.

These collections have been studied, published, and then transferred to museums. Nearly 50 French museums have received collections from underwater excavations and several new museums have been specifically created to receive these types of collections.

As a result of the official recognition of all of these aspects of underwater heritage, there has been a veritable explosion in the number of wrecks registered. For example, in the Bay of the Seine in northwest France, the number of wrecks registered by the DRASSM has increased by 100 in less than 20 years.

In order to cope with the increase in discoveries, DRASSM has developed comprehensive databases containing all available information on reported wrecks. These databases play an essential role in the protection and management of submerged cultural heritage. The work may be laborious, but databases of this sort are the only tools that guarantee a permanent means of accurate and exhaustive analysis of submerged heritage resources. At the same time, threats can be more clearly identified, emergencies better understood, and the importance of each site evaluated.

## **4. Key Accomplishments**

The identification, analysis, study, and protection of underwater heritage naturally demands substantial financial, logistical, and human resources. While funding is not always as plentiful as might be wished, the resources put at the disposal of DRASSM by the French Ministry of Culture are significant. Today, DRASSM employs 37 people, of which 20 are archaeologists or specialist technicians in underwater archaeology. This number will rapidly increase, as there are plans to recruit 11 new specialists over the next four years.

Each year, staff from DRASSM direct more than 20 surveys and systematic excavations on wrecks in France's inshore waters. Moreover, it supervises some 70 other projects undertaken by DRASSM's external partners. At least 300 people are actively involved in marine archaeological research in France. With the exception of personnel at DRASSM, these researchers are predominantly volunteers who have established a basic level of competence appropriate to the



project, as required by the scientific committees charged with monitoring and advising each archaeological project.

A quick summary of the results of each of these operations is published annually in a scientific report, the *Bilan scientifique du DRASSM*, distributed free of charge to all research partners. DRASSM is presently working towards publishing an English summary of the last 15 years of its research from 1992 to 2006.



## 5. International Projects

In addition to projects undertaken by DRASSM in Europe and in French overseas territories, DRASSM regularly works abroad in the interest of intergovernmental cooperation. Thus,

in recent years, DRASSM's archaeologists have worked in some 30 countries, including Egypt, Libya, the Philippines, Pakistan, Taiwan, and the Sultanate of Brunei (L'Hour 2001). These operations sometimes result from accords of international cooperation, such as the agreement ratified in 2007 with the Government of Taiwan, which states that DRASSM will assist the Taiwanese government in creating an official underwater archaeological service, based on the French model.

## 6. The Renewal of DRASSM

The increasing number of projects, as well as the planned increase in personnel, has led to big changes at DRASSM. The first is to relocate the organization's facilities. Since 1966, DRASSM has been based in a 17th-century fortress at the entrance to the fishing port of Marseille, which was not well suited for this purpose. For this reason, the team moved into a new purpose-built headquarters in the port of Marseille in December 2008.

The second major change decided for DRASSM is the construction of a new research vessel. After 41 years of service, *L'Archéonaute* urgently needs replacing. Technical studies have been completed, and construction of the new vessel began in early August 2010. The vessel is 6 m longer than the old *Archéonaute* and will have a crew of three. It will be able to accommodate ten archaeologists and technicians on longer projects, or a team of 30 specialists for short-term projects. In terms of project capacity, the new vessel will be able to launch ROVs or a submarine and will be easily converted to a work platform for remote sensing surveys.

## 7. Development of Deepwater Archaeology

In addition to supporting conventional surveys and excavation, the new vessel will allow DRASSM to continue work begun nearly 20 years ago towards developing deepwater archaeology on wrecks beyond the range of human diving. Since a survey in 1980 on the Bénéat 4 wreck site at a depth of 328 m (about 1,100 ft.), DRASSM has regularly planned systematic campaigns of exploration on wrecks in the 300 to 800 m depth range (1,000 and 2,500 ft.). These operations have allowed DRASSM to experiment with and develop methods of remotely working on wrecks lying at great depths. This is important, because many of these wrecks are better preserved than wrecks of vessels thrown against the shore.

However, all attempts by DRASSM over the last 20 years have been primarily exploratory



and the lessons learned merit being tested by the exhaustive exploration of a complex site. For this reason, DRASSM is planning an excavation campaign on *La Lune*, a 17th-century wreck discovered in 1993 in the Toulon roads on the south coast of France. In 1664, while returning from an expedition to the Barbary Coast with nearly 900 men, *La Lune* sank during a storm. There were only about 30 survivors, and nothing could be done to save the ship or its cargo. *La Lune* was rediscovered accidentally in 1993 during a training dive in the submarine *Nautilie* by the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER).



Lying in almost 100 m of water, the wreck is ideal for the development of new methods of investigating deepwater wrecks. In effect, it is sufficiently deep to guarantee the validity of the

trial and, at the same time, it is within reach of archaeological divers who will be able to physically check the work undertaken.

## 8. Providing Training, Combating Looting

With regard to projects such as *La Lune*, it is clear that underwater archaeology is at the point of moving to a new level. However, this cannot be accomplished without considerable effort in terms of training new specialists. The need for training is all the more important since a number of emerging countries have significant underwater heritage, but little funding and few resources. They face impossible demands on their resources, coupled with lobbying by private treasure-hunting companies that have both technical means and considerable financial backing. A collective recognition of this problem is necessary to ensure the future of France's underwater heritage. This will involve finding ways to combat international looting more effectively and to find relevant solutions to the training problem.

To combat looting, over the last few decades DRASSM has developed an extensive network of informants across the globe. As a result of these efforts in international cooperation, several specialized teams of looters have been arrested and convicted in recent years.

As a result of its participation in international activities, DRASSM is aware of the need for training in the international community, and as a result welcomes many young trainees in France. Planning has been underway over the last two years for an international training center for underwater archaeologists. This is an important project, which should begin in the next two years.

Founded in 1966, DRASSM is the oldest example in the world of an official government organization created to protect and study underwater cultural heritage. For this reason, DRASSM has a responsibility to the numerous countries who are taking their first steps in underwater archaeology. So, DRASSM is open to all forms of cooperation, with those who seek to protect and study the underwater cultural heritage of humanity.

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# Archaeological and Ethnological Research Pertaining to Underwater Cultural Heritage in China's Surrounding Seas

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“The area surrounding the China Sea” refers to the zone centering the southeast coast of China where China’s maritime culture flourished, developed and expanded, covering China’s four major sea areas, the continental margin areas of the Southeast Asian peninsula, Japan, Taiwan, the Philippines, the Indonesia island arc and adjacent sea areas. It is a transboundary cultural circle that links Chinese maritime culture and is a relatively independent section of the world coastal civilization system.

Maritime cultural heritage is a form of tangible and intangible cultural heritage formed and accumulated by the maritime cultural history of successive dynasties. It has historic, artistic and scientific value as well as the connotation in terms of economy, environment, landscape and ecology. The coastal ancestors of successive dynasties along China’s coasts created well-developed maritime civilization achievements, leaving a large number of unique and precious maritime cultural heritage relics that stand out amongst objects of world cultural heritage. These are the most direct and real historic memories of coastal ancestors understanding and conquering, utilizing and developing of the oceans, prospering and developing coastal economies, as well as creating various maritime cultures.

Since the founding of the PRC, there has been a tendency to value land and overlook the ocean within the cultural heritage protection system. Investigations, research and protection of maritime cultural heritage are comparatively lagging behind. Compared to the major contributions that endlessly emerged and archaeological (land focused) discoveries made in prehistoric China and on historical research, the academic value and potential of the multi-space-time and multi-aspect of maritime cultural heritage on the rebuilding of maritime cultural history has not

yet been excavated. Especially in the last 10 to 20 years and during modernization in the coastal areas, maritime cultural heritage, particularly the marine intangible cultural heritage, exterminated rapidly. Traditional port towns have changed beyond recognition in the large-scale old-town rebuilding and new-town construction wave. In the roar of the large and small steamships, the old sailing boats have disappeared; the sailing craftsmen have passed away one after another, traditional naval architecture has been forgotten, the “guide principles” and “cross-ocean guiding stars” of the old boatman inherited from generation to generation has no heir, and the tangible and intangible maritime cultural heritage has faced comprehensive endangerment. The investigation, records, research and conservation of maritime cultural heritage has become very important and an urgent task in order to inherit and carry forward Chinese traditional culture.

## **1. The Meaning and Composition of Maritime Cultural Heritage**

The maritime cultural heritage around the China Sea includes two types, that is, tangible and intangible cultural heritage. Through the investigation, protection, research and development of maritime cultural heritage, we can enrich and perfect the meaning and composition of the Chinese nation’s multi-component cultural heritage, promote and develop the traditions of Chinese maritime culture and re-write the history of maritime culture around China’s coasts from the position of maritime culture and from the perspective of cultural heritage.

The tangible maritime cultural heritage involves three aspects, including ocean settlement and port town remains, shipwreck cargo and maritime economic historical sites, marine management and administration heritage and coastal defense historic relics. The ocean settlement and port town monuments aspect includes seaside settlements from the prehistoric marine shell mound to the historical era, such as the harbor historic sites of ancient piers, ferries, docks, cargo evacuation land, bridges, Shi-Po-Si (Customs), etc., the navigation historical sites of ancient beacons, lighthouses, navigation route references, etc., port town remains of ancient streets, trade names, goods houses, letter bureaus, old-style private money houses, Fan (foreigners and people from other clans) inhabiting the region, post houses, Fan cemeteries, etc.. The marine economic historic relics aspect includes the system of ancient (merchant ship) shipwreck cargo (silk, porcelain, tea, iron, etc.), maritime porcelain (or porcelain for export) and related hinterland maritime historic relics, imported goods and overseas economic and trade historic relics etc. The coastal territorial heritage and coastal defense historic relics

aspect includes ancient coastal defense castles, navy military camps, government vessels, coastal forts and ancient navy, navy adherents settlements, seashore batteries and the settlement of ancient navies and navy descendants.

The intangible maritime cultural heritage relates to boat and ship ethnography, folk shipbuilding, traditional sailing and folk route guides, ocean boatman and social humanity. The boat and ship ethnography and folk shipbuilding include investigations, the collection and collation of texts of traditional wooden boat forms and structures, coastal traditional shipbuilding technologies as well as traditional shipbuilding methods. The sailing skills and literature include the collection, collation and research of navigation guides, such as boatman traditional sailing skills of physiography, astronomy, meteorology (wind from eight directions), treasured private copy of boatman sailing technology (water route book or needle guided route book) and ancient navigation charts, etc. The social humanity of ocean boatmen includes the marine populations and the boatman social pattern, the maritime folk-custom of multi-spatiotemporal maritime gods worship, memorial ceremonies for boat pray for winds, ceremonies of sacrificing for the sea, seeing off the king of boats as well as maritime literature and art. Relatively speaking, the rescue and protection situation of intangible cultural heritage is more urgent, as most remains lack a physical carrier, are disappearing or moving to the edge of annihilation faster and faster in the process of modernization. Thus, we should carry out on-the-spot interviews, recordings, collections, sorting and course research as soon as possible (Fig. 1).

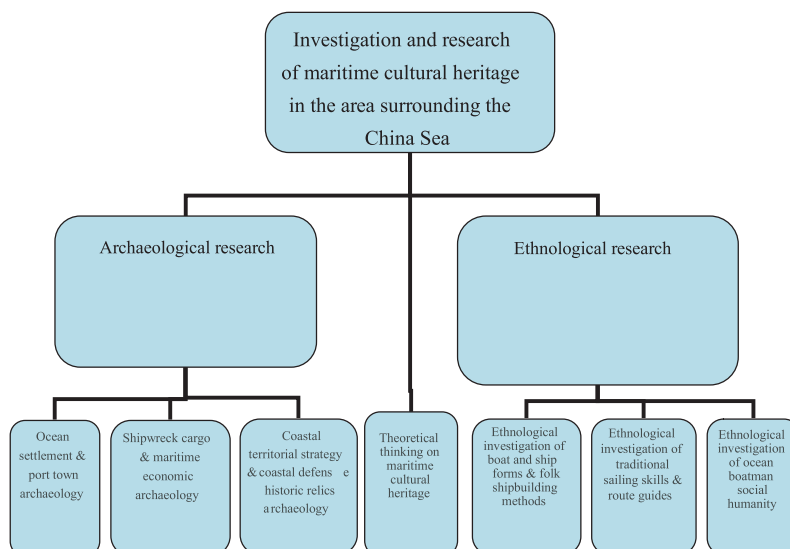


Fig. 1 The academic framework for the investigation and research of maritime cultural heritage

It should be clarified that the cognition of “maritime cultural heritage” is entirely different to “underwater cultural heritage.” Maritime cultural heritage is to grasp the connotation and nature of heritage from the source of human cultural behavior and is studied from an academic perspective based on cultural heritage research and cultural history cognition. Whereas “underwater cultural heritage” is to explore the connotation and nature of heritage from the burial form perspective and study aimed at protecting cultural heritage (Table 1).

**Table 1 The connotation relationship between “maritime cultural heritage” and “underwater cultural heritage”**

	Maritime cultural heritage (“blue civilization”)	Underwater cultural heritage
Heritage buried underwater	Shipwrecks and cargos, submarines, coastal settlements and port towns	Shipwrecks and shipwreck site in inland rivers and lakes
Heritage buried underground	Ships, cargo, imported goods silted in land along the coast, cargo origin, maritime hinterland economic historic relics, seashore settlements, port town historical remains, coastal defense historic relics	.....
Intangible cultural heritage	Ship and boat ethnography and shipbuilding methods, traditional sailing skills and folk route documents, social humanity of ocean boatman	.....

## 2. The Archaeological Research Pertaining to Tangible Maritime Cultural Heritage

### 2.1 Ocean Settlement and Port Town Archaeology

Settlement is the most important place of cultural practice activities of humanity, such as food, clothing, shelter and means of traveling, and is one of the most basic elements of human culture. The investigation and research of the activities of ancient humanity from settlement patterns has become a new topic in the field of archeology worldwide in the last half century and is also new territory that the archaeological community of our country is exploring and practicing. The concept of settlement archeology is to explore ancient settlements and environmental relationships starting with the “man-land relationship,” to explore the macroscopic form, layout, internal microcosmic structure, connotation of settlement unit from the “man-man relationship” also known as human and social organizing form perspective, to explore the diachronic development of settlements from a cultural perspective.

The coastal settlement form is the major stage that the coastal ancestors created and developed the maritime culture depending on the marine environment; and is one of the most basic forms of tangible maritime cultural heritage. In related fields, the academic community has launched a series of essential founding-works, such as new world sea-level fluctuations, changes of maritime environments, archaeology on parts of coastal prehistoric shell mound monuments and the environment, the investigation of a certain number of port histories, maritime traffic historic relics. For example, on prehistoric coastal settlements and environment archaeology, there is *Jiaodong Archaeology* by Yan Wenming; *Archaeology on Jiaodong Peninsula Shell Mound Monument and Environment* by the Institute of Archaeology, Chinese Academy of Social Sciences; *The Yangtze River Downstream Archaeological Geography* by Gao Menghe; *The South-Sea Islanders in Pre-Qin Dynasty-the Research on Gulf Shell Mound Monument* by Xiao Yiting; *The Archaeological Research of Minyue Capital* by Wu Chunming inspecting the changes of the Minjiang River downstream prehistoric settlement to the rise of the Minyue metal-smelting port town Jiao Tianlong, and discusses the relationship between the southeast coast neolithic cultural development and maritime environment in his book *The Neolithic of Southeast China*. On coastal historic relics and building, the coastal historian circle has studied many coastal building historic relics respectively in historical research of over ten coastal harbors, including Quanzhou, Guangzhou and other port towns and has carried out special subject investigations and research on sea communication historic relics. However, these investigations and researches are almost “completed independent”. They are lack of the cognitive frame of coastal settlement history and the systematic evolution historical viewpoint of the coastal settlement form from prehistoric seashore residences to port towns of successive dynasties.

Therefore, the concepts and methods of settlement archaeology should be applied to the investigation and research of the maritime cultural heritage around the China Sea in future work. The understanding of the historic relics of the development of maritime settlement around the China Sea in different stages should be started from the “relationship between man and sea.” For example, the historic relics including the coastal prehistoric shell mound historic relics, the representative ancient boatman village remains in south and north harbors, seaport remains of successive dynasties and sea communication historic relics, seashore city ancient building historic relics should be taken as a continually developed, related with the same origin and integrate maritime settlement form systems. We should carry out comprehensive and systematic investigations to study the characteristic and evolution of the maritime settlement forms around the China Sea. This detailed suggestion includes:

2. 1. 1 *Primary marine settlement form*, mainly referring to the development history of coastal residence settlements. The systematic investigation of coastal settlement monuments of a certain number of important maritime cultural areas such as the Round Bohai area, the Jiadong Peninsula, the Yangtze River Estuary, the Zhoushan islands, Fujian and Taiwan regions, the northern seashore of the South China Sea, etc. The historic relics include prehistoric coastal shell mound sites and seaside village sites of different eras. The development and evolution law of primary level maritime settlement formed in different times and spaces should be analyzed and researched.

2. 1. 2 *The occurrence and development history of port towns*. Port towns were the centre of coastal settlements and the “urban” community in maritime civilization. At this stage, we should carry out comprehensive investigations and research of Hepu, Panyu (Guangzhou), Dongye (Fuzhou), Quanzhou, Zhangzhou, Mingzhou (Ningbo), Taicang Liu Jiagang, Penglai (Yantai), Tianjin, Jieshi (Qinhuangdao) and other port towns; ancient piers, ferries, dockyards, cargo evacuation land, bridges, Shi-Po-Si (Customs), ancient beacons, lighthouses, navigation route references and other coastal relics; the ancient port town streets, trade names, goods houses, letter bureaus, old-style private money houses, Fan (foreigners and people from other clans) inhabiting regions, post houses, Fan cemeteries and the “west wind blew gradually to the east” port town architecture in modern times and other coastal trade settlements. The occurrence, developing and transitional history of port towns near the China coast should be researched and recognized.

2. 1. 3 *The theoretical summary of the development history of coastal settlements*. To carry out the basic archaeological typology and chronology research of China’s coastal settlements and port town is to clarify the various types of maritime settlement remains around the China Sea and study the developing and evolutionary stages of various kinds of maritime settlements. Under the background of the “relationship between man and sea,” the sea-land environmental backgrounds in which the various maritime settlements were formed should be studied from a macro angle to explore the relationship and differences between maritime and continental settlements. We can select representative port town settlements and investigate separately the inherent structure of different time-space maritime settlement under the “man-man relationship” background, to explore the port town internal ethnic cultural relationships, social class relationships and functional distinctions and so on from a micro perspective.

## 2. 2 Shipwreck Cargo and Maritime Economy Archeology

The maritime economic activity is the core content of humanity’s reliance on oceans, ex-

ploring oceans, developing regional and even global marine social and cultural forms. Maritime economic historical sites are one of the core contents of tangible maritime cultural heritage and maritime archaeology. The investigation and research in this field is an objective and effective way to understand maritime economic development history and to study the maritime economic and cultural links in areas around the China Sea.

In this field, scholars have made a series of achievements on shipwrecks underwater archaeology, ancient porcelains for export, the Marine Silk Road and other related research. The investigations and research carried out on maritime economics around the China Sea and trade relics from the shipwreck cargo started with the discovery and study of Song (960 ~ 1279) and Yuan (1271 ~ 1368) Dynasty shipwrecks in Xin'an in Korea and Quanzhou in Fujian in the 1970s. Korea and Japan held numerous international academic symposiums on over 20,000 pieces of Chinese porcelain, 28 tons of Chinese coins and a large quantity of Southeast Asian spices found in Xin'an shipwrecks and vast discussions have been launched on the origins of porcelain cargo, departure ports, trade routes and other related topics on China's social and economic maritime history. The discovery of spice cargo of Southeast Asia origin, porcelain remains, cargo labels found in the Houzhu, Quanzhou shipwrecks has also triggered the research on ancient ship routes, cargo, foreign trade and cargo management. In recent years, many fundamental investigations and research on trade related porcelain has been conducted with the discovery of shipwrecks found in the East China Sea, the South China Sea, the Paracel islands and other waters. Whereas on maritime traffic, foreign trade and Sino-foreign relations history, the Maritime Silk Road and ancient export porcelain, Professor Fang Hao has discussed the maritime traffic history in the general system of *Sino-West Traffic History* as early as before liberation. The works such as, *China Ancient Maritime Traffic*, *Zhang Xun Collected Works* by Zhang Xun have laid a foundation for the research of maritime traffic history since the foundation of People's Republic of China *China Ancient Maritime Traffic Activities* by Yang Xi, *Sino-Foreign Relationship Historical Research* and *Maritime Traffic and Trade Research* by Han Zhenhua, *China Overseas Traffic History* by Chen Gaohua, *Maritime Traffic and Civilization* by Sun Guangqi, *Sino-West Cultural Relationship History* by Shen Fuwei, *Ancient Chinese Export Porcelain Remains in South China Sea Islands* by Mr. Han Huaizhun, *The Discovery of Chinese Ancient Porcelain in Africa* by Mr. Ma Wenkuan and et al, *The Research Symposium of Ancient Chinese Export Porcelain* by Mr. Ye Wencheng, *A Few Questions on Ancient Chinese Export Porcelain* by Mr. Feng Xianming, *Chinese Junk and Foreign Trade* by Chen Xiyu, *China Ancient Foreign Trade History* by Li Jinming and Liao Dake, and *Overseas Traffic Historical Site*

*Research* by Zhuang Jinghui, exhibit academic originality.

However, these local works and research lack the height of maritime economic system and are not sufficient to reflect the entire internal structure of the ancient maritime economic links around the China Sea. The research category of “ancient export porcelain” and “the Marine Silk Road” misinterpreted the ancient coastal trade porcelain around the China Sea for the porcelain exported beyond national boundaries (including continental boundaries), and misinterpreted the coastal economic cultural system around the China Sea as developing continuously from prehistory to the historical era for the “transfer” of the “Silk Road” from northwest inland to southeast sea since the Tang (618 ~ 907) and Song Dynasties, all of which have clear limitations of continental cultural horizons.

At present and in the future, the theme of coastal economic archaeology is to search for economic maritime trade relics, including the sources and origin of different ship cargos, the marketing routes, etc. We should rebuild the internal form and structure of maritime economic and cultural links around the China Sea from the perspective of maritime business and the trading of tangible cultural heritage. Detailed content includes:

2.2.1 *Shipwreck cargo archaeology.* The investigation and excavation materials of ancient shipwrecks around the China Sea should be collected and collated, especially the latest shipwreck archaeological discoveries in Suizhong in Liaoning province, Penglai in Shandong province, Lianjiang in Fujian province, Pintan, Dongshan, Yangjiang in Guangdong province, Nan'ao, the South China Sea, the Paracel islands and other sea areas in recent years. The archaeological discoveries of Chinese shipwrecks in Japan and South Korea in northeast Asia, Vietnam, Thailand, the Philippines, Indonesia in Southeast Asia and other sea areas should be investigated and studied. The time framework of ancient shipwreck cargos around the China Sea should be constructed using a basic archaeological approach.

2.2.2 *The exploration and research of the origin of shipwreck cargos.* The investigation and research of the resources and production sites of major export goods around the China Sea in the economic trade history, such as the producing areas for silk, porcelain, tea, iron, etc. also known as the hinterland maritime economic historic relics should be carried out in the investigation and research of maritime kilns (or export kilns), to analyze and study cargo export areas of different times. Meanwhile, we must pay attention to the investigation and source exploration of imported goods, discuss the contribution that the world economy and culture has made to Chinese civilization from a cultural heritage perspective.

2.2.3 *The reconstruction of the history of the maritime economy around the China Sea.*



From the perspective of the marine economy development history, we should re-examine the theoretical limits of regarding the ancient Chinese developed maritime economic trade history as the transfer of the “Silk Road” from northwest inland to the “Maritime Silk Road” on the southeast sea since the Tang and Song dynasties, to establish a relatively independent horizon of continental and maritime economic and cultural systems, to explore the inherent source and course regularity of the maritime economy around the China Sea, and to reconstruct the continuous development of the maritime economy around the China Sea and the cultural systems from prehistoric generations to historic eras.

### 2.3 Archaeology Regarding Coastal Territorial Management and Administration and Historic Relics of Coastal Defense

Coastal territorial management and administration and coastal defense affairs mainly refer to the series of political and military practices carried out to resist foreign invasion from the sea. Strictly speaking, the military and political relationship of the policy of successive dynasties before the Ming dynasty (1368 – 1644) with the maritime world mainly belongs to the relationship of “national society” which takes “Huaxia-four directions” ethnic groups of ancient China and continental culture in the cultural framework as its centre with maritime southeast inshore “maritime territorial (local border) society”, it is the political, economic and cultural integration within the unity in scope of the Chinese nation and there is no real sense of a coastal defense problem. Since the “Japanese Invasion” during the Ming Dynasty, the coastal defense was highlighted in Ming and Qing (1644 – 1911) dynasties, the coastal management and administration and coastal defense historic relics are the symbol of sovereignty and historical memory of China's ancient imperial court politics of maritime zones around the China Sea. And they are the major components of China's coastal maritime cultural heritage. The various coastal heritage areas and coastal defense historic relics left by successive dynasties include coastal defense castles, coastal battery forts, navy military camps, ship office and politics relics, etc. . Based on the archaeological survey of these relics, we could investigate the development history of military management and administration from the time change of maritime defense relics.

For a long time, the historian circle has carried extensive theoretical research on coastal territory policies, coastal territory government and coastal defense practices, etc. of successive dynasties. Especially with the intensification of the maritime territorial sovereignty and rights and interest conflicts between the South China Sea and the East China Sea with the number of

neighboring countries increasing, the research of coastal territorial history and coastal defense history has become a hot topic. On the history of coastal management and administration, the Research Centre for Chinese Borderland History and Geography, CASS is the key place for such research. *History of Ancient Chinese Territory* by Lin Ronggui is by far the most systematic history of Chinese marine territorial management and administration and maritime territorial history; *Past and Present Research of China Coastal Territory* edited by Lv Yiran, *China Ancient Coastal Territorial History Synopsis* by An Jing, etc. are systematical monographs on coastal territorial history; *South China Sea Islands: Geography, History and Sovereignty* edited by Lv Yiran and *South China Sea Research: Past and Present* by Li Guoqiang are regional territorial historic works of South China Sea. In addition, one of the supporting units of this subject, the Nanyang Academy of Xiamen University, has made many important achievements on the research of the South China Sea territorial area and historical sites, such as, *The Symposium of the Historical Sites of the South China Sea Islands* by Han Zhenhua, *The Research of the South China Sea Territorial Area* by the book project director Li Jinming. On coastal defense history, *Coastal Defense History* by Yang Jinsen and Fan Zhongyi has deeply and systematically discussed the coastal defense history of the Ming and Qing dynasties. *China Coastal Defense Battery Chart* by Wang Zhaobin, *The Coastal Defense Water Village and Floating Soldiers in Ming Dynasty* by Huang Zhongqing, *Coastal Defense History in Fujian Province* by Lu Jianyi, *Coastal Defense History in Fujian Province* by Navy stationing in Fujian province, *Historical Draft of Fujian Ship-building Bureau* by Lin Qing Yuan, etc. are important special subjects and works on regional coastal defense history. However, the discussions of coastal territorial history and coastal defense history were mainly based on the records of historical documents, of which many involved coastal territorial and defense cultural heritage. The investigation and research from the perspective of relic archaeology and cultural heritage are currently inadequate, and the investigation and research on coastal territorial heritage and coastal defense historical sites ineffective.

The launch of coastal defense historic relics archaeological work could be started from the coastal territorial and coastal defense practices of successive dynasties as recorded in literature and ancient coastal territorial charts to investigate and record the coastal administrative historic relics of successive dynasties, to inspect and survey various kinds of coastal territorial heritage and coastal defense historic relics passed down from successive dynasties, and to highlight the significance of cultural heritage on the reconstruction of coastal territorial and coastal defense history. Detailed content include:

2.3.1 *The archaeological investigation and research of the coastal defense castle and sea-shore battery and fortress remains in Ming and Qing dynasties.* The city, fortress, customs, camp, mound under the Weisuo system established since the period of Emperor Hongwu during the Ming dynasty and other coastal defense building system historical sites should be systematically investigated and studied to build a complete graphic and data system and to identify the system changes of the Ming and Qing dynasties. The important battery and fortress remains such as Dalian, Lushun, Zhigu, Weihai, Yantai, Changshan islands, Jiangyin, Jiangning, Zhoushan islands, Wusongkou, Wenzhou, Fuzhou, Xiamen, Humen, Keelung, etc. should be searched, surveyed and studied.

2.3.2 *The investigation and research of ancient navy and navy military camp remains.* The remains of navy and navy military camps of successive dynasties in the coastal areas based on historical literature should be investigated; and archaeological excavation, survey and records conducted if necessary; ethnological investigation and research on the survey of social science and humanity of ancient navy, navy military camp descendants should also be carried out.

2.3.3 *The investigation and research of ship officers and historic relics policies in successive dynasties.* The remains of navy ship factories of successive dynasties from the ship officers in the Zhou dynasty (1029- 221 BC) to the ship policies in the Qing dynasty to be investigated based on literature.

### **3. Ethnological Research on Intangible Maritime Cultural Heritage**

#### **3.1 Ethnological Investigations of Ship and Boat Conformation and Folk Shipbuilding Methods**

Ships and boats can be viewed as the carrier of maritime culture. Ship and boat conformation, building methods and traditions are important factors and reflections of maritime culture, in particular in reference to time and space. Distinctive and various forms of ancient sailing ships are one of the core connotations of the maritime cultural history around the China Sea, which reflect the outstanding contribution of Chinese boatmen to the history of human maritime culture. In addition to referring to the records of masterpieces of literature and the information of shipwrecks mentioned above, the reconstruction of ancient shipping history around the China Sea should also focus on the remained traditional wooden boats and folk shipbuilding methods

and other maritime ethnological researches, to build the intangible cultural database of maritime ship and boat conformation and shipbuilding methods. The archaeological material and historical literature materials of the “dead shipwrecks” are integrated with “living ship history” to rebuild the development history of the sailing technology around the China Sea.

Since the founding of the People’s Republic of China, ship historic of our country has carried out a series of restoration studies on Chinese ancient shipbuilding history mainly based on traditional literature records and archaeological discoveries of some ancient shipwrecks in Quanzhou, Xin’an, and the ship models unearthed from tombs in Guangzhou, Changsha, Jiangling, and other objective materials. The two papers of *China Ancient Ship*, *China Ancient Shipbuilding Development History* and the book *Sailing Boat History* by Yang Xi are the founding works on the research of ship history. *China Shipbuilding History* by Xi Longfei and *China Ancient Shipbuilding and Navigation* by Jin Qiupeng are also masterpieces in shipbuilding history. *China Navigation History* edited by Peng Deqing puts ship history into the overall context of navigation history to complete the survey. *Ancient China Shipbuilding Engineering and Technical Achievements* by Zhou Shide has summed up the technical characteristics of different segments of Chinese shipbuilding history in subject of natural sciences and technology. *China Ancient Boat*, *China Ancient Ship Chart* by Wang Guanzhuo and *China Ship Score* by Peng Deqing, etc. have showed the history of Chinese ships in the form of cultural relic pictures.

Ship and boat ethnography is the material and method that foreign ship historians pay much attention to, but it is relatively neglected by ship historians of our country. Over half a century ago, fishery and aquaculture sectors investigated and collected part of the folk ship and boat material in coastal areas, for example, *Atlas of China Maritime Fishing Ships*, *Fujian Province Fishing Ships Atlas* and *Corpus on the Pattern of Wooden Sailing Ships in Fujian Province* are all important and pioneering ethnographic publications on the ship and boat ethnography of our country, but only few of such papers in the past entered the vision of ship historians. In recent years, a few scholars began to focus on the investigation of ship and boat ethnography, for example, *The Investigation on the “Mother-Son Boat” in Shidong, Taijiang, Southeast Guizhou and Its Significance on the Pacific Cultural History* by Wu Chunming and the related sections of ship and development history in *Shipwrecks around China Coasts*; these are based on ship history research and ethnic archaeology.

In the future, work will focus on the study of existing forms of traditional wooden boats around the China Sea, as well as traditional wooden boat construction technology and method literatures, to integrate shipwreck archaeology, masterpieces of literature and results of previous

studies, and rebuild the maritime ship and boat development history around the China Sea. The main content includes:

3.1.1 *Ethnographic research on the forms and structures of traditional wooden boats* around the China Sea. Traditional wooden ships disappeared in modern shipping because of upgrading, thus we should make great effort to search and visit some of the remaining traditional wooden fishing boats along the coast, the remaining wooden sailing boats which are still in use, abandoned old sailing boats in ports, new impetus boats in the original form of traditional ships, and the various forms of original boats still used in indigenous communities in southern China. At the same time, we should collect and collate wooden sailing boat diagrams and other related data of the aquaculture and fisheries sector since the founding of the People's Republic of China and launch systematic and classified research on the ethnographic traditional wooden boats in different space and times, to integrate with archaeological discoveries and historical literature and carry out tracing surveys.

3.1.2 *Research on wooden ship building technology preserved in coastal shipyards and traditional fishing villages.* In the north and south harbor along the coast in our country, there are some old shipbuilding factories that still keep some traditional characteristics or were upgraded based on traditional technologies, while in fishing villages, there are also many wooden shipbuilding locations. It is planned to select these sites for inspection and understand different types of construction technologies of wooden ships and related processes in different sea areas.

3.1.3 *The text collection and collation of the building methods for traditional wooden-structure sailing ships.* The folk shipbuilding craft is intangible maritime cultural heritage passed down through the times. It is planned to search in-depth for old shipbuilding factories, shipbuilding families in ancient port towns and to rescue and collect traditional shipbuilding methods as soon as possible.

The ship ethnography and shipbuilding method texts are all endangered objects of intangible maritime cultural heritage. The searching, recording and collection work of these materials will be of great difficulty, but because of their extreme importance for the study of maritime history, we must launch in-depth investigations and research to try and make some achievements.

### 3.2 Ethnological Investigations on Traditional Navigating Techniques and Sailing Route Guide

Navigating techniques are the basic technical support for maritime socio-economic cultural activities. In the navigation practices for thousands of years, the boatmen in successive dynas-

ties around the China Sea with the southeast coast as its centre have created unique navigating technology, from the original “smooth sailing” to the mature “making full use of the wind from all sides”, from the early stage physiographic navigation and “travelling with directions of the sun, moon and stars” to the advanced, quantitative “Zheng He’s Celestial Nautical Navigation.” The unique set of navigating techniques can be seen in literatures handed down from ancient times, for example, the navigating positioning techniques of measuring the Polaris height above water in the Yuan dynasty as presented in *Travels of Marco Polo* and the famous *Zheng He’s Nautical Chart* left by Zheng He’s fleet and so on. Moreover, navigating techniques are still preserved even more vividly in boatmen’s navigation memory and folk sailing route guides, and these are a precious objects of intangible maritime cultural heritage.

Ancient navigating techniques involve oceanography, geography, meteorology, astronomy, physics and other multidisciplinary knowledge and experiences. The navigation historic academic circle has carried out a number of basic researches based on literatures and archaeological data, such as *Nautical Astronomy* by Liu Nanwei, *Marine Meteorology and Oceanography* by Chen Dengjun, *The Achievements on the History of China Ancient Navigation Techniques* by Yan Dunjie, *Measuring Method of Distance In Ancient China Navigation* by Han Zhenhua, *On the Pulling Star Board* by Jin Qiupeng, *China’s Ancient Maritime Meteorological Knowledge and Its Application* by Sun Guangqi, *The Era of Appearance of Chinese Sailing Ship* by Wen Shangguang, relevant sections in *Shipwrecks in China Coast Rim* by Wu Chunming and so on. However, the research on the ethnography of folk boatmen’s navigating technology is still weak. On folk sailing route guide, the older generation of historians have done a number of pioneering and fundamental work, such as the *Two Hydrographic Needle Book* edited and annotated by Xiang Da, *A Study on Ancient Navigational Charts* by Zhang Xun, ‘*Navigating Direction Book*’ and ‘*Sketch of Geographical Position*’ of *Hainan Island Fishermen’s production and Navigation through Xinansha Islands and Other Sea Areas* edited by Han Zhenhua, etc.

Because of the ever-changing modern navigating techniques, traditional navigation technology and folk sailing route literatures have been lost for a long period of time. The preservation of traditional technologies by folk people is very limited, and are a form of endangered intangible cultural heritage of maritime culture. In this situation, we should rescue these materials on the basis of the existing study on the history of navigating techniques and folk sailing route guidance. The research contents include:

3.2.1 Through careful field research, the navigation families, especially in Guangdong, Fujian, Zhoushan, Penglai and other areas with prosperous ancient navigation, should be

sought to search for living boatmen, sailors and their descendants, to collect relevant physiography, astronomy and meteorology (making full use of winds in directions) and other traditional navigation practices and experiences recorded in historical memories. Combined with existing academic foundations, we can compile a record of relatively systematic folk navigation ethnography.

3.2.2 The in-depth investigation, collection of boatmen's navigating directions (water route book or needle compass route book) has been handed down for generations. At the same time we should make necessary investigations and explanations about the ancient nautical charts and other folk navigation route guidance.

3.2.3 Systematic collection, collation and study on the navigating techniques and sailing route materials recorded in the ancient literature of the China coast rim boatman, such as the measuring method of navigation presented in *Travels of Marco Polo*, the anonymous *Hydrographic Book*, the sailing route data in *Research of the East and West Ocean* by Zhang Xie as well as *Zheng He's Nautical Chart* and *Pulling Star Techniques in Wu Bei Zhi*.

3.2.4 In-depth and theoretical summary of the history of traditional navigating techniques for ancient sailing boats on the basis of data survey and researching results of predecessors in the integration research perspective of historic literature, archeology and navigation ethnography.

### 3.3 Ethnological Investigations of Maritime Boatman Social Humanities

The maritime boatman society is one of the main bodies that created maritime culture. The socio-cultural form of contemporary traditional maritime boatman is the continuation and recurrence of ancient maritime socio-culture. Its social humanities are the main content of intangible maritime cultural heritage, including ethnic group socio-culture, maritime religious belief, maritime folklore and maritime literature and art, etc. . It has reflected the rich and colorful connotation and profound accumulated tradition of maritime culture around the China Sea.

Although the academic circle has not yet carried out a systematic survey with the theme of "social humanities of boatmen," but anthropologists, ethnic historians, religious culture researchers, literature and art academics have launched a series of investigations and surveys regarding the socio-culture of boatmen around the China Sea. These have constituted fundamental research achievements. For example, on maritime ethnic group cultural history, the research related to Dong Yi, Bai Yue, Austronesian, Danmin, Quanzhou, sea-lane Muslims of Quanzhou in Fujian province, Eastern and Western ocean maritime immigration along the

Southeast coast, etc. have been a hot topic on the research of coastal area anthropology and ethnic history and has gained abundant results. On maritime humanities and folklore, there are also many regional investigations and research results, such as *China Fishing Island Folklore* by Ye Dabing, *Maritime Folklore in Shandong Province* by Shan Man, *The East China Sea Islands Culture and Folklore* by Jiangbin, *The Cultural Chart of Zhoushan Islands* by Wang Wenhong, *Zhoushan Dialect and East China Sea Culture* by Xu bo, *Huidong people of Fujian and Taiwan* by Chen Guoqiang, *Fishing Village Narrative: the Transition of Three Fishing Villages Along the Southeast Coast* by Peng Zhaorong, *The Research of the Boat Dweller of Zhujiang River Estuary* by Huang Xinmei, *Boat Dweller in Zhuhai* by Huang Jinhe. Maritime religious belief is the core content of boatman humanities. Especially on the research of one of the sea deities “Mazu”, the academic circle has gained many related results, for example, the work *Sea Gods- Belief of Sea Gods and Social Economy of China* by the sub-topic director Wang Rongguo is the most systematic result of this field. *The Aboriginality of Folk Belief in Southeast China* by sub-subject member Peng Weibin also has a unique creative viewpoint but lacks the systematic survey of boatman society from ethnic groups to humanities with intangible maritime cultural heritage as its core.

In the area around the China Sea, in order to launch the maritime culture-oriented investigation and research with boatman social humanities as its theme, tasks that could be carried out include:

3.3.1 Investigation and research of the history and present situation of ethnic groups around the China Sea in successive dynasties. We can investigate and research the social culture of Dong Yi, Bai Yue, South Island, Danmin and other maritime ethnic groups as well as the immigrated sea-lane Muslims on the basis of previous research. At the same time, we should survey the regional boatman humanities with obvious maritime culture characteristics in the Han nationality culture system, to explore its humanistic connotation, characteristics and generation processes.

3.3.2 In the form of a case study, a number of typical maritime social humanities settlement units can be selected to investigate the diverse forms of shipbuilding rituals, regular boat sacrifice, sea sacrifice and wind pray, the sending-off of king ships and other maritime folklore cultural content preserved in traditional boatman society, so that the relationship, difference and its causes of the boatman folklore humanities in different maritime cultural areas can be analyzed and interpreted to study the characteristics and development law of boatman folklore culture around the China Sea.



3.3.3 Investigations and research about the maritime literature connotation, maritime art form and other diverse forms of cultural connotation in different cultural flora. The folk stories, ancestor's legends, ballads and songs and other maritime cultural contents under maritime discourse should be collected and investigated to study the handmade products, construction patterns, folk arts and crafts and other art form connotation in the maritime culture context.

3.3.4 Investigation and research about the sea god worship in different maritime cultural flora. The sea god worships like the East China Sea Dragon King, Mazu of Fujian and Taiwan, the South China Sea Dragon King and Lingnan Dragon Mother, should be investigated and studied to find out the generation, development, evolution process and disseminating spatial scale of worship of sea gods to discuss the characteristics of oriental sea gods and their position in the world sea gods cultural system.

3.3.5 Research on the overall characteristics, inter-connection and time-space evolution and other issues of the various connotation of the socio-culture of maritime ethnic groups around the China Sea by integrating literature and new discoveries in maritime archaeology.

#### **4. The Theoretical Framework, Academic and Social Value of the Investigation and Research of Maritime Cultural Heritage**

The theoretical framework of the investigation and research of maritime cultural heritage around the China Sea is to systematically gain the content composition and space-time distribution of the maritime cultural heritage around the China Sea, to explore the real "historical memory" of China's ancestors' understanding, exploration about oceans, and maritime society around the China Sea. Based on multi-disciplinary investigations, the maritime cultural history around the China Sea can be reconstructed objectively in the "host" position of maritime culture.

Within this overall framework, the basic idea that this subject pursued is the spatial domain, the vision of maritime culture around the China Sea, the academic idea of cultural heritage research, multidisciplinary investigation and research methods, the purpose of rescue protection and promotion of traditional culture.

On spatial domain, the bias of "Zhongyuan (central China)" centre and continental farming culture center of traditional historiography's "Chinese history" are to be corrected. Based on the basic historical facts that the maritime space of Chinese ancestors' exploration and activities with the southeast coast as its centre has gone beyond the four sea areas of our coun-

try, the spatial domain of the “Around the China Sea” can be identified in terms of investigation and research.

On the cultural vision field, the value bias in the traditional “China maritime cultural history” research of viewing coastal territory on Zhongyuan perspective and viewing the coastal world in the position of continental farming culture can be overcome, so that the marine-based position can be established to highlight the value of maritime culture itself.

On academic ideas, the shortcomings of traditional archaeological work of stressing tangible materials and making light of intangible materials and stressing on historic relics making light of nature and human landscape should be corrected and overstepped, to upgrade from historical relic archaeology to the investigation and research of cultural heritage, to explore the rich and systematical connotation of maritime culture from cultural heritage.

On the methods of investigation and research, the rescue investigation and research of maritime cultural heritage is an important and basic academic project of China maritime research in the new period. The content is extensive and the work is heavy and will need the multidisciplinary coordination and integration of archaeology, history, ethnology, anthropology, science of religion, folklore, oceanography, marine engineering and so on.

On academic purpose, with the acceleration of the modernization step in coastal areas, maritime cultural heritage, especially the intangible maritime cultural heritage is facing extinction and endangered plight. Therefore, we should establish the sense of urgency and mission of the salvageable preservation of maritime cultural heritage and promote the fine traditions and deep value of China maritime culture through the survey, excavation, research, awareness and protection of maritime cultural heritage around the China Sea.

Through archeology, history, ethnology, marine navigation, marine science, folklore, cultural science and other multidisciplinary and comprehensive fieldwork, the investigation and research of endangered maritime cultural heritage, the excavation, awareness and protection of the real connotation of maritime civilization history around the China Sea all have important academic significances and social values.

On the one hand, the investigation and research of maritime cultural heritage is an objective and effective academic way to recognize and reconstruct the real history of maritime culture around the China Sea. Traditional historical science mainly relies on the “literature data” that takes Zhongyuan dynasty horizon as its center and is continental farming culture oriented. As a result, traditional “Chinese maritime cultural history” always falls into the appendage of the continental dynastic history. The marine history and maritime traffic history also always view

“maritime territorial humanities” and “coastal defense history” in the perspective of Central China, so the values of marine culture itself and its real history could not be manifested. The China coastal maritime cultural heritage is the objective reflection and the most real and direct historical memory of the maritime ancestors who had been recognized and developed for thousands of years. The investigation and research of this subject will be undoubtedly of significant academic value on the reconstruction of maritime humanities history, removing the traditional historiography dynasty politics centre horizon and the continental farming culture value bias as well as the establishment of China coastal maritime culture circle horizon and marine humanities topics.

On the other hand, the investigation and research of maritime cultural heritage around the China Sea provides a theoretical and policy basis for the preservation of the diverse content of maritime cultural heritage and the promotion of the new development of maritime culture. It is a major and urgent work to promote the fine culture and traditions of the Chinese nation. The accumulation, preservation and promotion of traditional culture form the basis of the survival and revival of Chinese culture and the construction of harmonious culture. The maritime culture is a major component of China's multi-component culture and an important factor that is currently neglected to an extent and in different historical periods. Therefore, it is of significant social value to carry out investigations and research of maritime cultural heritage around the China Sea and based on this, stress the preservation, display and promotion of maritime cultural heritage, to propel maritime soft power construction, and to demonstrate the status and value of China's maritime culture in the world maritime civilization system.

# Phased Results and Follow-up Archaeological Work at the Three Gorges

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## **1. The Natural Environment and Cultural Background of the Three Gorges Area**

The Three Gorges area is located in the upper reaches of the Yangtze River and the eastern part of the second unit of China's large landform. To the west is Chongqing, the east Yichang City, the north Daba Mountains, and to the south the mountain region of Sichuan-Hubei. It covers a gross area of 56, 700 km<sup>2</sup>. The landform of the modern Three Gorges mainly relies on two important orogenic movements in the late Mesozoic. Due to movements in Indonesia 150 million years ago, the anticline of Huangling Temple was uplifted and the original Yangtze River began to develop. The Yanshan movement in the 70 million year age formed the basic structure of the modern landform of the Three Gorges area. In 20 million years, the water system of the old Yangtze River source, which originates from the Tibetan Plateau, and the cutting and "traceability erosion" forms the main stream of the original Yangtze River. In the late Pliocene, 2 million years ago, a broad valley gradually formed in syncline structure, mudstone and sandstone while the great canyon in the Three Gorges, which is deep and where the cliffs are extremely high, gradually formed an anticline structure and the zone where the main component is carbonatite.

The modern Three Gorges area is in a humid subtropical climate zone and the vertical change of the climate is obvious. In the river valley region, under 400 m with abundant heat resource and little frost, rice can be harvested three times a year and the population density can reach as many as 625 people / km<sup>2</sup>. Available information indicates that the Three Gorges re-

peatedly experienced changes from a warm and humid climate to a cool and dry climate. The climate in the warm and humid period was muggier than it is today. The evergreen-deciduous broadleaved forest was dense and some animals living in tropical and south subtropical zones travelled to the Three Gorges. In the cold and dry period, the characteristics of the vegetation were of a thin needle broad-leaved forest. There distributed a range of shrub-land and the animals living in northern China and temperate zones migrated southward to the region.

The complicated geological and geomorphic condition, the changes in the forming process and the abundant and multiple climate environment of the Three Gorges area provided a good living environment for the survival and reproduction of the ancient peoples. Available information indicates that in early Pleistocene, humans made their way to the Three Gorges and is an important area for the exploration of the origin of humans in the east Tibetan Plateau. In the late Pleistocene, the signs of human activities in the Three Gorges increased significantly and other discoveries illustrate that the ancient peoples mainly lived in the wide valley region of the Yangtze River west of the Qutang Gorge. After Holocene, the activities of humans became more frequent and their choice of environment was similar to modern society. They centralized in the alluvial terraces converged by rivers and wide valley regions and created a continuous and constant material civilization.

Paleolithic culture of the Three Gorges mainly belongs to the same cultural region as South China areas from the south of the Qinling Mountains and the Huai River, and contains cultural elements of the north and southwest Paleolithic culture. Neolithic culture is divided by the Qutang Gorge and respectively belongs to the Daxi culture system in Hubei and other districts in the middle of the Yangtze River region and the Yuxiping culture system in Chongqing, Sichuan Province and other districts in the upper reaches of the Yangtze River. The two cultural systems maintain close connections to the Three Gorges area. The archaeological culture equivalent to the Bronze Age interacts at the Three Gorges area. Ba culture that is evidently different from the Chu culture of the east of the Three Gorge area is closely connected to the Shu culture of the Chengdu plain, jointly constituting a Ba and Shu cultural circle. During the Qin (221 BC-206 BC) and Han (206 BC-220 AD) dynasties, mainly after the rule of Emperor Wu of Western Han, it blended into the Han culture, but formed some new local cultural characteristics. After a general survey of the ancient culture of the Three Gorges area, it can be observed that the restriction of the independent natural geographic environment of the Three Gorges area has influenced the production and life style of the ancient peoples in this area, ancient civilizations and even the development process of modern society. The interaction between the environment

and humans is a significant underlying reason for the forming of strong regional cultural characteristics in the Three Gorges area.

## **2. Planning for the Three Gorges Project and the Preservation of Cultural Relics in the Three Gorges Reservoir Area**

### **2.1 Three Gorges Project Profile**

As early as 1917, Mr. SunYat-Sen put forward the concept of the Three Gorges Project in *The International Development of China*. During the period of the war of resistance against Japan, the National Government organized the investigation and design of the Three Gorges Project. After the establishment of the People's Republic of China (PRC), the Three Gorges Project was soon put back on the agenda. On 3 April 1992, the National People's Congress approved the resolution of the construction of the Three Gorges Project following a half year of continuous research. In 1993, a large-scale migration and movement from the Three Gorges reservoir area was implemented. In December 1994, the hydro-junction project for the Three Gorges formally started. On 8 November 1997, the river was dammed and in June 2003, water storage at 135 m was reached and after further flooding in 2006, water storage at 156 meter was reached. Two experimental water storage levels in 2008 and 2009 respectively reached as high as 172.8 m and 171.43 m. On 26 October 2010, the Three Gorges reservoir accomplished the designed goal of 175 m water storage for the first time.

The Three Gorges Project, with the Hydro-Junction Project in the Three Gorges as its full name, is located in the Sandou Ping of Yichang, in Hubei Province, at the centre of Xiling Gorge. The height of the dam structure is 185 m and is designed to increase by 96.8 m of the water level of the Yangtze River and the highest water storage level is 175 m. The backwater will reach Jiangjin, Chongqing, and the inundated area is as long as 660 km with a width of 1 ~2 km. The water front of the reservoir is 5300 km while the area reaches 1084 km<sup>2</sup>. The inundated land area is 632 km<sup>2</sup> and involves 23 administrative divisions of Chongqing City, Hubei Province, including 4 counties of Hubei Province and 19 districts, cities and counties of Chongqing.

### 3. Planning for the Preservation of Cultural Relics in the Three Gorges Reservoir Area

The earliest archaeological investigation of the Three Gorges area dates back to the 1920s or 1930s. N. C. Nelson, Missionary J. H. Edgar, *et al.* investigated the river valley of the Three Gorges from Yichang, Hubei Province, to Wanzhou, Chongqing. They discovered some ancient cultural relics and collected some stone implements that they recognized as exhibiting “Beijing Ape-man Culture” and classified them within the “Yangtze River Culture”. The series of investigations of the hydrological sculpture of the Three Gorges and the exploration of the Daxi relic in Wu Mountain in the 1950s; “Tongliang Culture” and the exploration of the graveyard of the Warring States Period in Xiaotianxi, Fuling in the 1970s; and, the exploration of the relic of the “Ape Man in Wu Mountain” in the 1980s; etc. are important achievements of archaeological work in the Three Gorges area of the past century. However, these discoveries are quite scattered. Due to serious restrictions to the scale of field archaeology in the past decades, the knowledge of the overall situation of cultural relic resources in the Three Gorges area was limited and most ancient cultural relics were still buried in unknown valleys, rivers and wilderness until the end of the last century. In 1988, the Office of the Yangtze River Basin Planning carried out an investigation of the cultural relics in the area under the water level of 175 m and discovered 44 cultural relics of which 29 were aboveground cultural relics and 15 were underground cultural relics. We have no basic knowledge about the Paleolithic culture of the Three Gorges, the Neolithic culture order of the west of the Three Gorges, the origin and development of Ba culture and other important archaeological areas. Essentially, prior to the preservation of the cultural relics of the Three Gorges Project, the archaeology of the Three Gorges area was lagging behind most areas in China.

The construction of the Three Gorges Project brought unprecedented pressure to the preservation of cultural relics in the Three Gorges reservoir and presented an opportunity to thoroughly identify all cultural relics and systematically carry out cultural relics preservation work. In order to undertake the work, the Office of the Construction Committee of the Three Gorges of the State Council held a series of conferences with the State Cultural Relics Bureau and developed and designed a preservation plan “Planning Before Implementation” for the cultural relics of the Three Gorges referring to the mode of the Three Gorges Project. The management mode has not only complied with the management mode of the Three Gorges Project and set up a scientific and ordered management platform of preservation of cultural relics of the Three Gorges, but

also commenced the scientific management of cultural relics preservation of China's large-scale construction projects and took lessons from the management of preservation of cultural relics of the Water Diversion from the South to North Project, West-East natural gas transmission project and other projects.

From the summer of 1992 to June 1993, the "leading group of preservation of cultural relics of the Three Gorges Project" of the State Cultural Relics Bureau organized the cultural relics departments of Hubei and Sichuan Province to immediately carry out investigations of inundated areas of the Three Gorges reservoir. They identified 828 cultural relics and formulated a *Planning Framework of Preservation of Cultural Relics of the Three Gorges*.

From November 1993 to 1994, the State Cultural Relics Bureau entrusted the National Museum of Chinese History and the China Cultural Relics Research Institute to coordinate the formation and establishment of the "Planning Group for the Preservation of Cultural Relics of the Yangtze Three Gorges Reservoir Area." This group is led by Yu Weichao and brought together many scientific research institutions and specialists to be responsible for the planning and formation. The planning group organized Hubei Province, Sichuan Province, Chongqing and over 300 specialized persons from 30 scientific research institutions and universities and colleges on archaeology, historic building, geological environment, paleontology, ethnicity, folk-custom and anthropology from all over the country and carried out the works of the investigation, rechecked and trialed excavation on a larger scale in the inundated area of the Three Gorges Project under 177 m (the highest water level of 175 m plus the waves line of 2 m).

In March 1996, the *Planning Report Concerning the Preservation of Cultural Relics in Inundated Areas and Relocation Areas in the Three Gorges Project* was formed. The Plan records 1282 places of cultural relics, which is 1238 more than the 44 proposed by the Yangtze committee in 1988 and 454 more than the 828 listed in the Framework. In June 2000, the Three Gorges Construction Committee of the State Council examined and approved the reduction of 151 locations of cultural relics and included 1087 locations of cultural relics in the preservation plan, which consists of 723 locations of underground cultural relics and 364 aboveground cultural relics.

The *Planning Report Concerning the Preservation of Cultural Relics in Inundated Areas and Relocation Areas in the Three Gorges Project* includes three sections of the general report, the provincial report and the county's report, and the detailed rules and regulations of the planning, additional remarks and county planning of ground cultural relics preservation, which amounts to 54 books, more than 2.8 million words and 200 one ten-thousand topographic maps



of cultural relics. It covers the largest scale, the widest scope and the greatest number of people in China, thus reflecting the guidelines, policies and ideas of China's preservation of cultural relics. Moreover, it represents the overall level of China's preservation of cultural relics and is considered one of the top ten archaeological discoveries during China's Eighth Five-Year Plan.

## **4. Archaeological Excavation and the Main Accomplishments of the Three Gorges Reservoir Area**

### **4.1 Performance of Archaeological Excavation**

There are 723 locations for the archaeological projects of the Three Gorges Reservoir area (excluding 21 in the Hubei Province dam area) and the buried area of cultural relics is approximately 25 million m<sup>2</sup>. According to the planning thoughts of key preservation and exploration, the planned exploration area is 12 million m<sup>2</sup> and the excavation area is 1.7 million m<sup>2</sup>. There are 217 places in Hubei Province with 2 million m<sup>2</sup> of exploration and 400 thousand m<sup>2</sup> of excavation; there are 506 places in Chongqing with 10 million m<sup>2</sup> of exploration and 1.3 million m<sup>2</sup> of excavation. According to the management mode of provincial responsibility, Hubei and Chongqing were placed in charge of the organization and implementation of archaeological excavation in their administrative districts.

Due to the limited experience in archaeological projects in Hubei Province, since the construction of the Three Gorges dam area in 1993, Hubei Province has invited 44 archaeological institutions from around the country. They have participated in the archaeological excavation of the dam area and the reservoir area and successfully completed 21 archaeological projects in the dam area and 223 in the reservoir area. The accomplished number of archaeological projects accounts for 103% of the plan. The excavations are 110 thousand, including 20,000 precious cultural objects.

More than two thirds of archeology planning tasks and key and difficult projects of the Three Gorges Reservoir area are in Chongqing. So there is no doubt that the effective organization and implementation of Chongqing archaeological work became key to the success of archaeology in the Three Gorges Reservoir area. On June 20 1997, the "Coordination Conference of the Rescue of Cultural Relics in the Chongqing Reservoir Area of the Three Gorges Project Supported by the National Cultural Relics System," was held in the Cygnet Hotel by the Cultural Relics Bureau of Chongqing after Chongqing became a municipality under the central govern-

ment. It was the first national conference and opened the Chongqing Three Gorges archaeology meeting. Since 1997, the Chongqing reservoir area has become the largest archaeological construction site in the world. Thousands of professional archaeologists were invited to Chongqing and jointly participated in the cross-century meeting in the Three Gorges Area in Chongqing, from 72 universities and scientific research institutions, such as the Institute of Archaeology of the Chinese Academy of Social Sciences, the Institute of Vertebrate Paleontology and Paleoanthropology of the Chinese Academy of Sciences and Peking University. As of 2008, Chongqing completed 528 archaeological projects in the Three Gorges area, and among them, 283 places of ancient sites and 245 places of ancient tombs. The amount of completed archaeological projects accounted for 104% of the planning. Incomplete statistics of unearthed cultural relics was 130, 000, including over 40 thousand precious cultural relics. Effective organization and smooth implementation of archaeology in the Chongqing reservoir area ensured the overall completion of archaeological planning tasks in the Three Gorges reservoir area and received national acceptance.

According to the statistics of the *Summative Research Report of the Preservation of Cultural Relics of the Three Gorges* by the National Museum (First Draft), the actual completed quantity of archaeological projects of the preservation of underground cultural relics of the Three Gorges was 774, which completed 103.5% of the planning. Excavation area: 1, 764, 782 m<sup>2</sup>; exploration area: 12, 198, 408 m<sup>2</sup>. Incomplete statistics of unearthed cultural relics is 247, 782 Nos., including 62, 751 Nos. precious cultural relics and 9, 815 Nos. cultural relics have been reused by means of exhibition, etc.

**Table I Statistics on Preservation Achievements of Underground Cultural Relics in the Three Gorges Reservoir Area ( Hubei Dam Area Included )**

Administrative Division	Planning Projects	Completed Projects	Added Projects	Completed Proportion	Unearthed Cultural Relics ( Nos. )	Precious Cultural Relics ( Nos. )	Unearthed Specimen ( Nos. )	Cultural Relics Usage ( Nos. )
Hubei Province	239	246	6	103%	114694	22730	92324	2500
Chongqing City	506	528	22	104%	133088	40021	93076	7315
Total	745	774	28	103.5%	247782	62751	185400	9815

#### 4.2 Staged Scientific Research Achievements of the Three Gorges Archaeology

The Three Gorges archaeology excavated a mass of ancient culture relics and achieved nu-

merous new important archaeological discoveries. Quantities of precious unearthed cultural relic specimens and scientific data relatively completed the Three Gorges cultural sequence and advanced scientific research work of archeology and relevant fields.

According to approximate statistics, there are hundreds of archaeological excavation reports and research papers of the Three Gorges reservoir area that have largely been published in core journals and professional publications, such as *Archaeology*, *Acta Archaeologica Sinica*, etc. There are tens of various report collections, archaeology specialty issues, academic monographs, academic paper collections, archaeological catalogs and cultural relic photo albums published by professional institutes, such as the Science Publishing Company, Cultural Relics Publishing House and so on, whose number of words is over fifty million. Additionally, a set of documentaries, popularized literature reading materials about archaeology, on-the-spot reports and excavation notes have been published.

At present, there are tens of items of scientific projects that have been carried out and completed on the Three Gorges archaeology, and state level projects come up to more than ten items, such as the important research plan of the National Natural Science Foundation of China--*Environment Archeology Study on Typical Sites and Natural Sections of the Changjiang Three Gorges Area*, research topics of the National Social Science Foundation of China--*Archaeological Culture Study of the Three Gorges Area the During Periods of the Xia, Shang and Zhou*, the China Compass Project --*Research on the Function of Salt Manufacturing Remains and Relics in Three Gorges Area*, and scientific research issues of the State Cultural Relics Bureau --*Research on the Genes of Prehistoric Graveyard Crowd Structure in Daxi, Wushan, Archaeological Research on Ancient Zinc Smelting in the Three Gorges Area, Study on Component and Craft of Bronze Ware in the Warring States Period in the Three Gorges Area* and so on. Among the published academic works, the research mainly relates to archaeological accounts, such as archaeological culture properties, cultural types, cultural periodization, cultural evolution, cultural communication, city archaeology, economic activities, production technologies, religious cultures, funeral customs, field archaeological techniques and preservation and repair of cultural relics. Furthermore, they involved relevant academic fields, such as history, ethnology, environmental science, geology and history of science technology.

### 4.3 Significant Discoveries and New Cognition on Archaeological Culture

#### (i) Paleolithic Culture

The Three Gorges area where karst landform was developed and buried abundant quaternary

ry South China stegodon -giant panda fauna fossil-is an ideal place to look for early ape man fossils and comparatively completed gigantopithecus fossils and may uncover the secret of human activities in Pleistocene. Discoveries of sites of early ancient humans ( “Jianshi Man” , “Wushan Ape-man” ) convincingly support this view. Due to the limit of sea-level elevation of the Three Gorges reservoir area, archaeology discoveries of Paleolithic culture were mainly at late Pleistocene epoch.

In 1993, the Institute of Vertebrate Paleontology and Paleoanthropology of the Chinese Academy of Sciences uncovered 68 stone implements and fissile places in Level II and III terraces along the Yangtze River, which included 38 locations of significant Paleolithic sites. The discovery filled the blank in the discovery of Paleolithic sites in the Three Gorges reservoir area. So far, more than ten thousand stoneware and quantities of zoolites have been unearthed in the excavation of 43 locations of Paleolith ruins. Sites of Gaojiazhen and Ranjialukou in Fengdu (approximately 140, 000 years ago) are the earliest wilderness type of Paleolithic sites currently discovered in the Three Gorges area. The thick, big and bulky choppers discovered in the sites are the major instrument of production used by ancient people, which were forged of gravel near the river. Jingshuiwan sites in Fengdu (80, 000 years ago) scattered in the Level III terrace of the Yangtze River. Remains were buried under loess as thick as 20 m. 910 stone implements (mostly choppers) were unearthed here. More than 60 pieces of Southern China quaternary typical fauna fossils (stegodon, cattle, deer, etc.) were also discovered. Analysis results of bud powder extracted from the sites by the Institute of Vertebrate Paleontology and Paleoanthropology indicate that the climate in the Level III terrace was moist and people lived in fallen leaves and evergreen mingled forest vegetation environment. Following, this area experienced climatic variation of two periods (dry and cool climatic environment to warm and dry climatic environment).

Paleolith of the Three Gorges area and Paleolith of Southern China (E'xi mountainous land, Liyuan River Basin of Hunan, Hanshui River Basin of Shannan, Baise Basin of Guangxi) have many characters in common and belong to the south gravel industrial system. Similarities of stoneware at sites at different periods in the Three Gorges area in style indicate the strong continuity in its cultural development. At the same time, one may see the crushing technology and small-sized stoneware phenomena in Northern Paleolithic culture in the Paleolithic sites in the Three Gorges reservoir area. The sharp edge crushing technology in Paleolithic culture of the Southwestern area indicates the development and variation of culture, which may be cultural communication led by transition of geographic locations and natural environment of the

Three Gorges reservoir area. Therefore, although Paleolith of the Three Gorges area mainly belongs to the south gravel industrial system, it has some cultural elements of the north and south-west area.

The Yufupu site in Fengjie (7, 000-8, 000 years ago) is located in the Level II terrace near Meixi River, Qutang Gorge, Yangtze River. Five m under the site surface, the Huotang site that was regularly arranged, stoneware, animal remains scattered around them were discovered. The major stoneware consist of scrapers, pointed tools and choppers, and most implements may have some relations to chopping meat and falling branches. Animal skeletons include wolf, pig, muntjac, fish, etc. The skeletons were broken and came from all parts of the body and some stones were burnt. The same as most sites scatted in the Level II terrace of the Yangtze River (e. g. Henglu and Santuo in Fengjie), in the aspect of cultural characters and time range, it is at the transition phase of Paleolithic age to Neolithic age and significant to the research of the transition of Paleolithic age to Neolithic age in the Three Gorges area.

#### (ii) Neolithic Culture

Before the 1990s, the connotation of Neolithic culture of local aborigines in the Three Gorges area was not understood clearly. The archaeology in the Three Gorges reservoir area discovered as many as 90 sites. Discoveries of sites of Zhongbaodao, Miaoping in Zigui County and Nanmuyuan in Badong County in Yichang City, Hubei Province, in particular Yuxi in Fengdu County, Chongqing City-Yuxiping site group, Zhongba in Zhong County-Shaopengzui sites group, Suheping in Wanzhou District, Dadiping in Yunyang County, Laoguanmiao site in Fengjie County, and the overall excavation of tens of Neolithic age sites, such as Daxi in Wushan County and Oujialaowu in Yunyang County, laid a solid foundation for understanding the archaeological culture of the Neolithic period in the Three Gorges and obtained important breakthroughs.

The same as the structure of two physical geography units in the Three Gorges area, Neolithic culture in the Three Gorges area is divided by Fengjie Qutang gorge and two different cultural systems existed there. The east part was the Daxi cultural system that mainly scattered in the middle reaches of the Yangtze River culture; the west part was Yuxiping-Shaopengzui System in the upper reaches of the Yangtze River, which is the most important discovery of the Three Gorges archaeology. About 5, 000 years ago, the two different cultures coexisted for a period in the Three Gorges valley area. From Yuxiping culture about 4, 500 years ago, the range of the coexistence became larger, and communication of cultures tended to be frequent.

*Daxi culture-original culture from the middle reaches of the Yangtze River;*

Daxi culture is a branch of Neolithic culture that was widely distributed in Hubei and Hunan areas of middle Yangtze River, and has a distinct development lineage of 9,000-4,000 years. Daxi culture in the Three Gorges area was discovered in the area to the east of Qutang Gorge.

In the Oujialaowu site of the Daning River Basin in Wushan, early stage remains of Daxi culture were discovered and important remains were unearthed. More than 120 Daxi culture tombs and quantities of fishbone pits were discovered under the site of an ancient city in Wushan. The most important discovery was still the name place of Daxi culture-the Daxi site in Wushan that has been excavated several times since the 1950s. Since 2000, this Daxi site has been entirely excavated, and nearly 200 tombs and more than 700 ash pits were found and important results were gained in many aspects-founded early stage remains of Daxi culture; uncovered the coexistence relation of late stage remains of Daxi culture and local Neolithic culture of Xiajiang; founded the evolution of various forms of burial customs, which can develop deep research of social structure of Daxi culture in combination with the results of DNA; founded quantities of implement pits, animal pits and fish stone pits, which may mainly reflect some consciousness of Daxi people or original religions ideas; the materials of site function partition provided data for settlement studies; the fishing, hunting and gathering of Daxi Culture in Xiajiang area is different from the rice grown agricultural economy in Jiangnan Plain area, which is a typical for the discussion of economic types and environment relations of Daxi Culture.

*Aboriginal Neolithic culture sequence represented by Yuxiping:*

The systematic excavations on the sites of the aboriginal Neolithic Age in the Three Gorges Reservoir Area have obtained the most important gains on the prehistoric archaeology of the Three Gorges.

The Yuxi site in Fengdu belongs to the sites in the middle period of the Neolithic Age with the upper-layer and lower-layer remains of two periods.

The wave pile-up formed by mutual lamination between household garbage, such as bone residues, in the lower-layer site of Yuxi and floods from the Yangtze River is 5 m thick, with up to 59 cultural layers. Furthermore, there are up to 27 layers of flood sediment deposits, which provide ancient environment scholars of the region with important details. Unearthed remains at the Yuxi site are mainly potteries, stoneware and animal bones. Tens of thousands of stoneware were found. The bodies of the former are relatively large and are mainly stone hoes, choppers and other scabbings and stoneware that were subject to one-time formation and simple

trimming, with a little amount of grinded strip axes. With relatively few potteries, the simple wares made include caldrons, pots, earthen bowls, bowls, basins, etc.; the characteristics on the changes of the caldrons are very obvious. The distribution range and cultural origin of the lower-layer site in Yuxi (temporarily named as “Yuxi Lower-layer Site”) need to be confirmed in further investigations. According to the results of Carbon 14 dating on 19 collagens, the Yuxi Lower-layer Site has a history of approximately 7600-6300 years, with the early, middle and late periods continuing respectively for 400-500 years. A significant amount of animal bones were found in the Yuxi Lower-layer Site; through verifications, there are 27 categories of animals, such as mammals, fish, bivalves, testudinales, birds and other animals. Most of these animal bones are crushed bones and may be the remains subject to dismemberment and eating by aborigines. To some extent, they reflect the local ecological environment of the time in Yuxi and also the economic type for lower-class people dominated by fishing and hunting as well as fishery.

The pile-up for the Yuxi Upper-layer Site is relatively thin and its remains are chopped and grinded into stoneware, multi-table small firestone casts and pottery. The main pottery samples are edge-folded kettles (pots), edge-rolled basins, deep-belly jars, globular bowls, earthen bowls with lugs, open earthen bowls, spinning wheels, etc.; the pottery ware are dominated by clay grey potteries. According to Carbon 14 dating for animal collagen of the Yuxi Upper-layer site, the region has a history of approximately 6200 years.

For the broad discoveries in the cultural relics of the late period of the Neolithic Age in the Three Gorges area, the important consensus relating to the cultural attributes, space distribution, age range, etc. have been basically formed. According to the latest research results issued, the culture in the late period of the Neolithic Age can be divided into three major development stages, which are named as three archaeological cultures.

*Shaopengzui Culture*: is represented by the Shaopengzui site in Zhong County with popularity of edge-rolled pots and its age is approximately equal to the mid-late period of Daxi culture, with a history of about 5500 ~ 5100 years. Shaopengzui culture and Yuxi upper-layer culture come down in one continuous line and its boundary to Daxi culture in the east is approximately located at Qutang Gorge. In the late period of Daxi culture, Shaopengzui Culture was increasingly strong and reached the Daxi site through Qutang Gorge. Shaopengzui culture has a close relationship with the Yingpan Mountain site of the Minjiang River basin in Chuanxi Plateau in the west.

*Yuxiping Culture*: is represented by the Yuxiping site in Fengdu with the popularity of

edge-folded jars. Its age is approximately equal to the period of Qujialing culture, with a history of 5100 ~ 4600 years. The discoveries of Yuxiping cultural relics have been made in the area from Hubei Yichang in the east to Yuxi in the west, the northeast area of Guizhou in the south-east and the northeast area of Sichuan. It belongs to the period of great prosperity from the late Neolithic culture of the Minjiang River in Chongqing.

*Zhongba Culture*: is represented by the Zhongba site in Zhong County with the popularity of lace cylinder implement groups, and has a history of 4600 ~ 3700 years. The early period of Zhongba culture dates back to 4600 ~ 4300 years and is classified into the last stage of the Neolithic culture; the late period of Zhongba culture can be dated back to 4300 ~ 3700 years and has stepped into the scope of Xia Chronology.

#### 4.4 The Xia (2100 ~ 1600 BC), Shang (1600 ~ 1046 BC) and Zhou (1045 ~ 256 BC) Dynasties

The discovery of sites of the Early Bronze Age Culture in the Three Gorges area began in the 1950s, but immediately halted shortly after. There have been nearly 100 relics discovered in the Three Gorges Reservoir area; hence, dramatic breakthroughs have been made. These relics experienced three development stages, and the cultural appearance is dominated by Ba Culture with co-existence of multiple cultural factors. These all objectively reflect the characteristics of the corridor culture of ancient ethnic groups in the Three Gorges area, i. e., constant migration and frequent cultural exchange.

There are three cultural appearances from the Xia Dynasty (2100 ~ 1600 BC) to the Middle Age of the Shang Dynasty (1600 ~ 1046 BC): Aboriginal culture in Xiajiang, Sanxingdui culture in Chengdu, and Erlitou culture in Central China. In general, they fall under the Sanxingdui cultural system and are the area types under the combination of Sanxingdui culture and aboriginal culture. According to Carbon 14 dating of the Zhongba site in Zhong County, the period from 1900 BC to 1050 BC belongs to the dating range of the Xia and Shang Dynasties. The period was dominated by fishing and hunting economies and relative importance placed on agriculture.

The period of Shidiba culture: the Middle Age of the Shang Dynasty to the early age of the Western Zhou Dynasty (1029 ~ 771 BC). Represented by the Shidiba site in Fengdu, this period is characterized by a broad distribution range, which stretches from Wu Mountain in the east, southeast flies over Wu River into the northeast area of Guizhou Province with most places at the middle and lower reaches of Jialing River. Being attributed into the same cultural system



with the Twelve-bridge culture of the Chengdu Plain, the Shidiba culture appeared from the late period of the Shang Dynasty to the early period of the Western Zhou Dynasty. The differences between the late period of the Shidiba culture and the Twelve-bridge culture have gradually increased; in the middle and late periods of the Western Zhou Dynasty, they respectively formed two independent cultures.

From the middle period of the Western Zhou Dynasty to the Spring and Autumn Period (722 ~ 476 BC), there were obvious differences between Asian and Western cultures in respect to cultural appearance. Wazhadi culture represented by Wazhadi site of Zhong County is mainly distributed to the west of Qutang Gorge with Carbon 14 dating between 1130 BC and 760 BC and the period approximately from the middle period of the Western Zhou Dynasty to the Spring and Autumn Period. In general, Wazhadi Culture was still kept in jars with pointed bottoms in the early period, which is the result of the development and evolution of Shidiba culture; the sudden increase in the quantity and types of jars with lace mouths is a symbolic feature of Wazhadi culture. The sites during the period from the middle period of the Western Zhou Dynasty to the early period of the Spring and Autumn Period, the Shuangyantang site in Wushan is representative of the cultural appearance to the east of the Three Gorges Area; though it inherited features of Shidiba culture and Wazhadi cultural, e. g. , jars with lace mouths, cups with pointed bottom, its typical wares, e. g. , *ge* (an ancient cooking tripod with hollow legs) and *zun* (a kind of wine vessel used in ancient times), are attributed to Chu culture. The above differences reflect the changes on population and culture in Chongqing after the middle period of the Western Zhou Dynasty. The west area of Chongqing is still dominated by aborigines and represents the cultural inherence from Shidiba culture to Wazhadi culture; the relics represented by Shuangyantang disclose such facts: in the period, the Chu culture at the middle reaches of the Yangtze River had a significant impact on the Three Gorges area.

#### 4.5 The Eastern Zhou Dynasty (770 ~ 256 BC)

In the Eastern Zhou Dynasty (770 ~ 256 BC), the archaeological cultures in the Three Gorges area were mainly attributed to the cultural categories of Ba and Chu.

Densely-distributed and orderly-arranged 400 graveyards in Xiaotianxi Burials (Fuling), Zhongba site (Zhong County), Daping graves (Wanzhou), Lijiaba site (Yunyang) and Yujia-ba site (Kai County) and a large number of graveyards to the west of Wanzhou, the cultural attribute is dominated by Ba culture and has important impacts on research regarding Ba culture of the late period.

According to the location of “Chu Guling” recorded in the *Notes on Book of Waterways*, Yunyang Guling was discovered with four large-size Chu tombs. Large-size Chu tombs (M66) with a full length of 17m and a coffin chamber of more than 10m in length, width and depth were discovered in the Yong’an Tombs (Fengjie). There are bamboo curtain splints laid out in the tombs and bronze dings, grain receptacles, pots, bronze vehicles and horses, gold-plated belt hooks, jade bi, chamilia beads and other relics were discovered. Additionally, a large-size Chu tomb with a suitable scale was also discovered in the Daqiuping Tombs (Wanzhou). The tombs of the middle period in the Warring States (475 ~ 221 BC) may be the tombs of the nobles of Chu. Moreover, for the Matuo Graveyard to the east of Yunyang, Shangguan Site of Fengjie and more than ten tombs in Wushan from the late period of the Spring and Autumn Period to the early period of the Western Han Dynasty (206 BC ~ AD 9), the overall features was consistent with the tombs of the corresponding period in the core area of the Chu culture in eastern China, which are attributed to the tombs of the Chu cultural style. Furthermore, dozens of Chu tombs in the middle period of the Warring States and several small Ba tombs in the late period of the Warring States were found in Yajiao Graveyard at Zhong County. This batch of Chu tombs are distributed in the typical Chu tomb group located at the most western end and the lower limit of the era and was placed no later than the period of Baiqibaying in 278 BC.

The tombs in the Three Gorges area from the middle and late period of the Spring and Autumn to the early period of the Western Han Dynasty are dominated by Ba and Chu tombs and exhibit cultural traits of Qin, Yue, Central Plains, etc. Tombs of Ba Culture from the late period of the Spring and Autumn to the early period of the Warring States are broadly distributed in Yunyang of Chongqing and its western area. The co-existence of Ba and Chu cultures presents in Fengjie, the east of Chongqing; the east area of Wu Mountain is mainly attributed to the Chu cultural area. In the middle period of the Warring States, tombs of Ba culture have been discovered in the area from Zhong County to Yunyang and in the late period of the Warring States, a large amount of the tombs of Ba culture have been discovered in Wanzhou and its western area. In the middle period of the Warring States, tombs of Chu culture have been discovered in the area of Zhong County, and the number of the groves and tombs increased in the late period of the Warring States. The tombs of composite culture mainly appeared in Zhong County and its east area after the middle period of the Warring States. There are very few Qin and Yue cultural factors. Tombs of the Central Plains culture sporadically appeared in the area of Wu Mountain in the late period of the Warring State, and gradually distributed west along the river.

As recorded in the references, Ba people had a close relationship with salt. In the Eastern Zhou Dynasty, the Three Gorges area controlled by the Ba people was an important area for the production of rock salt in China. The historic records on the exploration of bittern resource have been made continuously since the Han Dynasty (206 BC-220 AD). Some sites regarding salt production discovered since 1997 as an important production relics of Ba culture of the late period. In the excavation of the Zhongba site, the relics of cellaring, clay pits and troughs of some special structures with off-white calcium remains in inner walls were discovered. Furthermore, hundreds of house relics with the traces of grounds, postholes, troughs and fire use, which are attributed to production workshops, were discovered. The densely-distributed post-poles on the plane of the house relics are related to production; cups with pointed bottoms of a single type and jars accounted for 96% of the potteries are relics relating to salt production discovered. Zhongba Dragon Kiln, Wazhadi ceramics, etc. are accessory industries related to the salt production. Combined with multidisciplinary researches and the findings from related investigations, it has been indentified that the Ganjinggou site of Zhong County began to produce salt in the Neolithic Age; the production activities were frequent in the Xia and Shang Dynasties and were of great prosperity in the Eastern Zhou Dynasty. After the Han and Tang (618 ~ 907) Dynasties, the salt production industry, as a major industry, lasted until the modern times.

There are differences for economic types in different areas in the Eastern Zhou Dynasty. It is indicated by the findings from animal bones, the kernels of the fruit, grain of dry farming in the Zhongba and Wazhadi site that dry farming, animal feeding, fishing and hunting in the Ganjing River Basin of Zhong County were paid equal attention and that the main means of livelihood was the salt industry and affiliated ceramics. The productive tools for the Maliutuo site of Wanzhou have forged and polished stone implements, bronze tools and bronze metallurgical sites; there is a phenomenon that the types and quantity of animal bones tend to increase, which indicates the phenomenon of the existence of preferring fishing to agriculture. Common findings of various pendants, bronze arrows, skeletons of fishes, wild boars, etc. in Dachang Basin represented by Lanjia Village of Wu Mountain and popularity of iron cha, iron jue and other agricultural tools indicated the existence of local fishing, a hunting economy and rapid agricultural development.

## 4.6 Historical Period

Large-area disclosures of urban sites represented by Quren County of the Han Dynasty, the

ancient city site of Wu Mountain, the Mingyueba town site of the Tang Dynasty, Zigui Dongmentou City Site of Tang and Song (960 ~ 1279) Dynasties, Badong Jiuxianping County Site of the Song Dynasty and Baidi City of Fengjie, City Site of the Song Dynasty (Yong'an Town) are important gains of archaeology on mountainous cities and have important impacts on research regarding civilization processes, and social and economic development of historical periods in the Xiajiang Area.

Represented by the graveyards of the Han and Jin (265 ~ 420) Dynasties in Huinan (Fengdu), Wuyang (Zhong County), Matuo (Yunyang), Tuchengpo (Wu Mountain), Tudiwan (Zigui), etc. and the graveyards of the Tang and Song Dynasties in Shangguan (Fengjie), Baotaping, Mingyueba (Yunyang), the Three Gorges Reservoir area has a significant number of the findings of public and family cemeteries, which provide details regarding the funeral culture of historical periods in Three Gorges area and its relevant research with abundant data in combination with explorations on thousands of tombs of different types and discoveries of remains.

The relics of ceramics and porcelain manufactured after the Han and Jin dynasties have been discovered far and wide. The relics of iron-making, in places such as Yunyang and Wushan, provide important information pertaining to the traditional handicraft industry and economic history in the Three Gorges area.

Tang Dynasty salt stoves were discovered at the historic site, Zhongba in Zhong County, while the relics of the salt industry from the Song to Qing (1644 ~ 1911) Dynasties were discovered at the Yun'an salt site in Yunyang, including ancient salt production processes of well digging, halogen taking, delivering, bittern sediment, salt production, shipping and so on. The salt production technology in the Three Gorges area since the Song Dynasty has retained traditional practices that differ from the continuously developing well digging technology and halogen taking technology in Zigong district, Sichuang, and has high research value for the history of ancient salt industry technology.

Since the sites of zinc smelting in Fengdu in the Ming (1368 ~ 1644) and Qing Dynasties were confirmed, several units have carried out a large number of cooperative investigations, excavations and scientific research. More than ten sites of iron smelting were discovered in Fengdu, Shizhu, Fuling and Wulong. The excavations that focused on sites of zinc smelting in Fengdu resulted in the discovery of different types of iron smelting. The special subject investigation of zinc ore, coal and transportation lines within the scope of 300 km<sup>2</sup> in the southeast of Qiyue Mountain also resulted in important achievements. This discovery is an influential and

important discovery for research on the metallurgy technology history of China and even in the world.

## 5. Follow-up Work and Underwater Archaeology of the Three Gorges

During the Post-Three Gorges period, the works of the undergoing preservation and restoration of the excavations, classification of excavation data, compiling of archeological report and scientific research, the preservation of cultural relics in the riparian zone of the Three Gorges reservoir and an ecological barrier zone, which haven't been included into the planning phase, are important works undertaken during this time.

### 5.1 The Preservation of Underground Cultural Relics in the Riparian Zone

The riparian zone refers to the zone of land inundated in the repository area exposed to changing water levels due to the fluctuation of seasonal water levels of the Three Gorges reservoir. Upon the completion of the Three Gorges Project, the level of water storage for power generation in winter was 175m and the flood prevention level in summer descended to 145m. The riparian zone is the 30m of height of water between both levels. Statistics show that the riparian zone in the Three Gorges area reaches 349 km<sup>2</sup>, among which the area of the riparian zone in Chongqing is 306 km<sup>2</sup>, thus accounting for 88% of the riparian zone.

The archaeology work for the Three Gorges has completed planning for the principles of key rescue and key preservation. However, the proportion of the exploration undergoing execution only takes up half of the area of the sites that have been buried; the proportion of the excavation area is lower, from which we cannot ensure the excavation and preservation of all cultural relics. During the process of washing and undercutting the water storage and backwater, the sites and historic tombs that haven't been discovered and excavated would be exposed afterwards. Since 2008, we have rescued and excavated the Tombs of Taojiaba, Xituo Town, Shizhu County, Chongqing from the Han to the Six Dynasties; the Tomb of Qin Family's courtyard of Gaojia Town, Fengdu County from the Han Dynasty; and the Tomb of Kazibao, Nonghua Village, Mingshan Town, Fengdu County from the Han Dynasty. During the investigation in the riparian zone, it was discovered that the 246 cultural sites were distributed in districts and counties from Wushan to Changshou in the Chongqing riparian zone, among which the Three Gorges cultural preservation planning projects were 186 and the location of discovered

cultural sites was 60. On this basis, the Chongqing Archaeology Institute of Cultural Relics and Archaeology compiled the *Plan for Cultural Relics Preservation for the Chongqing Area of Repository Riparian Zone of the Three Gorges Project*, in which the exploration area was planned to be more than 1, 100, 000 m<sup>2</sup> and the excavation area more than 140, 000 m<sup>2</sup>. During the process of reservoir riparian, such discovery and rescue excavation would be long-term work. At present, the concerned state departments have paid close attention to such a circumstance by ranking the preservation of cultural relics in the riparian zone as key follow-up work to the Three Gorges and preparing long-term solutions.

## 5.2 The Preservation of Cultural Relics in the Eco-Screen Zone

The eco-screen zone of the Three Gorges refers to the eco-migration area above the submerging line. The eco-screen zone aims to protect forest resources, construct forest for conservation of water supply and soil conservation, and build green ecological screens on the two shores of the Three Gorges reservoir through taking the measurements of local conditions, such as returning grain plots to forestry and afforestation in Barren Mountain and uncultivated land.

The eco-migration activities in the eco-screen zone would undoubtedly damage the underground cultural relics to varying degrees. The cultural relic department is making changes to the preservation plan and carrying out archaeological work in this district. The work is expected to make up for the insufficiency in the discovery of the relics on the early and the medium term of the Paleolithic age, enrich the material on the remaining archaeology during the historic period and resolve related academic issues.

## 6. The Relationship Between the Three Gorges Archaeology and Underwater Archaeology

The area below 145m of the Three Gorges reservoir is permanently inundated. In accordance with the requirements of the Third National Survey of Cultural Relics, hundreds of the ancient cultural relics in this area have been registered as underwater cultural relics. Among them, it was difficult to conduct work for the ancient cultural relics which have not been listed into excavation plans.

The exploration and archaeological excavation hasn't been carried out in the buried areas where more than half of the ancient cultural relics are situated in the riparian zone. These buried areas were inundated regularly every year and damaged by washing and undercutting of the

water flow; which needs rescuing and preservation.

In fact, before the execution of the Three Gorges Project, flooding of the Yangtze River in the past had inundated and damaged the ancient cultural relics regularly to different degrees.

The flooding in the Yangtze River in the Three Gorges area was mainly formed by summer rainstorms for approximately 10 to 30 days. In a usual year, the Yangtze River would encounter a “large area” storm flood. In cases where the rainstorms of the overall river basin were concentrated, “whole-basin” floods with peak heights may have occurred. In accordance with the records of the *Historical Data Compilation of Flood Disasters of Sichuan in Two Thousands Years*, the flood records of the upper reaches of the Yangtze River can be traced back to the Western Han Dynasty in BC 185. The flood and water level elevation could be measured, happened in the 23rd year of Shaoxing (1153) of the Southern Song Dynasty, and was recorded in two stone inscriptions in Zhong County, Chongqing City. The most serious flood in a thousand years happened in 1870 (Gengwu ninth year of Tongzhi of the Qing Dynasty). At that time, the water level in Chenjiaguan of Jiangbei District in Chongqing City reached 197 m and the Nantuo Town of Peiling District reached 181 m. Hence, tens of states and counties on the upper reaches of the Yangtze River were submerged. Relevant studies have shown that since the early Han Dynasty to the late Qing Dynasty, 214 floods occurred in the Yangtze River basin; on average once a decade. From the early Qing Dynasty to the time before the establishment of the PRC, as the population increased and the reclaiming of land from the lake, the area of flood storage was gradually reduced, and the floods became more frequent. There was one serious flood approximately once every five years.

On the basis of the parameter of the natural water level of all sections in the main stream and tributaries on the preliminary design phase for the Three Gorges provided by the Yangtze River Basin Planning Office, in contrast to the elevation of underground cultural relic sites of the Three Gorges reservoir area, the statistics show that the influence of the underground historic relics of Three Gorges reservoir area were affected by regular floods. For example, the statistical result of planned cultural relic sites of the Chongqing reservoir area are shown below:

According to the statistical results in Table I, before the submerging of the Three Gorges reservoir, perennial floods had varying influences on the 65 cultural relic sites, which accounts for 12.85%. The floods that occurred once every five years had varying affects on 193 cultural relic sites, which accounts for 38.14%. The floods that occurred once every 20 years had different influences on 274 cultural relic sites, which accounts for 54.15%. And the floods that occurred once every 100 years had varying affects on 361 cultural relic sites, which accounts

for 71.34%. In comparison to the result in Table II, it could be stated that the floods at the same period have caused greater influence on important cultural relic sites of Level A and Level B.

**Table II Statistical Table of the Influence Condition of Various Cultural Relic Sites in the Chongqing Reservoir Area Affected by Floods**

Flood Cycle	Total Amount of Cultural Relic Sites	No Influence		Influenced		Partly Inundated		Inundated	
		Quantity	Percentage	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage
Perenniality	506	441	87.15%	36	7.11%	20	3.95%	9	1.78%
5 Years		313	61.86%	94	18.58%	53	10.47%	46	9.09%
20 Years		232	45.85%	88	17.39%	85	16.80%	101	19.96%
100 Years		145	28.66%	102	20.16%	88	17.39%	166	32.81%

**Table III Statistical Table of the Influence Condition of Cultural Relic Sites of Level A and Level B in the Chongqing Reservoir Area Affected by Floods**

Flood Cycle	Level A and Level B Cultural Relic Sites	Influenced	Partly Inundated	Inundated	Subtotal	Proportion
Seasonality	152	14	4	2	20	13.16%
5 Years		31	16	14	61	40.13%
20 Years		37	31	25	93	61.18%
100 Years		26	34	55	115	75.66%

Considering that rainstorms would be bound to have vast damaging impacts on ancient cultural remains above the flood level if the flood in the Yangtze River happened together with a rainstorm within the district, it can be further concluded that the condition of inundation by floods and damage by rainstorms of the ancient cultural remains in the Three Gorges reservoir area was far more serious than that concluded in the statistical results above.

During the process of archaeological excavations of the Three Gorges, the gap layers of flood deposition were commonly discovered in pre-historical sites such as Yuxi in Fengdu, Zhongba in Zhong County and Shaopengzui, the earliest of which was over 7,000 years. During the excavation, the phenomena of breakage, dislocation strata, anastrophe accumulation, secondary accumulation and serious abrasion of the remains were commonly observed. From the sporopollen analysis of the Three Gorges reservoir made in different locations and periods, it was difficult to obtain the ideal result. The researchers made nearly consistent judgments that



the elutriation of the water flow resulted in the serious loss of the sporopollen of plants. The phenomena formed the main support of the conclusion that the Yangtze River floods had significant influence and damage on the sites.

Due to the restriction of mountains and hill-based physical geography condition of the Three Gorges area, from the earliest times, human activities in the Three Gorges area have greatly depended on the valley districts of the Yangtze River and its tributary. In accordance with the statistics of the cultural relic resources in the related districts and counties in *Planning for the Preservation of Cultural Relics of the Three Gorges*, the cultural relics in the inundated area of the Three Gorges reservoir took up a very large proportion of local districts. Integrating the times, connotation, scale and other indexes of the cultural relic sites, the extent of the inundated influence of the ancient cultural remains was actually more serious. For example, the remains in the early period from the Stone Age to the period of the Shang and Zhou Dynasties in the vital districts of the Three Gorges, such as Zigui, Badong, Wushan, Fengjie, Yunyang, Zhong County and Fengdu, county town sites and important graveyards in the historical period, were all distributed within the inundated district. Therefore, the research on the history and culture of the Three Gorges area cannot be made without the cultural centre area--the Three Gorges. However, the traditional archaeology appears helpless to the research and the effective preservation of the ancient cultural remains of the Three Gorges.

In view of the three basic facts that the floods of the Yangtze River in history have regularly inundated and damaged ancient cultural remains to varying extents, the riparian area of the Three Gorges reservoir has made yearly inundation and damage to parts of the remains and the ancient cultural remains below 145 m of water level of the Three Gorges reservoir have been permanently inundated under the water. Therefore, we consider that follow-up archaeology work of the Three Gorges is closely related to the underwater cultural remains.

Including the preservation research on the ancient cultural relics of the Three Gorges into the preservation and research of underwater cultural relics and using continuously improving modern technology to develop the preservation of cultural relics and archaeology research work in this area has both important practical significance to the preservation of cultural relics of the Three Gorges reservoir area, and important effects as the reference and enlightenment for the preservation and research of the ancient cultural remains in the shores of rivers and lakes around the world.

# Underwater Archaeology and Cultural Heritage Management in the Baltic Sea-Using Public Outreach as a Means of Protection

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Throughout history, the Baltic Sea has been used as a common resource by the nations surrounding it. This has resulted in a large number of casualties at sea, and thousands of shipwrecks rest on the bottom as evidence of trade and warfare. The shipwrecks tie nations together. The ship might have been built in one country, have had an owner from a second, and cargo from a third. This underwater cultural heritage has the potential of becoming a new kind of sustainable tourist attraction, but as long as it is invisible, inaccessible, and unknown to the general public, it will remain under constant threat from pollution, deterioration, and insufficient or lacking legal protection.

In Sweden the National Maritime Museums are trying to turn this trend. Through interaction and outreach activities, such as dive parks and diving for non-divers, they strive to reach an underwater cultural heritage that is researched, accessible and preserved.

## **1. Safeguarding**

There are more than 3, 000 known shipwrecks in Swedish waters, and maybe some 100, 000 more are still to be found. In Sweden, as in many other countries, their safeguarding begins with a protection and information assessment.

The National Maritime Museums perform non-intrusive archaeological surveys, elaborating documentation and sensitivity statuses, leaving the shipwrecks and artefacts *in situ*. They explore and develop various uses for underwater technologies such as ROV and sonar. Selected shipwrecks are being watched and monitored by the coastguard. Technical monitoring solutions

including surveillance equipment installed on the shipwrecks themselves are also being tested.

As a service to the cultural heritage management and as a way to increase public awareness, archival information on them is continuously updated and extended. Some of these archives are available even over the Internet.



## 2. Interaction

An effective way to increase safety for the underwater cultural heritage is to interact with the sports diving community. Divers can report shipwrecks via a web-based form on the website of the National Maritime Museums, they are invited to seminars, and museum professionals take part in discussions on web-forums.

A ship that foundered more than 100 years ago is in Sweden protected through the Heritage Conservation Act. Nevertheless, in general everyone is allowed to dive on it as long as he or she does not interfere with the remains. However, on some sensitive shipwrecks in Swedish waters, diving is prohibited.

In the Dalarö area south of Stockholm, famous for its well-preserved shipwrecks from the 17<sup>th</sup> and 18<sup>th</sup> centuries, the National Maritime Museums run a pilot-project in which they will test allowing access also to shipwrecks where diving is until now prohibited. They will become underwater cultural reserves-designated areas where access will be allowed according to regula-

tions adapted to each particular shipwreck and its condition. Divers will need to be guided by dive leaders with a specific education.

Of course, the Museums interact not only with sports divers. Stakeholders such as local population, business and government should be involved at an early stage whenever an underwater site is about to be “developed”. Sometimes there is a lot of local awareness, for instance a local community association. If there is no involvement, or perhaps even reluctance, it is advisable to nevertheless consider the ideas of the critics, in order to eventually create a sense of “our heritage”.

A long-term perspective for interaction is vital. The challenge is to create a long-lasting attraction—one that will keep on evolving, and not languish because of other priorities and goals. This can be done by drawing up of a marketing and development plan. Also useful is to employ a variety of marketing tools. All possible target groups should be identified, and a selection be made which to attract first, second etc. It is important to find the ‘unique selling point’ (USP).

Local entrepreneurs can be encouraged to develop businesses such as boat or dive charter companies. In order to get good sustainability, management capabilities can also be emphasized and various guidelines provided.

In such an undertaking, collaboration, informal as well as formal, is vital, especially in the beginning of a project. This could be between business, regional government, and universities, and across various sectors, for instance collaboration between maritime archaeologists and maritime ecologists/biologists. Recurrent meetings, dedicated areas of responsibility, and common timelines are recommended.

Communication is very important. This includes the building of informative and, ideally, interactive websites. During fieldwork or other interesting activities, daily events can be published on a blog. Helpful is also to contact and stay in touch with the media. Media services are extremely interested in anything that involves diving, archaeology or shipwrecks. This advantage should be used.

### **3. Outreach**

The underwater cultural heritage, like any other heritage, should reach out to, be perceived and appreciated by all potential visitors regardless of background, age, gender or physical abilities.

A dive park is an excellent measure and can be welcoming divers as well as non-divers. Nevertheless, by using various methods and media, a situation can be created where the heritage protection services are able to reach also those who normally do not visit parks and other outdoor attractions. A creative use of underwater technology, including ROV, sonar, cameras, and screens mounted on tour boats or in a museum allows the visitor for instance to see the shipwrecks without getting wet. Digital media, (interactive) content, and multiple languages make it possible to tailor the experience for all potential visitors-in reality or virtually, for a regional, national or international public.



This does not need to be complicated and expensive.

It is of course possible to present 3D-animations on big screens displaying ships sailing, sinking, and turning into wrecks, as narratives are read by famous actors. The way to go could however also be much simpler-starting with a thorough inventory of shipwrecks and other sites and monuments, followed by a website with lots of information, photos, illustrations and downloadable site maps with GPS-coordinates for tourists visiting the area. This is what the Swedish National Museums have done in the Axmar Iron Works area north of Stockholm, where several shipwrecks connected to the iron works activities in the 17<sup>th</sup> and 18<sup>th</sup> centuries are visible just below the water surface. All the sites in the area are connected to Google Earth, and the public can almost visit the underwater world from the living room. The public can also report new shipwrecks through the site, and the Museums can post assignments for sports di-

vers when they want an area searched (see [www.axmarbluepark.se](http://www.axmarbluepark.se)). An interactive touch screen solution that will be placed in an old storage building by the water, is being produced. Attractions bring attractions-the Axmar area also has a well-visited restaurant.

Finally, I would like to stress the importance of the narrative. Without the stories, the silent shipwreck sitting on the bottom of the sea, is just an inanimate object.

# Remaining Treasures of the Maritime Silk Road-the Excavation of the Ming Dynasty Shipwreck : No. 1 Nan'ao

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## 1. Introduction

In late May 2007, the fishermen of Yunao Town in Nan'ao County, Guangdong, discovered a sunken ship filled with blue and white porcelains and salvaged several items. Later, professional staff of water archaeology conducted research in the marine space of the shipwreck and located it-No. 1 Nan'ao. The shipwreck is located between Wuyu and Banchaojiao of the Southeast Three-point Golden Coast, Nan'ao Island, Shantou. Since its discovery, the ship has open to the public again after being submerged under the sea for over 400 years.

More specifically, the location of the shipwreck is near Nan'ao Island in Nan'ao County, Guangdong, which is located to the east of Shantou, the only island county of Guangdong province, within the jurisdiction of Shantou. Nan'ao Island consists of 23 islands, including South Penghu Island, Lemen Island and so on. The County lids an area of 112.4 square kilometers with a coastline with a total length of 99 kilometers, among which, the main island lids 106.85 square meters with a coastline length of 77 kilometers. The marine area under the jurisdiction of Nan'ao County is 4,000 square kilometers. Nan'ao Island is located between the coastline of Guangdong and Fujian. And the line between Nan'ao Island and Maobitou in Gaoxiong, Taiwan, is the geography borderline for the South Sea and East Sea. Belonging to the South China Sea and the entrance of the Taiwan Strait, the sea area is an important international sea-line with over 300 transportation ships in use in the area. It has a subtropical monsoonal climate with southeast monsoons in the summer.

## 2. Underwater Archeological Work

The archeological work was jointly implemented by the Guangdong Archeology and Cultural Relics Research Institute, the Guangdong Museum and the National Underwater Cultural Relics Protection Center from April to July 2010. Over ten thousand relics were found in 16 shifting boards and 15 bulkheads. According to the condition of the shipwreck, the archeological team set a virtual excavation unit net of 10x30 meters ensuring the whole ship was included in the excavation unit net, moreover, two hard excavation unit nets were set underwater in accordance with the practical condition. The hard excavation unit was an iron box 1x1 metres, every 20 centimeter of which had a hole for a line, thus forming a grid suitable for underwater drawing. The first row of the hard excavation unit was E-W directed and located in Cabin No. 1 with serial numbers of T2020, T2120 and T2220. The second row was to the north of the first and located in Cabin No 2 with serial numbers of T1921, T2021, T2121 and T2221 with S-N direction. Rectangle plastic tags with excavation unit numbers were roped on the southwestern corner of each excavation unit and drilling steel was installed in the northwestern corner in T1920 as a permanent point (Figure 1).

The shipwreck consists of several bulkheads directed E-W from south to north. Since the two shifting boards in the most southern point were best preserved, they were temporarily numbered as Cabin No. 1 and marked with directional signs of N in the front, from which Cabin No. 2, Cabin No. 3 and etc. were numbered in series to the north; while the cabins to the south of Cabin No. 1 were marked with directional signs of S in front. Following analysis and comparison, it was found that Cabin No. 1 had the largest interval and was best preserved; so it was identified as the middle cabin of the ship. After the completion of the underwater archeological work, it was identified that the shipwreck had 16 shifting boards and 15 cabins (Figure 2).



Fig. 1 Underwater Surveying



Fig. 2 Hull Structure of shipwreck





Fig. 3 Piles of underwater wares

The ship cargo changed due to affects of the sinking process, however the heaping condition remained basically complete. Taking Cabin No. 1 as an example, the maximum excavating depth of the cabin was one meter, failing to reach the bottom of the ship. The relics found in Cabin No. 1 mainly consisted of blue and white plates, and bowls and small pots. Other finds included a small amount of powder compacts, small cups, dragon-patterned large pots, bronze pieces, minor coppers, tin pots, wooden beam of the steelyards and rings.

The blue and white plates were mostly regularly arranged and had been kept upright in piles of two rows in the same direction as the shifting boards. From this section, we can see that the blue and white plates had two or three layers. There were piles of bowls and small pots, arranged upright, filling the interval between the piles of the plates. Dragon-patterned pots were mostly found in the west of Cabin No. 1 inrows, but somewere left in the middle. Some pots had walnuts inside, among which, one had over 10 black nuts inside. Furthermore, some olive nuts were found in the sand, which may have originally been kept in the pots. Some wine cups, pieces of Weiqi and walnuts were found in one of the dragon-patterned pots. There were also some complete blue and white bowls with lids, the sides of which were all facing upwards. Additionally, there were some small pots in bowls. Most of the powder compacts were spilling in the west of Cabin No. 1. Generally, the powder compacts were packaged in three pieces with small ones inside medium ones and medium ones inside large ones. Also, rings and tin pots were found in the west of Cabin No. 1 (Figure 3).

Through theexcavation in 2010, we have a clear idea about the shipwreck. The longitudi-

nal length of the ship is about 27 meters and the length of the widest cabin is 7.5 meters. Through measurements, we found that the ship has a longitudinal direction of 10 degrees and a lateral inclining angel of 8 ~ 13 degrees (differences remain in different cabins). In the out port of Cabin No. 8, we found a large number of relics with small heaping thickness. Thus we can suppose that the ship may have broken apart, leading to the spilling of the cargos to the outside port. The preservation condition is rather better than that of other shipwrecks found on the coast of China.

During the excavation of 2010, we found 11, 248 underwater cultural relics including 10, 624 porcelains, 145 potteries, 113 metal implements, 54 additional implements and 312 coppers (154 strings plus 158 pieces; over 15, 000 pieces in total). Porcelains took up 95 percent of the relics found in the shipwreck, this is due to the fact that porcelain is solid and anti-corrosive, thus it can be well preserved underwater for long periods of time. Furthermore, porcelain was the most important cargo for Chinese foreign trade since the Tang (618 ~ 907) and Song Dynasties (Northern, 960 ~ 1127; Southern, 1127 ~ 1279). It is worth mentioning that there were many circular coppers with a purity of over 90 percent and a large number of copper coins in the ship. Due to a lack of clear written records for the cargo and ships, we also identified the year of the ship according to the porcelains. Through data analysis, it is estimated that the number of relics in No. 1 Nan'ao is over ten thousand. Among the porcelains, blue and white porcelains of the Zhangzhou Kiln make up the majority with the porcelains by plates, bowls, pots, cups, bottles and so on; and representative porcelains include blue and white glazed plates and blue and white bowl with lids, the porcelain body and enamel of which are quite thick, the colors slightly discoloured with blackening and graying features, the pictures of figures or plants are in a free style, the surface of the implements are glazed, the legs of the ware are glued with a sand called "Sand Leg Ware", a common kind of ware in foreign trade of that time.

We also found a rather large number of blue and white porcelains and polychrome wares from Jingdezhen, Jiangxi Province; the blue and white powder compacts and dragon-caved bowl with flared mouths found are exquisite. Moreover, there were other kinds of relics, including wooden ware, glazed pots, iron pans, copper coins, copper sheets, remains of many kinds of animals and plants and so on. Among the ware found, the blue and white ware of Zhangzhou Kiln were greatest in number (Figure 4).



i. Blue and white grails



ii. Five-color powder compacts



iii. Nuts



iv. Copper implements



v. Blue and white glazed Jars with Flower Pattern



vi. Dragon-patterned jars

Fig. 4 Some Relics of the shipwreck Nan'ao No. 1

### 3. Primary Investigation into the Place of Origin and Place of Marketing of Porcelain

The main characteristic of Zhangzhou Kiln is its producing of pottery for foreign trade. It dates back as far as the Ming Dynasty (1368 ~ 1644) and the middle of the Qing Dynasty

(1644 ~ 1911) (see Fujian Museum: *Zhangzhou Kiln*, Fujian People's Publishing House, 1997). From the data available, the unearthed and handed down Zhangzhou Kiln products are relatively rare, and are placed at the Shanghai Museum, the Fujian Museum and cultural institutes in Quanzhou and Xiamen, which are out of proportion to the production time and scale of the Zhangzhou Kiln. In addition, a great number of Zhangzhou Kiln products have been collected in Japan in East Asia, and Singapore, Malaysia and Indonesia in Southeast Asia. In sunken ships dating to the 17<sup>th</sup> century discovered by foreign underwater archaeologists, such as San Diego and Witte, many blue and white porcelain products from Zhangzhou Kiln were found (see Concerned Citizens for the National Museum "Saga of the San Diego", 1993). In the 1990s, China's archaeologists conducted an investigation and exploration of the Fujian Zhangzhou Kiln, which rouse significant international attention. The objects found in the No. 1 Nan'ao shipwreck were mainly implements produced by Fujian Pinghe Wuzhai Erlong Kiln. The centre sections of the plates were decorated with symmetrical pairs of flowers, bird figures and/or lace, and the bases with deer, unicorns, phoenixes, plucked flowers and figures. The whole picture presents an open and vivid artistic style. Artifacts produced by Pinghe Nansheng Huazilou Kiln with variegated patterns and terse structures, are quite rare. What's more, archaeologists have never seen multicolored artifacts made by Nansheng Wuzhai and Dalong. From the time, we can judge that it is produced by Zhangzhou Kiln in the late 1500s to the early 1600s, and the age of the shipwreck also corresponds to these dates.

Having started work with the cargos in the shipwreck, we came to the conclusion that No. 1 Nan'ao started its journey from Fujian Zhangzhou Yuegang. The time was after the limited access of the sea in the Long Qing Period (1567 ~ 72) of the Ming Dynasty. However, that was the choice of the Emperor Long Qing who was under pressure from smuggling, and the fundamental purpose was to "better carry out the sea forbidding policy through limited access to the sea." Particular forms in the coastal areas were not exactly the same. Generally speaking, Guangdong mainly allowed foreign ships to import cargo, but it limited Portugal, who settled Macao, and only imports, not exports, were permitted. While Fujian was forced by pressure from the population and attracted by huge profit in overseas trade, usually its form was local merchants to export cargos, and there were only exports, and no imports. "The opening to the sea in Fujian only benefits Fujian, for China exports its cargos to the foreign countries but no foreign ships enter China" (Deng Zhong, *Qian Tai Wei Zuan Part 1, Wo Li Lun Hai Shi*). Moreover, the coexistence of blue and white porcelain made by the Zhangzhou Kiln and those made by Jingdezhen also supports this judgment. Yuegang lies 50 miles southeast of Zhang-

zhou, and is the area of sea used for transportation and inland river transportation. During the first year of the Long Qing period (1567), the Ming government partially opened access to the sea, and established a “Foreign Trade Market” for exporting cargos overseas. Jiangxi and Fujian not only were close in geography, but also communicated with each other in kiln technologies. The porcelains sold overseas had two land and sea routines, including Guangchang-Yong'an-Zhangping-Haicheng (Yuegang) and Guangchang-Changting-Dapuzheng-Zhangzhou-Haicheng. The porcelains were firstly shipped to seaports and waited to be transported to Oriental regions, to Penghu Islands, Taiwan, Luzon, and then shipped to Japan, Korean and Ryukyu. When passing through the Atlantic, the China Sea and the Batavia, they were being shipped to Southeast Asia, South Asia, West Asia and Africa and finally would reach European countries (Tang Weichun, et al. : Primary Investigation into Foreign Traded Porcelains of Fujian Pinghe Kiln, Cultural Property in the South. 1996, Vol. 4).

Nan'ao sea area lay in the common borders among Fujian, Guangdong and Taiwan. It is the exit to the south of the Taiwan Strait, and is close to the main ship route. Throughout the ages, it has played a role as a necessary mooring site and transshipment station. In the 2<sup>nd</sup> year of the Wanli Period, Ming Dynasty (1574), *Donglizhi*, revised by Chengtianzi, recorded that, “in the 7<sup>th</sup> year of Chunxi (A. D 1180), Yangwanli was promoted to Xingyu in Guangdong. At the beginning, pirates attacked Nan'ao, and Yang ordered the local soldiers to beat them.” This indicates that Nan'ao became known to the outside world no later than from the establishment of the Song Dynasty. What's more, the Ming Dynasty was regarded as the “Sea Market” for its frequent oversea trade. Gu Zuyu once said that Nan'ao was, “broad inside and narrow outside...and a majority of foreign ships moored there” (*Essentials of Geography for Reading History* -Guangdong Nanzhoufu-Nan'ao Mountain, Vol. 130). At that time, the Dutch called Nan'ao the “Cape of Good Hope” (Capo de Goede Hoop) — (*Formosa under the Dutch*, 1624 ~ 1662) Cheng Shaogang trans. , Taipei Lianjing Publishing Company, p. 133). It is thus clear that at that time, the sea routes engaged in communicating China with foreign countries were quite busy. Therefore, the number of sunken ships due to various reasons was reasonably high.

#### **4. Change in Trade Systems in the Later Period of the Ming Dynasty**

After the 15<sup>th</sup> century, great changes took place in the history of human civilization, and

the great discoveries of geography opened doors for communications among civilizations. Ocean trade became an important part in the global trade system and the Maritime Silk Road entered a new historic stage. During the same period, China's trade system also changed significantly. Looking deep into the overseas trade of the Ming Dynasty, generally we can treat the Longqing Period as the dividing line, i. e. the earlier stage (1368 ~ 1566) of tribute ships and late-mid stage (1567—1644) of merchant ships and smuggled cargos.

However, we must notice that the so-called capture of the forbidden sea in the Longqing period only aimed at specific areas and was not representative of the time. The so-called "Gong Chuan" is "the same as trade ships" in Wang Qi's words (Xu Wenxian Tonggao. Vol. 26. Shi), and was under the pretext of transporting tributes to the emperor, but in fact it aimed at conducting trade. Essentially, in the Ming Dynasty, the monopolization of the sea by the government was only through policy. In regard to the nature of overseas trade in the Ming Dynasty, Wang Qi once said that, "the Gong Chuan was under the command of the government to travel in the sea market and do business. The law prohibited overseas trade doing business in the sea." Gong Chuan trade reached its peak before the Jia Jing period. After the middle period of the Ming Dynasty, China's foreign trade had changed a great deal, and corruption in the government and declined central control made the ship trade business more prosperous day by day. The so-called ship trade business was overseas trade conducted by individuals and was not recognized by the government. In a sense, it was abnormal trade. The meaning of No. 1 Nan'ao is the direct evidence it provides of the exchange of materials and cultures among different civilizations and areas. In the archaeological activities that focus on real objects, every object we find possesses positive and abundant historical, cultural information. By investigation these historical samples, we are able to discover additional historical facts so as to verify and rediscover time that has gone by, and remodel our understanding of history.

# Introduction on Underwater Excavation of Cultural Heritage in Korea

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**Abstracts:** After 1971 , the number of reported cases of underwater cultural heritages is 239. Thus far , underwater excavation efforts have yielded some 94 , 000 relics from 17 sites , which included the excavation of two foreign ships and eight Korean ships of the Goryeo period. Early on , due to a shortage of experienced manpower , the project teams relied heavily on assistance from the Korean navy , especially for divers. However , the expertise acquired from a growing number of excavation projects led to the creation of a civilian underwater excavation team , following a project conducted at Biando Island , Gunsan , in 2002. Thereafter , an Underwater Excavation Division was established in March 2007 , which serves as the national organization responsible for overseeing the excavation and preservation of underwater artifacts.

## 1. Introduction

Surrounded by the sea on three sides , it was water and maritime transportation that really developed in the Korean peninsula rather than ground transportation. Records of such high maritime activities are well documented and ships and relics that were sunk during the process are scattered under water. Most excavations of Korea's underwater relics begin because of accidental discoveries during fishing activities. The existence of relics is confirmed and the excavation begins. At present , the number of reports concerning such underwater relics since 1971 have come from about 239 sites and reports of relic discoveries reaches about 5 , 400.

Academic excavations in Korea started with the Shinan underwater excavation and in Wan-

do, has even excavated a celadon transport ship carrying ceramic ware. Then followed the Jindo excavation that dug up a wooden vessel, the Mokpo Dallido excavation that found a Goryeo vessel, the Shinan Anjwado, the Ansan Daebudo excavation as well as the Mu-an Doripo excavation that discovered a diverse array of celadons, the Gunsan Biando and the Sibidongpado excavations. Goryeo celadons were found also in Gunsan Yamido, Boryung Wonsando, Taean Mado, etc. Until now up to 2 foreign vessels and 8 Goryeo vessels as well as around 94,000 underwater relics were discovered from a total of 17 sites. Out of these locations, 13 were excavated by our research institute. In this paper, I would like to briefly introduce the achievements of Korean underwater excavation and its future prospects.

## **2. The Underwater Excavation Process**

Underwater excavations are divided into two groups in Korea—excavation and field surveys—and it's carried out by a professional institute or organization by registering to, and getting approval from, the Cultural Heritage Administration. As of now, the only organization that has approval from the Cultural Heritage Administration to carry out underwater excavations is our organization, the National Research Institute of Maritime Cultural Heritage.

We carry out our excavations completely autonomously. For exploring the sea area where the discovery took place, we use a diver. In the case that the sea area is too large, we use sonar and a Chirp Acoustic Profiler. When there is an irregular object found at the seabed, we send in a diver. When a relic is found through the exploration process, the underwater excavation process usually goes through a procedure in the order of 1) approaching the site, 2) installing a Grid, 3) excavation, 4) research around the broader site area, 5) writing the report and carrying out conservation procedures.

Especially in underwater stripping procedures in the excavation process we are using the vacuum suction, developed on our own in 2008, from the previous Air lift method. The air lift method had problems with the weight of the air lift head which weighed close to 100kg. This new method allows us to control the size of the head to fit our purposes and therefore avoid the problems that came with the air lift head. This way we are able to increase the efficiency and precision of the stripping procedures. Through this new method we were able to safely remove take care of the crops such as millet, rice seeds, and so on.



### 3. Underwater Results

The very beginning of the Korean underwater excavation enterprise was May of 1975 when a fisherman caught a few ceramics in his net while fishing in the coastal waters of Shinan. The fisherman reported the finding to the then responsible agency for such findings but they claimed that such a high quality Chinese ceramic could not possibly be salvaged from the sea and didn't pay much attention to the report, dismissing it as probably being an attempt to win a reward. Sometime after the incident there was a grave robbery and it was only after they had rounded up the smugglers that a legitimate excavation project was launched.

With the help of a Navy diver, the Shinan underwater excavation took place for a long period of time between 1976 to 1984 with about 10 attempts. The excavation yielded, with the boat itself, 20, 000 pieces of ancient Chinese (Song and Won Dynasty) ceramics, 28 tons of coins, and 1, 000 units of precious lumber- "red sandalwood" (紫檀木). Besides all of this, weights with the engraving of the Zhejiang, Qingyuan province (慶元路) helped us infer the out port location. In addition, we were also able to determine the original date of departure and destination of the vessel by looking at the mark "至治參年" (the era name of the Yuan Dynasty, 1323 A. D. ), a Japanese person's name, and tally on the cargo with an inspection mark with a Japanese name. By investigating the relics that were salvaged, we were able to discover that the Shinan vessel had started out of Yung-Pah port in China and was heading towards Kyushu Hakda port in Japan when it sank in the coast of Shinan. In addition, the Shinan excavation was able to shed light on the shipbuilding technology and the product itself of the middle ages, which were only accessible through educated guesses from historical records up until that point. It also unveiled the truth about East Asian maritime trade routes of the historical era.

The next hallmark excavation following the Shinan excavation was the Taeon excavation, also referred to as the "celadon found by the webfoot octopus." In May, 2007, a fisherman was fishing in the coast of TaeonIsland and noticed that a webfoot octopus he had caught was holding a celadon. He immediately reported it to the Taeon-Gun Agency. The webfoot octopus has the natural habit of holding onto shells in order to protect its eggs from harm during the Spring time. As it turns out, it had found the celadons scattered all over the seabed and was using them instead.

Once we got the report about the incident, we immediately initiated an excavation investi-

gation. It yielded 9 celadon works within 12 meters, give or take, underwater and we were also able to confirm ourselves that there were multitudes of celadons scattered along the seabed. Because the information about the incident and the site's location was made known to the media, there was a real danger of grave robbing and there was also a need to protect the relics from becoming damaged by fishing activities. As such, we took measures with the Cultural Heritage Administration to restrict the sea area as a protected area for cultural heritage and also forbid any fishing activities or underwater diving activities in the area.

The excavation took full force between July 2007 to June 2008. The excavation yielded 25,000 celadons and salvaged, with the cargo ship itself, a multitude of relics including wooden tablets, which were used as cargo tags. The celadons included the likes of large bowls, plates, cups, ink stones, and Buddhist plates used by monks. They are estimated to be from the middle of the 12th Century and its origins, by looking at the wooden tablets, were most probably the Gangjin region, a region that was very famous for its production of Goryeo Dynasty celadons. The recipient of these goods was someone in Gaegyung and was most likely a member of the Goryeo royal family or at least the aristocracy from the characteristics of the goods.

In recent times, the hotspot for underwater excavation has been the sea areas of Taeon Mado. Reports and discoveries of relics were very frequent in this region since the 1970s but the trigger was actually while the Taeon Island excavation was going on. A fisherman had over three times collected a total of 25 celadons and this became the catalyst for a new excavation project. The excavations did not yield anything in 2007 but we were able to find a concentrated burial site in 2008 containing Goryeo celadons and were able to salvage around 500 celadons. In order to protect the relics, they were designated as historical relics.

Following these excavations, we were able to salvage, including the Mado Vessel 1, crops, ceramics, and bamboo products. Especially noteworthy discoveries were wooden tablets and bamboo records that contained in them information about the shipments, the date of departure, the sender and recipient, the types of cargo, the amount, and so on. This was the first time that Goryeo period bamboo records were excavated from underwater.

The decoding revealed that it seemed the shipments, which included crops, ceramics, and salted seafoods, were placed on board from somewhere in the southern coastal areas of the Korean peninsula over the period of time between the winter of 1207 and the beginning of 1208 and was destined for a government personnel in Gaegyung when the ship sank in the coastal areas of Mado.

In 2010, we were able to salvage, along with the Mado Vessel 2, the shipment of 2 celadon vases (梅瓶), all kinds of ceramics, crops, wood and bamboo products, and wooden tablets with information including the types or cargo and its recipient. Especially noteworthy among the salvaged goods were the vases not only because of their incredible craftsmanship and elaborate form but because of the bamboo tags that were found with them. Through deciphering the tags, we were able to discover recognizable Goryeo names for pot (樽 or 盛樽) and honey (蜜), which told us that these were used as containers of these precious liquids. It was valuable evidence that allowed us to go one step further than the studies that were done until now that discovered that these were used as flower pots and as containers for alcoholic liquor.

In addition, Korean and Chinese ceramics from different time periods are also being salvaged in the regions in and around Mado. Korean ceramics range from 11th Century Goryeo celadons to 18th Century Chosun white porcelain. Chinese ceramics range from Song and Won Dynasty celadons, white porcelains, pottery, and so forth. Among some are Chinese characters. From the Ming Dynasty relics are 15th to 16th Century porcelain (青華白磁) from the southern parts of Fujian (福建省) and were exported quite a lot of Southeast Asia. From the Chung Dynasty were relics from the 18th Century, Jun-type (鈞窯系) goods including white porcelain (白磁鉢) and moon-white glazed bowl (白濁釉鉢).

From a long time, the Taean Mado maritime regions were the main sea routes from the southern coastal areas of the peninsula to the capital such as Gaegyung and Hanyang and had many marine transport vessels going through the passage. It was the main route for trilateral trade between Korea, China, and Japan. The tidal currents and the speed of the water in general was very high that it used to be called, “sea route of dizzily flowing currents.” (難行梁) As you can see from the name, the day and night difference between the ebb and flow were very severe and the currents were very fast, which led to frequent sinking of vessels. There are historical records which tell us that because of this reason, they even changed the name to “sea route of safety and prosperity (安興梁)” in hopes of better fortunes. Not only that, there were attempts both during the Goryeo and Chosun Dynasties to dig a canal for create a safer route. In addition, they established a visitor’s hall called “An-heung Jung (安興亭)” which served as a place for layovers for vessels carrying traders or envoys. Looking at the findings in this region that include ceramic ware from all kinds of nationalities, it proves to us without a doubt that the region was a central and key area for international trade.

## 4. The Future of Underwater Excavation

Even simply by looking at the ever-increasing amount of reports in relation to discoveries of relics, it would not be an exaggeration to say that the Korean coastal areas are a treasure house of underwater relics. However, the speed of the currents, the less than ideal line of sight, the impossibility of winter time excavations, and other such conditions make the underwater conditions a nightmare for excavation. In these conditions, state-of-the-art technologies for excavation projects are indispensable. Since 2008, we are using the Multibeam Echo-sounder, which allows us to look at the seabed in 3D and explore the sea bottom for underwater relics. We are also using a stripping system that uses a vacuum pump specially designed for our difficult underwater conditions and we are successfully and safely collecting relics.

Currently we are in the process of building an old vessel hardening treatment room and conservation building in order to ensure the safe conservation and management of the relics that are being salvaged in the Taean coastal areas. In addition, we are building a 290-ton ship specifically designed and constructed for underwater excavation, using a budget of 5 billion KRW. It will be introduced into the excavation sites beginning in July, 2011.

Underwater excavation has come a very long way. In the early stages, the lack of experience and personnel made it necessary for us to work in cooperation with the Navy but we continued to gain experience, gaining not only professional human resources and advanced equipment but also establishing a system for academic research. Since the Gunsan Biando excavation in 2002, we were able to rely solely on our own human resources to form underwater excavation teams and finally in March 2007 we were able to newly construct the nation's one and only institution specifically geared towards the purpose of underwater excavation, the underwater excavation division, and have been in charge of underwater excavations and conservation project of salvaged relics ever since. And finally, in addition, by changing the name from the "National Maritime Museum" to the "National Research Institute of Maritime Cultural Heritage," we are committed to not only salvaging relics and vessels under our waters but to the relationship between man and the sea, and the consequent cultural heritage, promising to continue to lead the way in re-writing the history of maritime culture.

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**Session 2    Presentation of Underwater  
Cultural Heritage and  
Technical Issues**

# Baiheliang Ancient Hydrologic Inscription

—No. 1 Ancient Hydrometric Station in the World and  
In-situ Underwater Protection Project

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**Abstract:** Baiheliang, a natural sandstone ridge, stands in the water of Yangtze River, north to Fuling town, Chongqing city. This sandstone ridge was named the Baiheliang (White Crane Rocky Ridge) since flocks of birds, especially cranes, used to perch on or fly over it in the ancient time. Baiheliang, whose top elevation is about 138m, has been submerged under water until the end of winter when the river is low-flow. On Baiheliang many inscriptions had been engraved in the ancient time, which recorded the water levels of 72 low-flow years of Yangtze River since the Tang Dynasty (763). Baiheliang inscriptions could be fairly claimed as the No. 1 well-preserved Ancient Hydrometric Station and the rare under-water inscription in the World. These inscriptions emerge from water once every three or five years. The Baiheliang inscription is the national-grade key cultural relic preservation unit. It is significantly valuable in science, history, art, etc. Unfortunately, Baiheliang ridge will be submerged into the water forever when the normal storage level of TGP's reservoir rises to the elevation of 175m. To preserve these underwater cultural relics really and integrally, the in-situ 'No-Pressure Vessel' protection scheme is proposed, which comprehends the multidiscipline techniques, such as the cultural relic, water conservancy, architecture, civil, navigation channel, submarine and special devises. By this protection scheme, the Baiheliang Ridge is preserved in-situ and could be visited in its intact state after the protection project is completed. The total construction area is 8433 square meters and the total investment is 0.19 billion RMB. The constructions of the Baiheliang in-situ protection project began on Feb. 13, 2003, fin-

ished and open on May 18, 2009. It is the only underwater museum that is constructed in the over-40-meter-deep water in the world. It provides a successful paradigm for the cultural relic in-situ protection under water, glorifying the great Three Gorge Project of China.

**Key words:** Baiheliang Inscription; Ancient Hydrometric Station; Three Gorges Project; Underwater in-situ protection for ancient cultural relics

## 1. Introduction to Ancient Hydrometric Inscription of Baiheliang

The No. 1 ancient hydrometric station of the world—— Baiheliang inscription stands in the water of the Yangtze River north to Fuling City, which is located at the reservoir area of the Grand Three Gorges Water Control Project. Since the Tang Dynasty (763), the Chinese people had been used to engrave the pattern of fish on the Baiheliang ridge to record the water level for each low-flow year in the last 1200 years. For flocks of birds, especially white crane, used to perch on or fly over this ridge in the ancient time, this ridge was called Baiheliang (White Crane Ridge).

The Baiheliang stands in the main channel of the Yangtze River, in the section of Fuling town, Chongqing City, 1 kilometer away from the join of Wujiang River and Yangtze River. It is a natural stone ridge with length 1600m and width 25m, stretching along the west-east direction and parallel to the Yangtze river. The elevation of ridge top is 138 meters; about 30 meters lower than the highest flood level of Yangtze River. Baiheliang consists of three sections, i. e. . the west, the middle and the east section. The inscriptions were engraved on the 220m-long middle part, especially on the east 65m-long area of the middle part.

The surface of Baiheliang Ridge is formed with a smooth thin layer of light color sandstone, which is quite suitable for engraving. It inclines with a gentle angle of  $14.5^{\circ}$  towards the main channel of Yangtze River. According to the incomplete statistics, the inscription falls into 165 paragraphs and has total over 30000 characters, among which one paragraph is from Tang Dynasty, 98 Song Dynasty, five Yuan Dynasty, 16 Ming Dynasty, 24 Qing Dynasty, 14 Modern Time and seven whose time were not clear. There are 18 fish engraved on the stone ridge, among which one is engraved in the 3D relievo, two in bas-relief and 15 in plane line relievo. Moreover, there are also one white crane sculpture and three status of Bodhisattva.

These inscription and relievo locate at different places. They usually submerge under water in winter and only emerge from water in the quite low-flow winter. According to the statis-



tics, they emerge one time every 3 ~ 5 years. In ancient times people engraved fishes on the stone to indicate the water level. The emerged fishes on the stone used to harbinger a harvest year. For generations and generations in the ancient time, people recorded on the stone the exact time of the fishes emerging from the water, the name of the observers, and the distance between the fish marks and the water surface. They even wrote and engraved articles and poems on the stone which told about the grand occasions when people cheered the fish marks' emergence.

## 2. Location of Baiheliang Ridge

The Baiheliang ancient hydrological inscription is located at the reservoir area of Grand Three Gorges Water Control Project (TGP). Fig. 1 shows the relative locations of TGP, Fuling and Baiheliang ridge. Fuling Town is located at the merging join of Wujiang River to Yangtze River, which has been the important port city of East-Sichuang basin and the biggest exchange center of goods in the Wujiang basin. In Fuling City live the Han, Tujia, Miao, Hui and Mongu nationality people, which have a long history. There are over 2000 cultural relics in reservoir area of TGP, among which the Baiheliang Inscription is the most famous. Baiheliang Inscription is also the earliest national-grade key cultural relic preservation unit in the res-

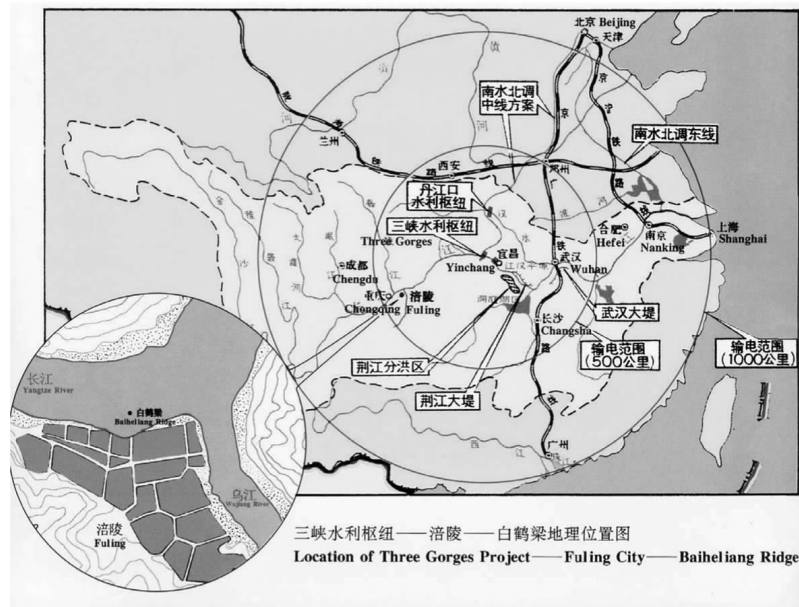


Fig. 1 The relative locations of TGP, Fuling and Baiheliang ridge

ervoir area which will be submerged. The location of Baiheliang ridge and the situation of Yangtze River at Fuling City are shown in Fig. 2. The Baiheliang ridge is immediate to the deep-water channel of Yangtze River. Fig. 3 is the Baiheliang Ridge viewed towards south at the north area of Fuling City. Fig. 4 shows a certain local view of Baiheliang inscription.

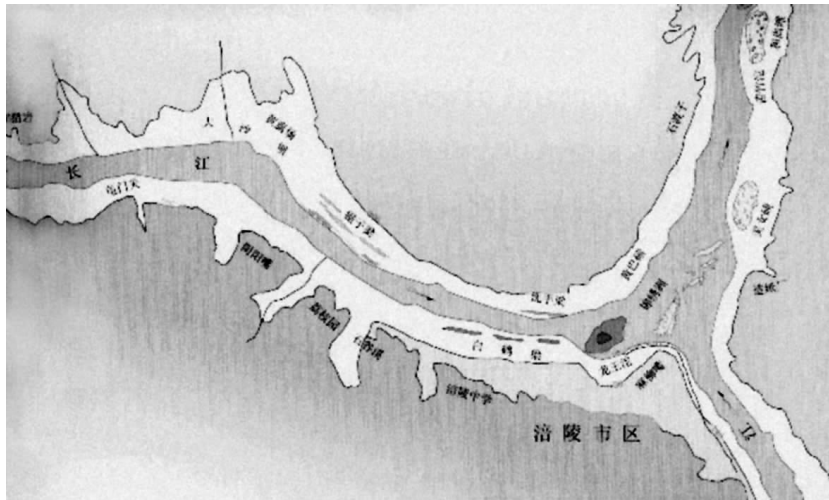


Fig. 2 The location of Baiheliang ridge and the situation of Yangtze River at Fuling City



Fig. 3 The Baiheliang ridge is immediate to the deep-water channel of Yangtze River



Fig. 4 The local Baiheliang Inscription

### 3. Scientific Value of Baiheliang Inscription

The rocky fishes engraved on Baiheliang ridge were actually used to record the lowest-flow level of Yangtze River in the ancient time. It provides extremely valuable physical references for studying the variation rules of global and local climate and the hydrology of Yangtze River in history. Before Tang Dynasty (763), there had been two fish carvings. But now only one remains. It is 60 centimeter long and two characters “石鱼” (Rocky Fish) in Li Script were carved on it. The exact engraving time remains to be investigated though it is proven that they were engraved before A. D. 763. The governor of Fuling engraved the couple carp fish to replace that fish engraved in Tang Dynasty in the 24th year of Emperor Kangxi of Qing Dynasty. According to investigation, the elevation of the eyes of Double Fish is equal to that of the zero-point-water-level of the local Chuanjiang navigation channel and the elevation of Tang Fish paunch equal to the average elevation of low-flow levels of all years recorded by hydrometric station in Fuling City.

Baiheliang inscriptions have recorded the water levels of 72 low-flow years in history, which are handed down to us with extremely valuable hydrologic data. Fig. 5 shows the rarest stonefish. The ancient hydrologic data suggests that the lowest-flow of Yangtze River during the 1200 years occurred in Song Dynasty (1140), which was suggested by the inscription “水去

鱼下十尺”（Water level was ten chi below the stonefish）in that time.

The hydrologic data mentioned above are of significant scientific importance for the comprehensive development of Yangtze River basin, inland navigation, field irrigation, bridge construction, urban water supply, etc. Both Gezhouba Hydroelectric Power Station and Grand Three Gorges Water Control Project consulted the above hydrologic data in their design stage. In the international conference of hydrology organized by UNESCO in Paris in 1974, the representative of China introduced the Baiheliang Ridge（Ancient Hydrometric Station）, which greatly interested the specialists and scholars. So, we can say that the Baiheliang is the earliest-found, the longest-spanning and the most abundant hydrologic inscriptions for the low-flow water level records. There are also the similar hydrometric inscriptions in Nile in Egypt, but the quantities and the spanning-time are much less than that of Baiheliang.



Fig. 5 Stone fish

#### 4. Historical and Artistic Value of Baiheliang Inscription

Since the Tang Dynasty, the achieved scholars, officials and merchants from different dynasties visited to Baiheliang Ridge and engraved poems on the ridge, among whom are 300 famous figures including Huang Tingjian, Zhu Ang, Qin Jiushao, Liu Jia, Huang Shou, Wang Shizhen, and Gong Wu. The calligraphies were engraved in various type fonts and different styles. Some of them were written in Mongolian. Among these inscriptions, that by Huang Tingjian, the great litterateur of Song Dynasty, is the most famous. The inscription is “元符庚辰涪翁来”（Huang Tingjian visited in A. D. 1100）, few words but impressive, shown in Fig. 6. Fig. 7 shows the carving fish, modeled on a wooden fish, which was made in 1333, Yuan Dynasty. The official of Fuling town, Zhang Badai, engraved on it. Fig. 8

shows the stonefish and the inscription (140cm × 47cm) by Dong Weiqi in the 45th year of Emperor Kangxi, Qing Dynasty. Fig. 9 shows the 280-centimeter-long fish relievo by Shifan Zhang in the 20th year of Emperor Jiaqing (1815). Fig. 10 shows the inscription (97cm × 47cm) by Sun Hai in the 7th year of Emperor Guangxu (1881), which is vivid, elegant and majestic. Fig. 11 shows the mother Bodhisattva engraved on the ridge. Fig. 12 shows the Chirping White Crane.

Baiheliang is an underwater wonder and deserves the name Collection of Stone Inscriptions for the large amount of stone inscription, long history, detailed records of hydrological data, rich content of inscription, wonderful forms and merging into an organic whole with Yangtze River and circumstance.



Fig. 6



Fig. 7

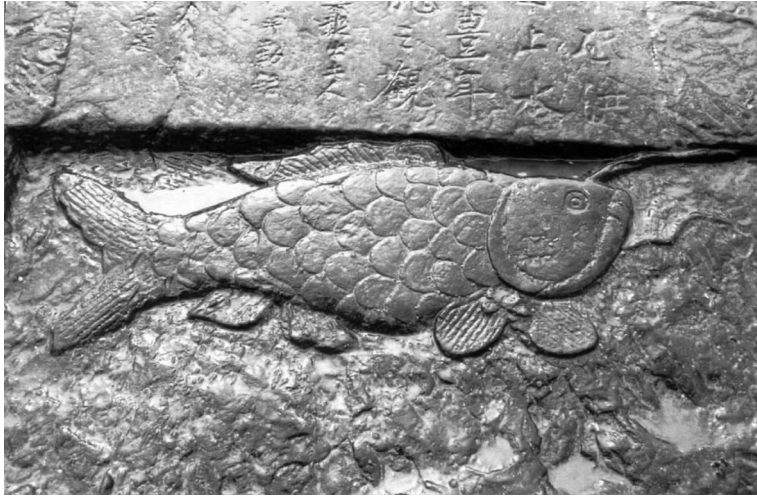


Fig. 8 Stonefish and inscription by Dong Weiqi



Fig. 9 Fish relief by Zhang Shifan in the 20th year of the reign of Emperor Jiaqing in Qing Dynasty (1815)



Fig. 10 Inscription by Sun Hai in the 7th year of the reign of Emperor Guangxu (1881)



Fig. 11 Inscription of Mother Bodhisattva



Fig. 12 Inscription of Chirping White Crane

## 5. The Three-Gorge-Project and the Ancient Hydrometric Inscription of Baiheliang

The construction of Ground Three Gorges Water Control Project began in 1992 and completed in 2009, lasting 17 years. TGP is the mostmagnificent hydropower station, with double five-grade ship lock. The reservoir of TGP is 600 kilometer long, the tailing water reaching the Chongqing City. Fig. 13 illustrates the back water of TGP. From Fig. 13, it is seen that the Baiheliang is located at the bottom of reservoir near Fuling town. Therefore, the Baieliang will be submerged under water forever. According to the scientific experiment, the Baiheliang inscription will be submerged in the silt of reservoir bottom in about thirty years after the TGP is constructed.

The present paper only makes a brief introduction to the TGP of China. Fig. 14 is the birds-eye view of TGP. The profile of the spillway dam of TGP shown in Fig. 15. The hydro-power station of TGP consists of three parts, i. e. . the left behind-dam power station (14 power units), right behind-dam power station (12 power units) and the underground power

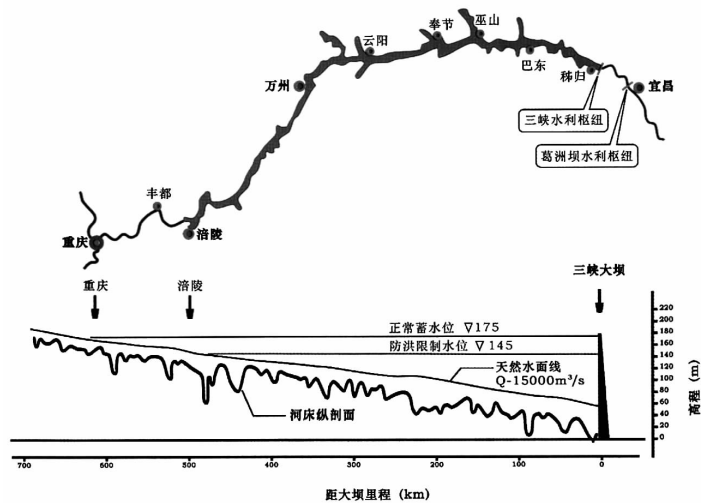


Fig. 13 Illustration of back water in TGP reservoir

station (6 power units). Fig. 16 shows the profile of behind-dam power station. The total capacity is 22400MW. The TGP has a double five-grade ship lock, which ensures that the 5000 ton ship can directly reach Chongqing City. Fig. 17 and Fig. 18 respectively shows the profile of ship lock and the running conditions. The adjustable capacity of TGP reservoir is 33 billion cubic meters, which can ensure the safety of cities along the lower reaches of Yangtze River in case of flood which happens once in one hundred year. The length of TGP reservoir is 600 kilometer and the submerging area is shown in Fig. 19.



Fig. 14 The birds-eye view of TGP



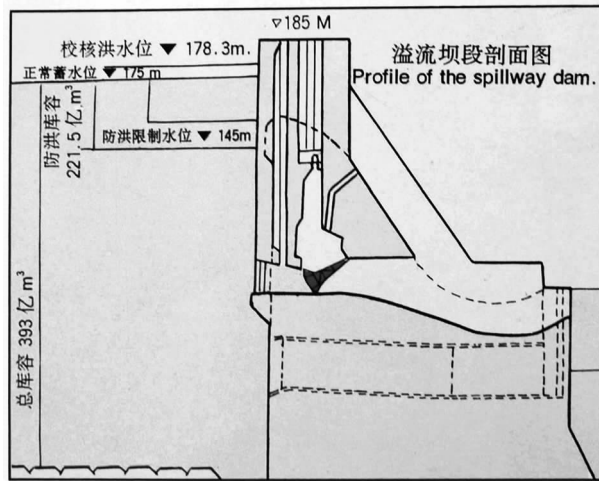


Fig. 15 The profile of spillway dam

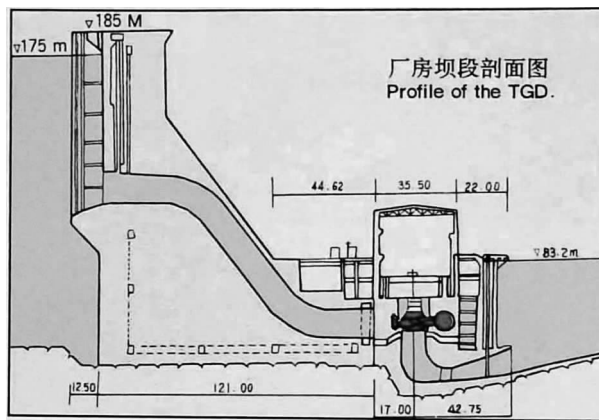


Fig. 16 The profile of behind-dam power station

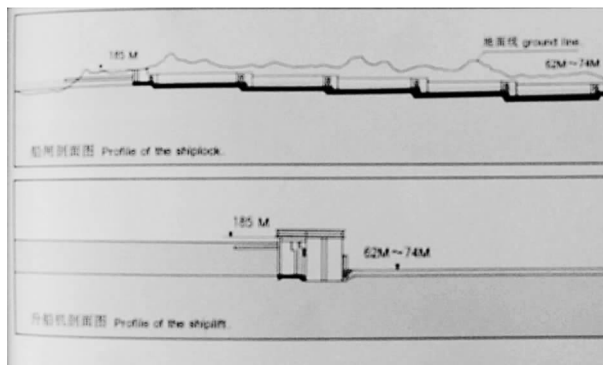


Fig. 17 The profile of ship lock and ship lift



Fig. 18 Ship lock picture

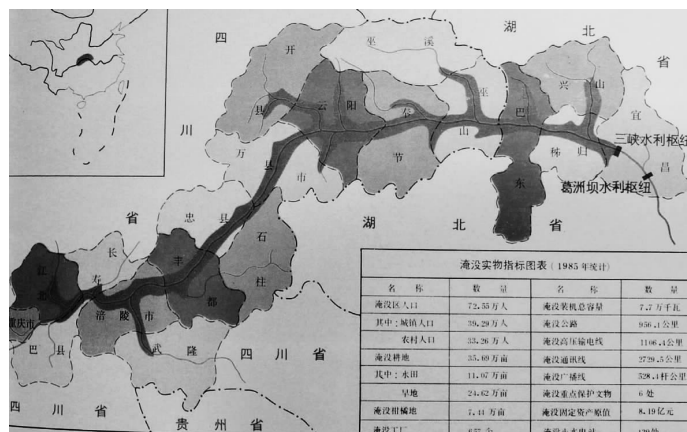


Fig. 19 Illustration of submerged area of TGP's reservoir

## 6. The Proposed Schemes for Baiheliang Protection in Recent Years and Some Comments

Since 1994, many major studies on Baiheliang protection have been organized by the competent government department. For the purpose of saving space, only two typical protection schemes are briefly introduced in this paper.

The first one is the “Crystal Palace” scheme proposed by Tianjin University. It suggested

that the inscription should be protected by a shell. Fig. 20 shows the Crystal Palace scheme. This shell is a double deck (dome) arch shell 20m × 120m, which is made of reinforced concrete. The grouting curtain is adopted along the foundation to prevent water seepage, leaking-off and to protect foundation rock. An underwater tunnel is built. The feature of this scheme is that people can directly enter the underwater shell to see the ancient inscription. But this shell structure will bear 40 meter water-head pressure; it is actually a pressure vessel.

The shell structure is big, so the load applied on it is big. Certain damage on the shell structure can lead to a sudden collapse during construction. Once it is the case, no one can escape from it. When this “Crystal Palace” is put into use, the impact from ship on shell or the heavy object drop can also make damage on the shell structure to collapse. Once this happened, the visitors under this shell structure have no chance to escape.

Moreover, the building of grouting curtain might damage the Baiheliang inscription for these inscriptions are engraved in a thin sandstone layer. Even the curtain grouting were built, the water will seepage through the layered rock mass due to the big difference of water pressure, which will make damage to shell structure upmostly.

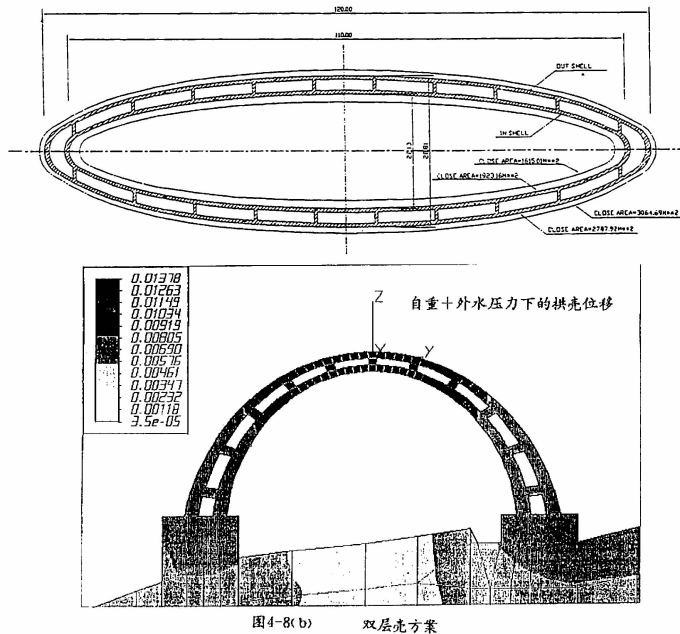


Fig. 20 Illustration of ‘Crystal Palace’ Scheme

The reason that Baiheliang inscription could be preserved well during more than 1000 years is that it has been submerged into water of Yangtze River and exposed into the air in few

time. If the ‘crystal Palace’ were implemented, these inscriptions would be exposed into air in long term and will be damaged due to rock weathering. Additionally, due to the long period of building, expensive cost and serious influence on navigation, the ‘Crystal Palace’ scheme was completely denied in 1998 after investigations. It gave such impression that underwater in-situ protection of Baiheliang inscription seemed to be nearly impossible!

The second scheme could be briefed as ‘protected in-situ, but displayed out-situ’. The so-called in-situ protection in this scheme is actually in-situ buried. That means the most suitable approach to protecting these inscriptions is to bury them with silt subjected to the current technique and economic situations. These inscriptions could be excavated and presented to people when the economy and technique are developed enough after one or two hundred years in our country. Another part of this scheme is to duplicate the Baiheliang inscription with 1:1 scale using the model material and display them in a museum on the bank. This protection scheme must have a serious negative influence on the historical relic protection of our country and the Three-Gorge-Project. Moreover, whether these inscriptions are still safe during so long-term bury is still suspended. Additionally, this protection scheme is not conforming to the principles of historical cultural relic protection. Because at that time no other better protection schemes were proposed in many national congresses and the time was tight for the reservoir of TGP was going to storage water, the Examination and Appraisal Meeting seemed to approve

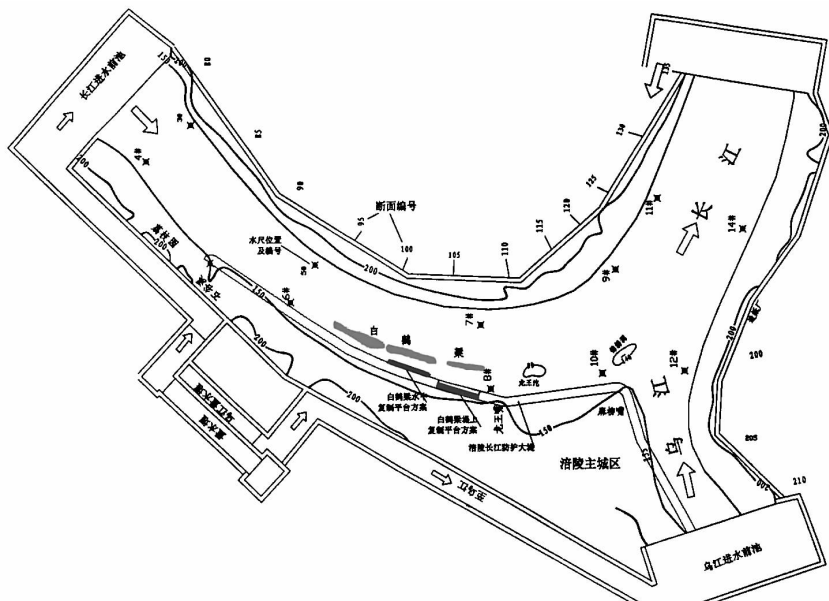


Fig. 21 The museum for the duplication of Baiheliang ridge on the river bank

this scheme ahead and some relevant design work had been asked to process in February of 2001.

## **7. Proposing a New Innovative Scheme – no-pressure Container Scheme for Protecting Baiheliang Inscriptions**

The author attended the Fuling meeting very occasionally in Feb. 2001. It was the first time for us to attend the Baiheliang's protection meeting. When we learned various protection schemes and their evolutions. The author did not agree with the scheme which would be adopted by the meeting. After meeting at day, we considered whether the new scheme could be better to protect the Baiheliang inscriptions or not at night. A new scheme gradually was formed. When the meeting nearly closed, approved by the meeting organizers, the author took presentation for half an hour, proposed a new in-situ underwater protection project based on the concept of no-pressure container after passing the scheme of cover by soil in situ, exhibition of the copy for Baiheliang at another place. It is fortunate that the scheme of no-pressure container was unanimously agreed by all the committees, who suggested the relative responsible departments should carefully study and consider the new scheme.

Explanation in simple: The no-pressure container does not mean that it has no pressure in container, but the pressure outside underwater protection body is the same or basically the same as that inside it with a little difference. So the technical difficulties of damage failure, seepage damage, grouting curtain and so on are avoided. That is to say, water pressure inside protection body synchronously changes with that of the Yangtze River outside it. However, according to the progress of the Three Gorges Project, the underwater protection project must be completed before the flood season in 2006. Otherwise, it was not of possibility. It seemed too late in February 2001, although they all agreed with no-pressure container scheme.

Therefore, the author wrote the letter to present the mechanism of no-pressure container scheme to Premier Zhu Rongji on March 23rd, 2001, in order to obtain the support by national leaders. At the same time, the suggestions by Chinese Academy of Engineering were submitted to the state council. At last a feasibility study on the scheme of no-pressure container was admitted to carry on by national authorities in August 2001.

## **8. Formation, Approval and Construction of the No-pressure Container Scheme for the in-situ Underwater Protection Project for Baiheliang Ancient Hydrometric Inscriptions**

In Sept. 2001 approved by State council Three Gorges project construction committee office, National historical relic bureau and Chongqing government, coordinating with Changjiang institute of survey, planning, design and research, the author was in charge of writing feasibility research report which was completed for three months. On March 2002, engineering design was carried on at once after the revision of feasibility research report was approved by the concerned leading departments. Changjiang institute of survey, planning, design and research was in charge of design, where the author was a consultant of the project in the institute and investor. Because of complexity of the project, the nine special subjects were studied by the Institute of Rock & Soil Mechanics, Wuhan, China, Chinese Academy of Sciences, the Institute of Geotechnical Engineering, Shanghai Jiao Tong University, The forth investigation and design institute of China railway, Wuchang shipbuilding industry company Ltd., Huazhong university of science and technology, Wuhan University, Chongqing institute southwest hydrology science, Chongqing Jiao tong College and so on. The topics of special subjects were as follows: (1) Influence of the in-situ underwater protection project for Baiheliang ancient hydrometric inscriptions (hereafter the 'underwater protection project') on flow pattern and trend by tests; (2) Three dimensional nonlinear structure analysis on the Underwater Protection Project; (3) Underwater traffic gallery (immersed tube method); (4) Visiting gallery design of the underwater protection project; (5) Underwater lighting and CCD remote controlled observation system; (6) Pressure balance between inside and outside underwater project, circulate water system of filtration; (7) Safety and health monitoring system of the Underwater Protection Project; (8) Research on construction methods of the Underwater Protection Project; (9) Research on channel and navigation. The total design was completed by the end of Oct. 2002. The engineering design and budget were approved by the concerned state department on 2002. In 13th Feb. 2003, the in-situ Underwater Protection Project for Baiheliang was started to construct. ( See Fig. 22).

Particularly the principal part of the underwater protection project was completed during the low-flow season from Nov. 2004 to April 2005, which was a basis for the whole project.



Fig. 22 Start of the in-situ underwater protection project for Baiheliang

## 9. The Basic contents of the in-situ Underwater Protection Project for Baiheliang Ancient Hydrometric Inscriptions

The basic concepts of the no-pressure container in the in-situ underwater protection project are as follows:

- Water table of reservoir was basically the same as that of the container in the underwater protection project.
- From 1200 years history it was shown that water in Yangtze River is of good quality, which is a best medium to protect Baiheliang. But water of the Yangtze River should be filtered to avoid silting and make water transparent, which is good for visitors' viewing on inscriptions.
- The underwater protection project is built on the above 65m long area in east of middle section of Baiheliang where the most of main inscriptions are distributed.
- Inscriptions of Baiheliang are surrounded by ellipse-shaped reinforced concrete guide wall of 3.5m in thickness in plane. The sections of more inscriptions distributed are protected by guide wall and dome. (See Fig. 23)
- Guide wall is covered by the strong reinforced concrete dome shell of 1m in thickness, in which internal mold without removing are formed of stainless steel composite boards.
- The serious accident can not occur because of no-pressure characteristics of the container. The principal part of the project with low cost and short construction period can be restored.

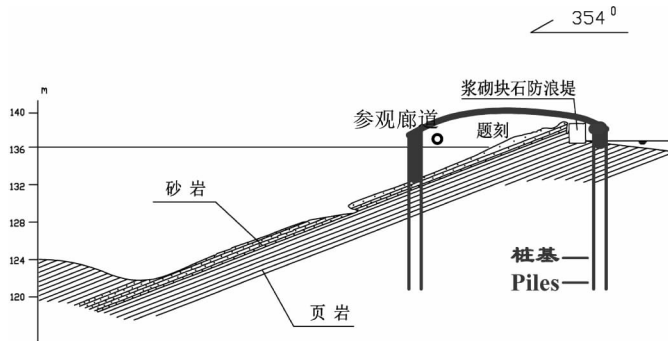


Fig. 23 A profile of engineering geology

- The visitors can go into the museum on the shore, pass through slope and horizontal traffic galleries of high pressure, enter the visiting steel gallery inside protection shell, and watch Baiheliang ancient inscriptions from observation window at any time. Fig. 24 was shown that condition of low-flow season in 2006.

- There are underwater lighting system of high power LED and advanced camera devices. Visitors can observe Baiheliang inscriptions from glass windows by handling the remote device inside visiting gallery (It can bear pressure of 60m water level according to submarine design).

- Exit of frogman is established, special visitors can watch inscriptions guided by frogman.



Fig. 24 Scheme of the in-situ underwater protection project in Fuling



- Based on the planning, the principal underwater part of project can be completed in three low-flow seasons, corresponding to the progress of water storage in Three Gorges Project. It is not serious to hinder navigation during construction.

- Compared with the scheme of crystal palace, it costs lower.

From the above mentioned, there are some principles to be abided by Baiheliang In-situ underwater protection project as follows

Keeping the cultural relics in their original state, corresponding to international principle of protection cultural relics.

Principle of protecting important relics. The underwater protection project is built on the above 65m long area in east of middle section of Baiheliang, where the most of main inscriptions are distributed.

Principle of easy watching for visitors except protection.

Principle of feasible implementing.

Principle of engineering integrity.

Principle of sustainable development.

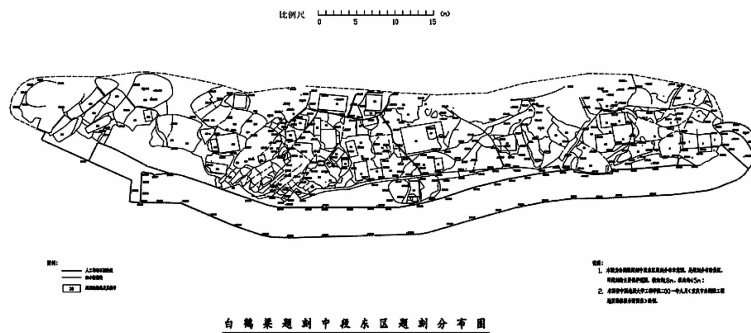


Fig. 25 Distribution map of inscriptions in east of middle section of Baiheliang

## 10. Construction of the Principal Part of Underwater Protection Project

It is a key to successfully complete main principal part of underwater protection project. Elliptical guide wall, next to deep water channel with high flow velocity, is located on the slope, so the whole rigid mold are adopted, underwater concrete are needed. Construction of 3.5m thick guide wall in the protection structure is shown in Fig. 27, transporting condition of embedded pipe joints in Fig. 28, completion state of guide wall in Fig. 29, cofferdam con-

struction is shown in Fig. 30. The state of approaching completion of cofferdam is shown in Fig. 31. Successful close cofferdam created favorable conditions for follow-up construction by dry method. Construction field after closing cofferdam is shown in Fig. 32. Construction of the horizontal traffic gallery at up and downstream is shown in Fig. 33 ~ 36, and construction of the slope traffic gallery is shown in Fig. 37 ~ 40. The approaching completion night scene of horizontal and slope traffic galleries are shown in Fig. 41. Visiting galleries are key metal structures in underwater protection project, which are formed of circle steel structure pipes with 3.2m in diameter, 28mm in thickness, which can bear more than 40m water-head pressure, which are designed and constructed according to submarine standard totally.



Fig. 26 Rigid mold



Fig. 27 Construction of 3.5m thick guide wall in the protection structure



Fig. 28 Transport of embedded pipe joints



Fig. 29 Completion state of the guide wall



Fig. 30 Cofferdam construction



Fig. 31 Approaching completion of the cofferdam



Fig. 32 Construction field after closing cofferdam

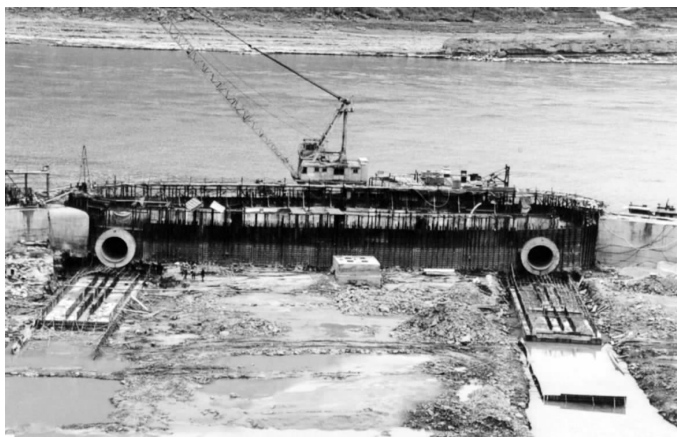


Fig. 33 Construction of the horizontal traffic gallery at up and downstream (1)



Fig. 34 Construction of the horizontal traffic gallery at up and downstream ( II )



Fig. 35 Construction of the horizontal traffic gallery at up and downstream ( III )



Fig. 36 Construction of the horizontal traffic gallery at up and downstream ( IV )



Fig. 37 Construction of the slope traffic gallery (I)



Fig. 38 Construction of the slope traffic gallery (II)



Fig. 39 Construction of the slope traffic gallery (III)



Fig. 40 Construction of the slope traffic gallery (IV)



Fig. 41 The night scene when approaching completion of horizontal and slope traffic galleries

Fig. 42 is a section of visiting gallery loading manufactured by Chengdu chemical pressure vessel plant from Chengdu. In this section five round cylinders in pipe are observation windows with double glass, which is resin glass with 800mm in diameter, 82 mm in thickness (Fig. 43). The whole visiting gallery is constituted of seven pipes with 23 observation windows. A lifesaving spherical storehouse (Fig. 44), an equipment spherical storehouse and seven pipes are hoisted and installed inside cavity of guide wall. The maximum weight of pipe is up to 45t. Every pipe is accurately oriented and welded without water. All welds are strictly inspected by many methods, must be 100% qualified. Fig. 45 through Fig. 47 show visiting galleries assembled and welded are installed in the protection shell cavities, shown in Fig. 45 through 47. Fig. 48 and Fig. 49 show installation of steel frame in dome and steel meshes of re-

inforced concrete dome. A tunnel-type escalator is installed in up and downstream, slope traffic gallery (Fig. 50). The scene submerged by the Yangtze River after construction of the principal part of the underwater protection project is shown in Fig. 51.



Fig. 42 A section of visiting gallery loading from Chengdu

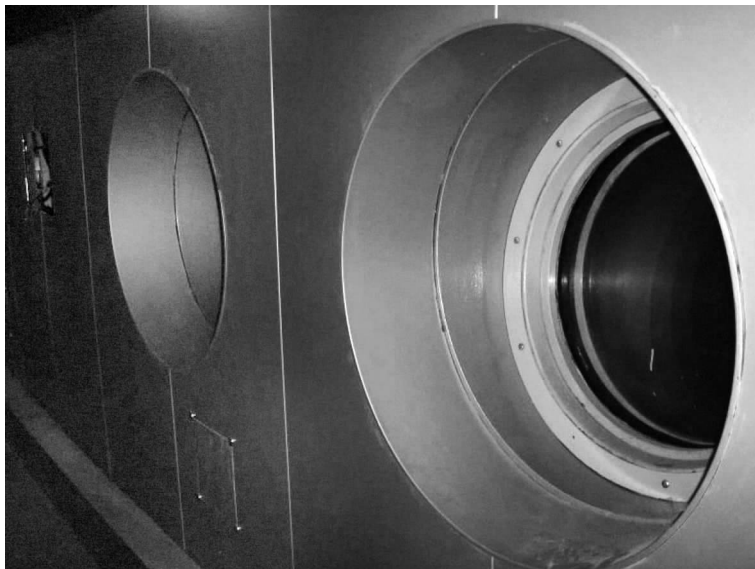


Fig. 43 Observation window





Fig. 44 A lifesaving spherical storehouse and equipment spherical storehouse



Fig. 45 Visiting gallery installed in the protection shell cavity (I)



Fig. 46 Visiting gallery installed in the protection shell cavity (II)



Fig. 47 Visiting gallery installed in the protection shell cavities (III)



Fig. 48 Steel frame in dome



Fig. 49 Steel meshes of reinforced concrete in dome



Fig. 50 A tunnel-type escalator



Fig. 51 The scene submerged by the Yangtze River after construction of the principal part of the underwater protection project

There are eight systems in the underwater protection project as follows:

Circulating water system —— ensure small difference of hydraulic pressure between inside and outside of protection body to meet design requirement, filter suspended matter to make water clear as city water, automatically replace water body in a certain period.

Underwater lighting system —— 108 sets of high power LED lamps and lanterns with maximum power of 63w.

Underwater camera system —— 28 sets of underwater camera devices of automatic track-

ing for the target, which can be used by visitors to watch the words clearly.

Fire control system.

Lifesaving system and high pressure gas supplement system.

Air-conditioning and ventilation system in visiting gallery and traffic gallery.

Low power lighting system inside protection body.

Health diagnosis system inside protection body.

## 11. Exhibition Hall on the Shore

The exhibition hall is built on the flood fighting dike in Fuling city to save land. The effect figure of the exhibition hall is shown in Fig. 52, its bird's eye view in Fig. 53. Due to limited space, exhibition hall in detail is not introduced in paper.



Fig. 52 The effect figure of the exhibition hall on the shore



Fig. 53 Bird's eye view of the exhibition hall on the shore

## 12. Strong Influence of the Underwater Protection Project on Societies

The project is concerned by national persons, and reported by various media. Two examples are as follows.

In recent years a text in the language textbooks of national compulsory education standards is named by ‘ups and downs of Baiheliang’ at the next term of sixth grades, which introduces the scientific, humanism and artistic values of Baiheliang inscriptions, and the scheme of no-pressure container. The cover and directory of the textbook are shown in Fig. 54 and Fig. 55. Up to now about 100 millions school boys and girls have learned ‘ups and downs of Baiheliang’ in China.

The second question in the 2004 national college entrance exam of language (12 points, the three points) was reading comprehension of the paragraph which took Baiheliang as a topic.



Fig. 54 The cover of the textbook

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Fig. 55 The directory of the textbook

## 13. Conclusions

The ancient hydrometric inscriptions of Baiheliang are the excellent representatives of Chinese ancient civilization and scientific achievements, matchless in the world, and underwater tablet forests of Baiheliang are pearls of Chinese culture. The great Three Gorges Project's construction makes them on the bottom of the Three Gorges reservoir. So it is necessary to protect

them by scientific method. The completion of the underwater protection project will be a good example for our cultural relics protection and the Three Gorges Project.

Because the ancient hydrometric station takes the stone fish as an indicator, it is not advisable to resettle them from bedrock and bury them in situ.

The principle of in-situ underwater protection is correct, based on the concept of no-pressure container.

'No-pressure container' concept overcomes the technical difficulties of mechanics, structure and rock & soil mechanics. It is feasible and reasonable.

Scientific innovation is our soul of scientific research, which is a guideline of the underwater protection project of no-pressure container scheme.

The underwater protection project is supported by the all levels leaders and lots of persons. The proceed of adopting no-pressure container scheme shows that the party and the government pay more attention to cultural relics protection and scientific suggestions, which are adopted (Quoted from Lu Y. X., vice chairman of China National Congress).

### ***Acknowledgement***

Thanks persons who have paid out effort for protecting Baiheliang whether their schemes suggested are adopted or not.

The project is supported by The State Council Three Gorges Project Construction Committee, National Cultural Relic Bureau, Chongqing People's Government, Chinese Academy of Engineering, Chinese Academy of Sciences, China Three Gorges Corporation, Shanghai Jiao Tong University, and Institute of Rock & Soil Mechanics, Wuhan, China, Chinese Academy of Sciences.

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# Interpreting and Displaying the *Mary Rose* to the Public in a New Museum

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## 1. Introduction

The *Mary Rose* was a purpose-built warship and had a successful career until she capsized and sank in a battle against a French invasion force in 1545. The hull and her contents were excavated during the 1970s and 1980s and the *Mary Rose* was raised in 1982 and placed in a temporary museum. Thirty years later a permanent museum is being built for the *Mary Rose*. This paper attempts to give a brief background to the project and describes how we wish to display the hull and contents of the *Mary Rose* in the new museum in a way that will bring ancient aspects of our culture to life.

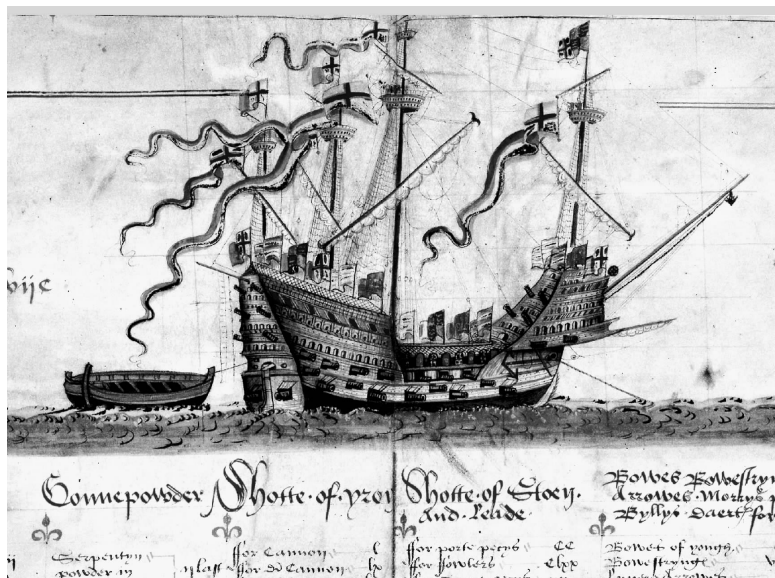
## 2. Background History

The famous English king, Henry VIII, ordered the building of the *Mary Rose* soon after he came to the throne in 1509. It was a revolutionary warship and was one of the first to have lidded gun ports cut into the side of the hull so that heavy guns could be positioned low down in the hull, closer to the water line (figure 1). She served the King well for almost the whole of his reign but sadly he witnessed the sinking in July 1545 just 2000m from Southsea Castle on the south coast of England. There are many theories about why the ship sank, but the most likely explanation is that it was a combination of factors including some overloading, some human error, the battle itself and a gust of wind tipping her over. The best account of the sinking came from an eyewitness who said that they had fired the guns on one side and were turning

to fire the guns on the other side when a gust of wind made the ship heel over and plunged the open gunports under the water. This flooded and sank the ship as they had not closed the gun ports. It was a great tragedy and over 500 men lost their lives. Attempts were made to salvage the ship in 1545 but it could not be raised from the seabed and only some of the guns and rigging were recovered (Childs 2007). The *Mary Rose* was then left to rot on the seabed. Luckily, silt built up both inside and around the wreck so that half the ship was eventually completely covered and was thus protected from further damage in an oxygen-free environment.

### 3. Modern History

Apart from a brief period in the 1830s when early pioneer divers rediscovered the ship, she was left alone until 1965 when an English historian called Alexander McKee started a search for ancient ships in this area of the coast (McKee 1982). The first timbers were revealed from beneath the seabed in 1971. Between then and 1978, excavations around the hull showed how much of the ship had survived beneath the protective mud. In early 1979, two meetings were held with all the appropriate experts. One meeting was to decide whether the *Mary Rose* should be excavated and raised from the seabed and the other meeting was to decide whether the *Mary Rose* could be excavated and raised. As the answers from the experts to both of these questions was 'yes', a charitable foundation called the Mary Rose Trust was formed





with the following aims: ‘to find, record, excavate, raise, bring ashore, publish, report on, preserve and display for all time in Portsmouth the *Mary Rose* ; all for the education and benefit of the nation’. Over the last 30 years the Mary Rose Trust has been achieving these aims and the current tasks are to finish the conservation process and build a permanent museum in which to display the *Mary Rose* for all time.

#### 4. Excavation

Between 1979 and 1982, the main excavation of the *Mary Rose* was carried out. Up to 50 divers each day worked in shifts to carry out the work and by the end of the project over 500 divers had helped with the excavation. A total of 28, 000 dives was carried out in this period totalling over 23, 000 hours work on the seabed (Rule 1983; Marsden 2003). Many new techniques were perfected (figure 2) and the excavation was very important for raising public awareness of maritime archaeology and for changing attitudes to the underwater cultural heritage, making people realise that it should be preserved for everybody rather than salvaged for profit.



This author is in no doubt that the Nan Hai 1 excavation will eventually surpass that of the *Mary Rose* both in numerical terms, and in the quality of the result; for it will be possible to excavate that ship in excellent controlled conditions inside the new Maritime Silk Road Museum at Yangjiang. However, the team may benefit if they can learn from both the mistakes and triumphs of the *Mary Rose* excavation, just as the *Mary Rose* benefited from the earlier excavation of the *Vasa* in Stockholm, Sweden.

## 5. The Salvage

Just as the *Mary Rose* excavation pioneered new techniques for archaeology underwater, so to did the raising of the hull pioneer new techniques for the salvage of ancient vessels. One particular problem was that only half the hull had survived so that the ship itself had little structural strength even though most timbers were still extremely solid. This meant that the classic salvage method of lifting a hull on strops positioned under the hull could not be used. Instead, the lift was done by clamping the hull with 170 bolts and wiring 67 of these up to a lifting frame. The raising was done in 3 phases. Firstly, a series of jacks were used for the initial lift of a few centimetres; then the hull was transferred underwater, suspended from a lifting frame into a cradle built to the shape of the hull. Finally the whole package was lifted into air (figure 3) and the cradle placed on a barge for towing back into Portsmouth (Dobbs 1995).



It is interesting to compare the approaches used by the major projects of maritime archaeology over the last 50 years. Whilst the *Vasa* was salvaged complete with her contents using

more traditional techniques and then excavated ashore, the *Mary Rose* was excavated underwater *in situ* and then raised when empty and placed in the museum. Other ships have been taken apart underwater and then reassembled ashore. In contrast, the Nan Hai No 1 was raised complete with its contents so that it can be excavated underwater but in controlled conditions in the vast pool built in the museum at Yangjiang. I am confident that this could result in an excavation to even higher standards as there need not be the time constraints imposed on the earlier projects. That method was not available to the *Mary Rose* as it requires all the technology, expertise and significant funding to be available at the start of the project and maritime archaeology was at its infancy at the time the *Mary Rose* was discovered and excavated.

## 6. The Collection

Although it is the hull of the *Mary Rose* that initially attracts visitors, it is the extraordinary collection of objects that were found inside it that really brings history to life. One advantage of underwater archaeology is that a different range of materials survive when compared to sites on land. Although metals do not survive so well in the underwater environment, we do get the wooden objects (figure 4), the leather objects and the environmental remains that do not survive on land. The *Mary Rose* archive includes over 29, 000 registered items. 19, 000 of these are objects, but there are also over 4, 000 timbers, 1, 100 human remains, 3, 500 samples including environmental remains and an archive of many thousand photographs, videos and x-rays taken during the excavation.



Details of many of these objects are included in the latest publications of the Mary Rose Trust and in particular volume 4 that deals with the extraordinary range of artefacts found on board (Gardiner 2005) and volume 3 that describes the guns and fighting weapons (Hildred 2011).

## 7. Conservation

Since 1983, the hull of the *Mary Rose* has been housed in an adequate but temporary building while the conservation process is being carried out. It was open to the public from December 1983 until September 2009 when preparatory work started on the new building. During the period from 1983 to 1996, the hull was sprayed with chilled freshwater that kept the timbers constantly at a temperature below 5°C. A misting system maintained a high relative humidity (95%). Research was carried out to determine the best way to permanently preserve the timbers and the ship was recorded and photographed for Volume 2 of the archaeological publication (Marsden 2009). The scientific research headed by Professor Mark Jones concluded that the most suitable conservation programme would be to spray the hull with low molecular weight polyethylene glycol until this had saturated the timbers and then to use a high molecular weight polyethylene glycol (PEG) to consolidate and seal the surface (Jones 2003). So PEG 200 was sprayed on the hull from 1996 until 2006 and then changed to PEG 2000. This final spraying phase is due to finish in January 2012. The ship will then have a careful programme of air-drying until 2016 when the major phases of the conservation programme will at last be complete.

## 8. The New Museum

When the *Mary Rose* came ashore in 1982, she was moved into a dry dock in Portsmouth Naval Base and a temporary building was constructed over the ship. This allowed the conservation to go ahead and the public to view the ship from special galleries. Although it has been recognised that the Mary Rose Trust has a collection of national importance, the Mary Rose Museum is not a national museum, and relies on income from visitors, grants, donations and sponsorship to carry out the work. The latest phase of the project; to finish the conservation of the hull and to build a permanent museum, was made possible by a £ 21 million grant from the UK's Heritage Lottery Fund. The Mary Rose Trust has to find the rest of the cost (£ 14

million) from donations and grants from companies, charities, individuals and the general public. By March 2011, over £ 12 million had been raised and the foundation stone for the new museum was laid by HRH Prince Harry on 18 March 2011. The formal opening will take place in early 2013. The museum is located in Portsmouth Historic Dockyard (figure 5). very close to Lord Nelson's flagship *HMS Victory* that was to play such an important role in British history at the Battle of Trafalgar in 1805 The stated vision of the museum project is 'to create a sensational and sustainable museum, where *Mary Rose* and her artefacts will tell their unique stories'. It is intended that the museum will:

- Reunite, the ship and the objects
- Put as many objects on display as possible
- Use the objects to tell the stories
- Capture a moment in time
- Excite our audiences
- Increase access



Taking these points in turn, the temporary building constructed over the ship had two great disadvantages. Firstly, it was temporary and secondly, it did not have either the space or the correct environmental conditions for displaying the stunning collection of objects found inside the ship. These had to be displayed in a different building over 500 metres away. Whilst these exhibitions have been very successful and over 8 million people visited the *Mary*

Rose between 1983 and 2010, the old museum housed just 1, 000 of the objects recovered from the ship. The new museum will re-unite the ship and objects and house some 14, 000 objects with over 9, 000 of these on permanent display.

One enormous advantage of the Mary Rose collection is that it contains an extraordinary range of objects reflecting everyday life-not just the fighting objects from a warship or the functional objects of a sailing ship. There are the personal possessions of the crew, their chests, their clothing, their combs, their rings, their thimbles, even the ends of their shoelaces and the pepper grinders and peppercorns that they used to spice their food. These objects capture a moment in time; they help to bring our history to life; they can be used to give insights into the crew and tell stories about the individuals. We feel that it is these personal insights into the lives of people who lived 500 years ago that will excite our museum visitors. We want to appeal to a wide range of the public, not just the people who normally go to museums.

One way that we hope to do this is to centre some of our displays around the personal possessions of individuals that lived on board the *Mary Rose*. In many areas we found intact chests which contained the items belonging to one person. Sometimes we even found the remains of a person nearby, with their clothing, their knife and even a comb in their jacket pocket. The chests also contained professional items such as the carpenter's tools or the surgeon's ointments and instruments. In this way we can build up a picture of individuals on board; their status, their interests, their profession. These items will be displayed in individual cases in the centre of some of the galleries and the wider themes such as carpentry or medicine will be displayed in the wall cases nearby.

Another extraordinary feature of the Mary Rose excavation was that we discovered many of the large objects such as the canon still in position on the decks and sticking out through the gun ports where they had been stationed before the ship sank. As the ship is too fragile to allow visitors to walk along the actual decks, we will be creating walkways so that on one side the visitors can see the real ship and on the other side they will see a mirror image of the ship containing many of the thousands of objects displayed opposite where the diving teams had found them during the excavations (figure 6). This will give visitors the closest experience they can get to walking along the deck of a 500-year-old warship.

We also want to increase access to our collection for those with disabilities. This does not just mean those who have difficulties with seeing, hearing, or mobility but also those who have learning difficulties. Introducing different ways of experiencing the collection, including touch, smell, hearing and other senses can bring benefits to all visitors, not just those with



disabilities. Interestingly, given that this lecture is to be given in China, I have been guided by the saying of Confucius: “I hear and I forget, I see and I remember, I do and I understand”. Learning from, or experiencing a museum collection through doing things: through hands-on and interactive displays is a very powerful way for visitors to understand the past, and enables them to both enjoy their visit and learn from it. Most of the objects in the collection are too fragile and precious to be handled by the public and have to be viewed in the safety of their display cases. However high-quality replicas will be made allowing visitors to experience the collection using different senses.

## 9. In Conclusion

Although we also have technical constraints, we have enormous advantages as underwater or maritime archaeologists or as curators of maritime museums. Our projects are inherently different and interesting for the public. Visitors can be enthralled by the sheer human endeavour that is required for projects like the *Mary Rose*, Nan Hai No 1 or the underwater museum at Baiheliang. We also get different materials surviving in the underwater environment so that whole new aspects of past cultures can be studied. Finally in the case of shipwrecks like *Mary Rose*, *Vasa* or Nan Hai No 1, we have a whole cross-section of society preserved that was full of life until struck by the catastrophe. This is very different to sites like burials (whether they are terracotta armies or within pyramids) where the contents that were buried were carefully

and deliberately chosen. We have the opportunity to bring the past to life with insights into the everyday possessions of normal people-not just the high value goods of the ruling classes, the Kings or Emperors that are displayed in many museums. We can attract new audiences to our museums that might not normally go to a traditional museum.

But we need to acknowledge that every visitor is different and that a whole range of methods needs to be used to make sure that every visitor has the opportunity to experience the collection in a way that is suitable to them. We should not restrict ourselves to showcases but should use AVs, smells, sounds, replicas, re-enactments, hands on activities and even games to bring our museum collections to life. The Mary Rose Trust has been designated as the 'Lead Museum for Maritime Archaeology in the UK'. We are happy to share our ideas with and to continue learning from our international colleagues.

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# The Presentation and Valorisation of Shipwrecks on the Example of the *Vasa*

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## 1. Introduction

This paper aims to present the *Vasa* shipwreck and the *Vasa* museum in Stockholm. The *Vasa* museum is one of the most visited maritime museums in the world. How can we understand the success of the museum and the fascination of its content? And how does this fascination relate to all other well-preserved Baltic Sea shipwrecks still in situ?



## 2. What is the *Vasa* ?

The Swedish man of war *Vasa* was built in Stockholm between 1626 and 1628 and it was,

with 69 meters length, 52 meters height and 5 meters width, one of the largest ships of its time. The young King Gustavus Adolphus II commissioned the ship and Dutch shipbuilders built it. Once the ship set sail, the *Vasa* turned out to be unstable and difficult to manoeuvre. It sank only 30 minutes into her maiden voyage in the very centre of Stockholm with thousands of people witnessing the disaster. The *Vasa* was the king's pride, built to expand the Swedish kingdom and an embarrassing fiasco.

The ship was not fully manned or equipped when it sank. About 150 persons were on-board, and approximately 30 of them lost their lives. Remains of 16 individuals were later found onboard the shipwreck.

The recovery of the wreck took several years. Navy divers dug 6 tunnels under the ship's hull, which lay in a depth of 32 meters. Steel cables were drawn through these tunnels and attached to lifting pontoons on the surface. Finally, after several separate lifts, the wreck was brought to the surface in 1961. The archaeological excavation of the shipwreck was then conducted on the surface. It took about half a year to complete and resulted in the recuperation of 40,000 objects.



The shipwreck with all its objects and its wooden structure of mainly oak wood, weighing 1500 tonnes, was of course an enormous conservational challenge. After examining a number of possible methods and materials, the synthetic polymer polyethylene glycol (PEG) was chosen to treat the *Vasa*'s wood from a fast and destructive drying-process. PEG spraying began in April 1962. The PEG concentration was gradually increased from a low concentration of 5%, ending with a solution of approximately 40%. Boron salts were added to prevent microorganism growth and to neutralize acids.

Various types of PEG were tested on the wreck over the years, and PEG 4000, 1500 and 600 have all been used. The PEG ran over the hull's surface, was collected in tanks and re-used. The spray treatment lasted for 17 years, from April 1962 to January 1979, followed by

another 9 years slow air-drying. To strengthen the surface of the wood a final surface layer of PEG 4000 was applied.

The conservation of the *Vasa* began as a huge experiment but the pioneering research by *Vasa*'s conservators has paved the way for numerous other shipwreck excavation projects around the world.

The *Vasa* was open to the public from its recovery on in a temporary museum. The *Vasa* museum of today opened in 1990 and was calculated for 600, 000 visitors per year. This is a very high estimation for any museum, but the museum has since then never had less than 730, 000 visitors any given year. In 2010 the museum had 1, 2 million visitors. Only 25% of these visitors were Swedish. The *Vasa* museum is one of most visited museum in Sweden, and one of the most visited maritime museums in the world.

### 3. The Success of the *Vasa* Museum

How do we explain the success of the *Vasa* museum? What attracts visitors?

It is a hard task to answer this question, and I will not be able to give a full analysis of this matter in the present article. However, I would like to point out some aspects that stand out in particular.

#### 3.1 A media darling

The day that the *Vasa* was scheduled to break again the water surface, all of Sweden held its breath. Newspapers, radio and TV from all over the world were there, and Swedish TV made its first live broadcast to Europe. The *Vasa* got a lot of media attention from the very beginning, and since then, a lot of effort has been put into marketing the wreck and the museum to the public in Sweden and in other countries. Today the *Vasa* is widely known and regarded as a national treasure. A long-term marketing strategy has made the *Vasa* museum a landmark and a must-see for visitors to Stockholm.

#### 3.2 A one-object museum filled with strong stories

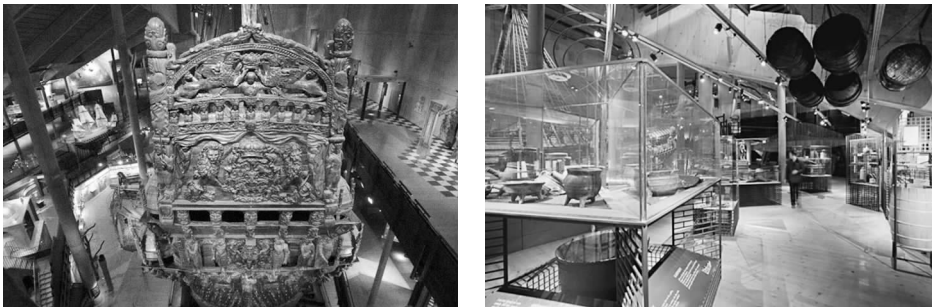
The average visitor to the *Vasa* museum may not find the political, military or economic history of Sweden interesting. Instead, the history of the *Vasa* would fit any Hollywood movie. It touches upon larger human experiences. It tells stories of life, death, hope, disappointment, the royal splendour of the sculptures, the hardship of recovering the wreck and the

Pompeian character of the wreck as a time capsule.

The *Vasa* museum also makes use of the fact that a ship is a spatial experience. Spatiality is a key factor in the design and architecture of the building. The theatrical presence of the ship hits the visitor upon entering. The light is carefully designed, both for conservation purposes and for maximizing the impact. There is an impression of a cathedral or perhaps a temple in the open space with its slanted ceiling some seven stories up. All exhibition spaces within the building are subordinate to this spatial experience, few corners of the museum are closed off from the ship and all displays have to work within the larger framework of the interior.

### 3.3 Good service

The *Vasa* museum has a reputation of having a professional visitor's service of a kind that you rarely find in museums. To welcome as many persons as possible in the building on any given day, despite climate restrictions, an efficient system of queuing and guiding practices has evolved. The entrance system is designed to let people in as directly as possible. Opening hours are generous and groups are let in before or after closing. Guided tours in several languages are constantly being held by groups of students from a multicultural background. Texts and films are also written and spoken in different languages. Museum staff employs various schemes to steer clusters of visitors away from the most crowded points in the museum. The visitors, most of them in the *Vasa* Museum for the first time, will find guides in distinct clothing around the museum. There is a visitor services desk near the entrance which acts both as an information point on the *Vasa* and as a booking center for taxis and the like.



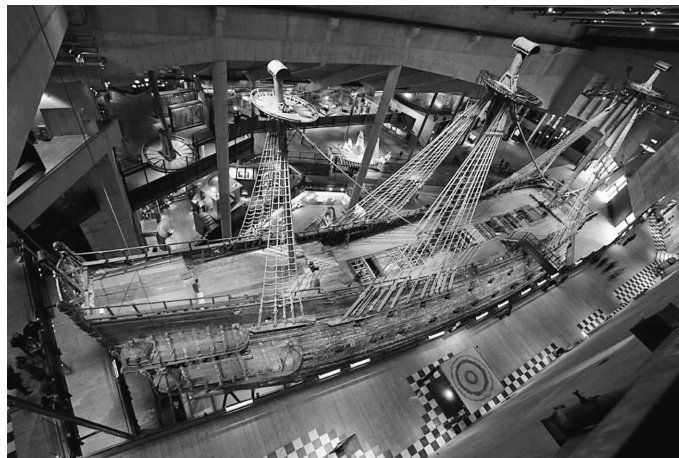
Despite visitor pressure in the summer months the system appears to work well. In 2009, the *Vasa* Museum was presented with the “TRIP Global Award” for best experience in Sweden for foreign tourists-in competition with major hotels and amusement parks.

## 4. A Role-model Shipwreck?

The *Vasa* has become a positive example of an archaeological recovery operation and the museum has made underwater cultural heritage accessible to millions of people. The success of the *Vasa* museum is often used as an argument to recover shipwrecks.

However, despite the high numbers of visitors, the *Vasa* museum has never, and will never be, a financial success. It is important to realize that a recovery of a shipwreck as complex as the *Vasa* would not happen today in Sweden. It would be regarded too costly an operation compared to the scientific reasons for recovery and a too big a risk when it comes to conservation and the possible development of a successful museum.

Indeed, since the 1950ies many shipwrecks have been recovered in Sweden and in other parts of the world. Very few grew to become world famous tourist attractions. Despite having high scientific values and strong stories, most recovered shipwrecks ended regrettably up in museum collections inaccessible to the public.



In the late 1950ies and early 1960ies, recovering a shipwreck was an act of preservation. Today, when we face the challenge of safeguarding thousands of well preserved Baltic Sea shipwrecks, many of the same quality as the *Vasa*, we need to think of other approaches.

## 5. Stories of Ships and Shipwrecks

It is evident that ships are strong symbols in our times. They occur as symbols in the most

various situations and examples. The French philosopher Michel Foucault wrote:

“...the boat is a floating piece of space, a place without a place, that exists by itself, that is closed in on itself and at the same time is given over to the infinity of the sea and that, from port to port, from tack to tack, from brothel to brothel, it goes as far as the colonies in search of the most precious treasures they conceal in their gardens. You will understand why the boat has not only been for our civilization, from the sixteenth century until the present, the great instrument of economic development, but has been simultaneously the greatest reserve of the imagination.”

“In civilizations without boats, dreams dry up, espionage takes the place of adventure, and the police take the place of pirates.”

Foucault, M. 1986. Of other space, *Diacritics* 16. 1 (1986): 22-27.

Shipwrecks share the same stories as ships, but their narratives become enforced and stronger by the location under water. Also, in the usual well-preserved Baltic Sea shipwreck the structure of the ship is more or less undamaged and the objects are still in place as they were when the ship foundered. In comparing a well-preserved Baltic Sea shipwreck to the *Vasa*, the *Vasa* actually seems arranged and reconstructed.

Today the strategy applied is therefore to preserve the shipwrecks *in situ*, to conduct research and to make them accessible through dive parks, digital registers, websites and exhibitions. First tries using ROV (remote operated vehicles) to visit and visualise *in situ* shipwrecks for non-divers are promising and may prove to attract thousands of people in a near future.

The *Vasa* is a great success and it is a fantastic experience to visit the museum. However, it is a responsibility of museums professionals within cultural heritage management services to preserve also all other non-recovered shipwrecks. They need to take on the challenge of using the same fascination that attracts million of peoples to the *Vasa* museum, to create a public understanding for the ambition to preserve shipwrecks *in situ*.

# Innovative Thoughts on the Preservation of Underwater Cultural Heritage in China: No. 1 Nanhai as a Project Example

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## **1. The Achievements and New Trends of the Preservation of China's Underwater Cultural Heritage**

The emergence of the SCUBA (Self-Contained Underwater Breathing Apparatus) in the 1940s accelerated the process of mankind's exploration of the maritime world and the search for human cultural heritage buried in the seabed. On the one hand, modern underwater archaeology that first emerged in the Mediterranean after the 1960s, has gradually extended to North America, the Caribbean and the Asia Pacific region; on the other hand, the commercial salvage of underwater cultural heritage has become more prosperous. Merely in the South China Sea coastal area, there are dozens of shipwrecks, where over a million ancient porcelains have been salvaged. Because of the intensification of commercial salvaging, the State Administration of Cultural Heritage (SACH) developed a plan to support the development of professionals of underwater cultural heritage preservation. Since the dissemination of "The Administrative Regulations on the Preservation of Underwater Cultural Heritage of the People's Republic of China" in 1989, China has become one of the few countries in the world to preserve underwater cultural heritage through legal means. In addition, China has aimed to develop underwater cultural heritage preservation by dispatching professionals abroad to learn the latest theories and techniques of underwater archeology and by inviting foreign experts to teach in China. As a result, China has completed three decades of western underwater archaeological courses in only ten years, including the successful implementation of the archaeological investigation and exca-

vation project of Suizhong San-dao-gang shipwreck in Liaoning province (1991 ~ 1997)<sup>①</sup> and Lianjiang Baijiao I shipwreck in Fujian province (1990, 1995 and 2000)<sup>②</sup>. These investigations indicate that China has formed a strong underwater archaeology team and talent pool over this short time period.

Since the beginning of the twenty-first century, the replenishment of China's underwater archaeological equipment has accelerated, and the application of new technology and new equipment has continuously raised the systematic and scientific level of underwater archaeological work and increased the quantity of diving equipment. Moreover, positioning equipment has increased; various types of remote sensory equipments have been put into common use and underwater archaeological projects have continued to increase. For example, the underwater archaeological survey project along the Guangdong coast included 12 projects from 1988 to 2004, and from 2005 to 2008, over 20 survey projects were completed.<sup>③</sup> Technology upgrading, equipment renewal, project increases, and continuous improvements of the talent squad in turn has injected new vitality into China's new century of professional underwater archaeology and has brought with it new changes. In brief, these changes can be represented via three key aspects. Firstly, *changes in preservation attitudes from "underwater archaeology" to "underwater cultural heritage preservation"*. Taking the foundation of "China's Underwater Archaeological Coordinating Group" in 1987 as the beginning of China's underwater archaeology, the focus during the first 10 years of China's underwater archaeology was staff training and team construction. Correspondingly, archaeological investigation, prospecting and small-scale excavation with a focus on developing underwater archaeological technology has become the major target for archaeology. Since the beginning of this century, China's cultural heritage preservation has experienced a historic transformation<sup>④</sup> from "cultural relic" to "cultural heritage". Underwater cultural heritage related careers, an important part of cultural heritage, has also acceler-

① [ Zhang Wei (chief editor): *San-dao-gang Shipwreck of Yuan Dynasty in Suizhong*, Science Press, 2001. ]

② [ Sino-Australian united underwater archaeological professional training class, Dinghai investigation & excavation team: "The Annual Survey and Excavation Report of Dinghai, Lianjiang, Fujian Province in Year 1990", *Journal of Chinese History Museum*, volume 18, 19, 1992; Sino-Australian united Dinghai underwater archaeology team: "1995 Annual Survey and Excavation of Dinghai Shipwreck Relics", *Archaeological Research of the Southeast China*, volume 2, Xiamen University Press, December 1999; Zhang Wei, Lin Guo, Wu Chunming: *Related Issues on the Shipwreck Archaeology in Dinghai, Fujian province*, *Archaeological Research of the Southeast China*, volume 2, Xiamen University Press, December 1999. ]

③ [ Wei Jun, Lou Xinli: *China's Two Decades of Underwater Archaeology*, *Cultural Relic Studies* Volume 16, Mount Huang Press, 2009 ]

④ [ Shan Jixiang: *Walk from the "Cultural Relic preservation" to "Cultural Heritage preservation"*, Tianjin University Press, 2008 ]



ated the transformation process from “underwater archaeology” to “underwater cultural heritage preservation.” With the transformation from key-point survey to common survey of underwater cultural heritage resources, the extension of underwater cultural heritage continues to expand; ancient shipwrecks are not the only object of interest, the survey of ancient ports and ancient battlefields of coastal areas have obtained preliminary results and become important objects of study, as have inland water shipwrecks (such as the Zhong Shan warship in the Yangtze River), town sites (such as the Shi Cheng underwater ancient city in Qian Dao lake), handicraft sites (such as the ancient quarry of ShiYan Rock in Xiqiao mountain) and underwater inscriptions (such as Baiheliang in Fuling, the Dragon Spine Stone in Yunyang, etc.). Furthermore, proposed concepts of modern underwater cultural heritage, linear underwater cultural heritage and underwater cultural heritage burial areas reflect the continuous development of the preservation of China’s underwater cultural heritage. Similar to continental cultural heritage preservation work, the emphasis has been on historical tradition and public participation in cultural heritage preservation, which are important for the transformation of underwater cultural heritage preservation.

Secondly, *changes in preservation attitudes from salvageable excavation to diversified preservation*. Since the 1980s, the salvageable archaeological excavation of underwater cultural heritage is one of the major means of China’s underwater cultural heritage. In long-term practice, our country has gradually found a set of underwater archaeological techniques and methods suitable for the China coast rim, which exhibits low visibility and complex sea conditions. Since the current century, while adhering to salvageable excavation as an important method for underwater cultural heritage preservation, cultural heritage workers have begun to adopt a more flexible and diverse underwater cultural heritage preservation strategy that relates to specific circumstances of different kinds of underwater cultural heritage and have formed simultaneous salvageable excavation (such as the excavation of “Huaguangjiao I” and “No. 1 Nanhai” shipwrecks, etc), in-situ preservation (such as the preservation of the underwater inscriptions of Baiheling, Fuling) and relocation preservation (such as the salvage of “No. 1 Nanhai” shipwreck)<sup>①</sup>.

Thirdly, *changes in preservation methods from single-sectoral commitment to multi-sectoral cooperation*. Underwater cultural heritage preservation work relates to multi-sector and mul-

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① [Wei Jun: *The Present and Future of China’s Underwater Archaeology*, *International Museum (Chinese edition)*, volume 4 2008]

tidiscipline work, thus it is difficult to effectively accomplished by merely relying on the strength of individual cultural relic departments. The practical experience in recent years has proved the importance of cooperation and combination of heritage archaeology, ocean maritime affairs, the police, meteorology, transportation, salvage practices, the media and other sectors. This type of sector-cooperated underwater cultural heritage preservation has achieved clear results in underwater archaeological projects, such as “No. 1 Nanhai” and “No. 1 Nan’ao.” At the national level, underwater archaeological cooperation and the framework agreement recently signed by the National Historical Relic Bureau and National Bureau of Oceanography on the co-launching of underwater cultural heritage preservation work have played an important role in the promotion of underwater cultural heritage preservation in a scientific and sustainable way. Meanwhile, the technological research on various types of underwater cultural heritage preservation also correspondingly involves historic relic archaeology, physics, chemistry, maritime environment, biology and other disciplines, which has also assisted in the launch of multidisciplinary collaborative research.

As one of the most important projects on underwater cultural heritage preservation in the China coast rim area, the innovative method and mechanism of the “No. 1 Nanhai” project embodies the new changes and thoughts on the development of China’s underwater cultural heritage career since the new century.

## **2. “No. 1 Nanhai” Preservation Project**

In August 1987, the Guangzhou Salvage Bureau of the Ministry of Communications by chance discovered an ancient wooden shipwreck in the Yangjiang sea, Guangdong Province, during salvage operations. After the determining of the unearthed relics by archaeological experts, it was confirmed to be an ancient merchant ship that sunk during the 12th century. From 1989 to 2004, the National Heritage Relic Bureau organized an underwater archaeological team to conduct eight surveys for an archaeological trial excavation of the shipwreck—“No. 1 Nanhai”. The survey confirmed the ship’s length to be 30.4, width 9.8, depth approximately 4m, submersion below the sea surface 24 meters, and also that the surface was covered with 1 ~ 1.5 m of silt. The “No. 1 Nanhai” shipwreck’s overall preservation situation was good, the structure of the under-deck was complete, the cabin was filled with an estimated number of 60 to 80 thousand objects, including ancient folk kiln porcelains made in Jiangxi, Zhejiang and Fujian provinces and a large number of metal ware (including gold, sil-

ver, copper, iron and tin etc. ), lacquered ware, stone artifacts and animal and plant debris.

According to the underwater cultural heritage preservation strategy, “preservation in-situ” is the preferred method recommended in the “UNESCO Convention on the Protection of the Underwater Cultural Heritage.” Meanwhile, underwater heritage preservation through salvageable archaeological excavation is also an effective method commonly used worldwide. However, the burial situation of the “No. 1 Nanhai” shipwreck meant that the two methods mentioned above could not be effectively implemented. “No. 1 Nanhai” is located in a traditional fishing area involved with the offshore fishing industry and fishery production (especially trawling fishery), which has posed a serious security threat to the shipwreck. Although the shipwreck site was supervised and inspected by the Border Defense of Public Security, dealing with illegal fishing and the stealing of underwater cultural heritage brought pressure to commence preservation work; additionally, the nearest distance of the shipwreck from land was approximately 20 nautical miles. Considering the high value of the potential scientific research of the well-preserved “No. 1 Nanhai”, the implementation of “in-situ preservation” was not the best method of preservation, and to preserve “No. 1 Nanhai” through salvageable archaeological excavation also faced problems. Firstly, the particles suspended in the waters of the shipwreck site were rich, the water visibility was very poor (usually 0 to 20 cm) and conventional underwater archaeological excavation could not guarantee scientific accuracy of archaeology research and data acquisition. Secondly, the shipwreck was submerged 24 meters below the sea surface and the surface of the hull was covered with approximately 1.5 meters of silt, in addition, the hull was very large, thus long working hours would be required in order to complete all excavation work. Furthermore, the sea conditions at the shipwreck site were complex-long-time monsoons and a fast rate of seabed sediments deposition-therefore, the implementation of underwater archaeological excavation would cause more harm than good.

Considering that neither in-situ preservation nor salvageable archaeological excavation were effective methods of preservation for “No. 1 Nanhai”, following numerous studies, experts raised the idea of “ex situ preservation”, that is, to conduct an “overall salvage” and fix the shipwreck and its environment elsewhere, more specifically to relocate the shipwreck and its environment to an artificial controllable environment for long-term preservation and display. The seabed sediment drilling results of the shipwreck site indicated the seabed within 50 meters was of fine silt soil, which provided an ideal condition for the implementation of an “overall salvage” of the shipwreck.

“No. 1 Nanhai” was found to be well-preserved and thus held a large amount of valuable historical information. It could be considered to be a concentrated unit of ancient society and life and a time capsule representing maritime life. In order to comprehensively and systematically explore such information, the salvage, preservation, study and display of the ancient shipwreck involved systematic engineering. The successful implementation of the overall salvage maximized the preservation of the original status of “No. 1 Nanhai” and its existing environment, and although it does not fully comply with ideas of the “integrity” and “authenticity” of underwater cultural heritage, it does embody the new thoughts in China’s underwater cultural heritage preservation work. The innovation of the project can be explored via three aspects: method, technology and institutional innovation.

2.1 Method innovation. The method innovation of “No. 1 Nanhai” includes salvaging, preservation and display, and can be summarized in three areas. Firstly, *the underwater archaeological method of overall salvage of the ancient shipwreck by using the caisson method*. The general idea of this method is to design a steel container larger than the size of the ancient shipwreck, and through precise positioning and static pressure sink the designed height mark of the seabed, fix the shipwreck and its surrounding sediment in the container and form a sealed caisson by installing steel joists and a soil and water protecting board at the bottom of the container. Then, with the coordination work of a large-tonnage floating derrick and a 10,000 tonnage-class semi-submersible barge, salvage the whole steel caisson loaded with the ancient shipwreck out of the water and relocate to a designated location for preservation and protection. Compared to the nacelle salvage method<sup>①</sup> of the British “Mary Rose” shipwreck and the dual barge lift salvage method of the Swedish “Vasa” warship, the “overall salvage” method more completely preserves the protosomatic environmental information of the shipwreck. Secondly, *the preservation method of underwater cultural heritage by using artificial environmental control technology*. The overall salvage method offers new possibilities to realize underwater cultural heritage ex situ preservation. As “No. 1 Nanhai”, which sank to the seabed over eight hundred years ago without rotting, has a burial environment that is conducive to the preservation of the shipwreck and ship-borne relics to a certain extent, hence the general concept was to place the shipwreck in an adjustable artificial water environment. Through simulating and optimizing environmental factors of the original burial site of “No. 1 Nanhai” in the artificial water envi-

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① Peter Marsden, *Sealed by Time: The Loss and Recovery of the Mary Rose*, Pp. 51 ~ 59, The Mary Rose Trust, 2003.

ronment, the deterioration process of shipwreck relics could be slowed. On the basis of comparing the differences in physical-chemicals, analyses of the biological indicators between the water of the shipwreck site and the “No. 1 Nanhai” preservation site were conducted to assess the potential impact of various environmental changes on the underwater cultural heritage, and water environmental factors that needed artificial adjustment. To utilize modern technology, first impurities were removed and solids suspended in the water with a media filter, then, sterilizing technology and ultrafiltration systems were adopted to kill and remove organic matter in the water; as a supplement, the oxygen volume in the water was reduced by nitrogenization and oxygen discharge. On this basis, to achieve long-term preservation of “No. 1 Nanhai”, the monitoring of water environmental factors and effective cycles was conducted. At present, the method to preserve underwater cultural heritage through artificial water environment adjustment is being gradually implemented in the newly-built museum, and researchers will continue to optimize and adjust the artificial control method and equipment based on monitoring results. Thirdly, *the ex situ excavation and display method of the ancient shipwreck*. After the successful execution of the archaeological salvage of “No. 1 Nanhai”, the shipwreck was moved to “Crystal Palace” at the Guangdong Maritime Silk Road Museum, which was built specially for long-term archaeological excavation and public display of the ship. The ex situ excavation of the shipwreck not only avoided adverse effects from the natural environment, climate, time and other factors on underwater archaeological work, but also due to the ability to conduct detailed excavation in the artificially controlled environment, the accuracy of the collected archaeological information was increased significantly. At the same time, the underwater archaeological excavation of the museum also ensured the maximum the security of the underwater cultural relic as well as archaeological staffs.

2.2 Technology innovation. The core technologies used for the “No. 1 Nanhai” preservation project were independently designed and have successfully realized multiple technological innovations in relation to historic relic archaeology and underwater engineering, and include the following:

Firstly-*huge steel caisson design technology*. Steel caisson is an important carrier for the overall salvage. Its design must have the following functions: to form a sealed caisson by installing a bottom joist; support static pressure sinking, bottom joist threading, inverted beams, soil and water protection, lifting and other function; have strength, stiffness, stability under positioning, sinking, surrounding excavation, bottom seal-off, floating, relocation and other complex conditions during the project implementation; and guarantee the safety of relics. To



Fig1: Steel caisson

achieve the above requirements, the steel caisson structure was designed with a connected top-and-bottom, an open bottom, a flat surface with a structure similar to the shape of the Chinese character “回” ( *hui* ); it was 35.7 meters in total length, 14.4 meters in width, 12.2 meters in height and 550 tons in dead-weight (Figure 1). To meet the functional and safety requirements, the steel caisson was formed with two layers of upper and lower layers (the upper caisson was 7.2 meters in height, the main function was to cover the shipwreck and form a bottom seal-off caisson after the bottom joist threading procedure, etc.; the lower caisson was 5 meters in height, the function was to ensure when the caisson periphery was being excavated; the sludge within the caisson will not run off the bottom because of changes of inside and outside pressures. It also played a supporting and fixing role on the upper caisson). The wall of the caisson was designed to be a hollow “double-shelled structure.” On one hand, this will make a caisson wall with a total thickness of 1.2 m, which effectively prevents the shape from changing because of pressure. On the other hand, by filling in the hollow wall with sand to increase the weight of the caisson, the sinking speed of the caisson could be accelerated (when the ballast is in place, the 96 holes reserved on the bottom of the upper caisson could be opened to discharge silt inside the wall and reduce the lifting weight). At the same time, the static pressure area located in the middle and two sides of the caisson top surface could evenly

bear the pressure from the cement block-thus, the design of the hydraulic jack that connects the hook and the guiding steel cable ensured the successful rate of bottom joist threading, while the design of the 16 endocentric-structure, 300 tons semi-circular hanging points on top of the caisson, ensured the balanced force of the lifting steel cable.

Secondly-*caisson positioning technology and sinking monitoring technology*. In order to ensure the shifting and tilt of the caisson during the sinking process would not endanger the safety of the underwater cultural relics, and to overcome the sway of the caisson due to stormy waves and currents during the salvage process, DGPS, electronic attitude director, ultrashort baseline positioning and other advanced equipment were used to carry out underwater positioning and sinking attitude monitoring. At the same time, the positioning framework and L-type framework were used for stability during the sinking process, in this way, the caisson could cover the ancient shipwreck accurately and sink to the designed height mark steadily. During the process of caisson sinking and static pressure ballasting, the following equipment and techniques were utilized: three-dimensional monitoring system of surface base station, beacons installed in the four corners and in-wall of the caisson, GAPS attitude director to carry out 24 hour real-time monitoring of the caisson's balance degree during sinking, underwater attitude and sinking depth, to ensure the caisson sink in place steadily and accurately through adjusting the position of the boom or static pressure block (Figure 2).

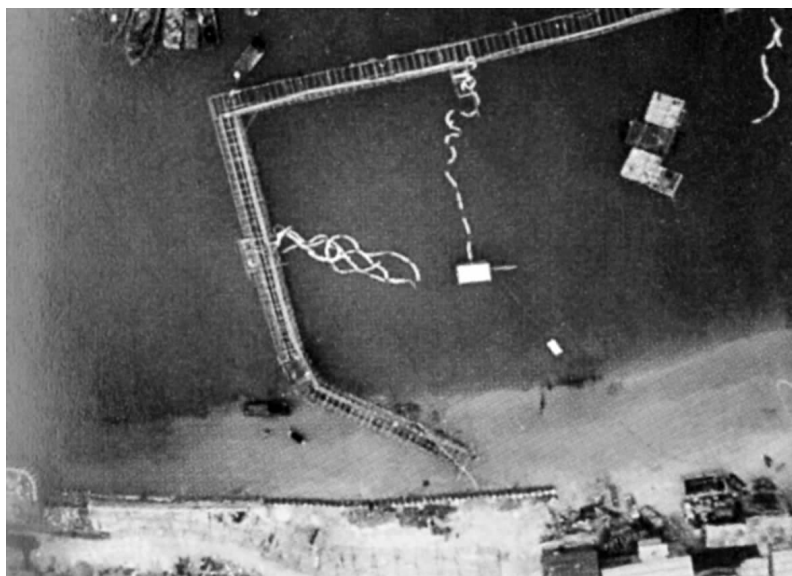


Fig 2: Caisson positioning

Thirdly-*30 m underwater bottom joist threading technology*. After static pressurizing to the designed height mark, in order to withstand the weight of the steel caisson and its stowage in the floating process, 36 bottom joists were installed at the bottom of the upper caisson, to form a stress ensemble with the caisson. The bottom joist was a watertight hollow structure and was 14.48 meters long, 0.83 meters wide and over 5 tons in weight. In order to ensure the successful threading of the bottom joist with a cross-sectional area of  $0.83 \times 0.43$  m, 140 tons traction and 100 tons jacking thrust equipped separately at the head and tail of the joist in the construction process, while three buoyancy bags, bound on the joist and adjusted to the state of semi-floating with weight of 500 ~ 1000 kg, solved the problem of the stable installation of the bottom joist. The successful threading of the bottom joist allowed a height and horizontal direction deviation of a maximum of 10cm, therefore the control on its axis during the bottom joist threading process played a critical role in the successful threading. During the construction work, on one hand, by means of installing gantry brandreth on the threading hole to control the shifting degree of the pulling ring during the traction process, and on the other hand, by installing three groups of different direction high-pressure water cannons on the head of the bottom joist, on the basis of in time measurement of the bottom joist's axial direction, high-pressure water cannons were utilized to control and adjust the bottom joist's direction ultimately controlling accurately and increasing the threading speed of the bottom joist. By using the independently designed bottom-joist-specific threading and pulling equipment, the technical challenge of pulling the 36 bottom joists with a weight of over 5 tons for 15m with an axis deviation within 10cm in almost zero visibility, the 33m deep underwater mud layer was conquered. This was the most critical procedure and the most technologically difficult stage of the "No. 1 Nanhai" overall salvage project.

Fourthly-*mud and water protection technology of the steel caisson*. To ensure the preservation of the "No. 1 Nanhai" environment and the safety of historic relics, in addition to the structural strength requirement of the steel caisson, the sediment and water inside the steel caisson could not run off during and after the floating stage. Through an analysis of the seabed sediment properties and the structure of the caisson and bottom joist, by installing a mud protection board among the adjacent bottom joists and adopting a processing technology of plugging material in the space on both ends of the bottom joists, the mud and water could not run off the caisson, consequently making it basically watertight. After the bottom joists were all threaded, according to actual measurement, there existed a 3cm to 15cm gap between the bottom joists, thus staff carried out a sawing process on the mud protection board according to the ac-



tual size of the gap, then linked the mud protection board to a 26mm steel wire rope, pulled one end of the steel wire rope with an oriented network or steel wire lead frame, threaded the mud protection board into place and sealed off the gap between the bottom joists. Finally, using plugging material to block the gaps between the mud protection boards and bottom joists, the upper caisson was made to be a totally hermetic caisson with a mud-water protection function.

Fifthly-*steel caisson floating technology and onshore relocation technology*. As a result of water buoyancy, the total weight (including adhesive force) of the upper caisson in the seabed was around 3, 200 tons after the separation of the upper and lower structures. However, once the upper caisson loaded with “No. 1 Nanhai” was lifted up from the sea surface, its weight surged to 5, 400 tons. To lift the steel caisson directly from the sea was, to China and even Asia in terms of existing maritime lifting equipment, an “impossible mission.” As a result, the project scheme designed the caisson floating mode to combine a floating crane and a semi-submersible barge. The floating crane was a newly-constructed marine crane with a capacity of 4, 000 tons and was named “Hua Tian Long.” This new type of ship was 175 meters in length, 48 meters in width, equipped with a boom rotation of 360° and 109 meters in length; it could operate normally in 7 grade strong winds, and at the time was Asia’s largest modern lifting salvage and maritime engineering ship. The modified semi-submersible barge- “mission 1601” -had a loading capacity of 16.000 tons.

The detailed floating procedures were as follows. Firstly, the “Hua Tian Long” was used to lift the steel caisson off the seabed, then the “mission 1601” semi-submersible barge was submerged 8.5 meters below the sea surface. Following, the “Hua Tian Long” was used to accurately lower the steel caisson whose top was already 1.5 meters above the sea surface into the caisson bottom tray installed on the deck of the semi-submersible barge. On confirmation of the caisson in place, the semi-submersible barge drained off the water and float off, at the same time, the main hook of the “Hua Tian Long” was used to conduct auxiliary lifting until the steel caisson loaded with “No. 1 Nanhai” was completely lifted off the sea floor (Figure 3). After the consolidation treatment and ensuring of the safety of the caisson, the sling of the “Hua Tian Long” and the “De Peng” tugboat were loosened to tow the “mission 1601” loaded with the caisson approximately 33 nautical miles to a temporary pier at Hailing Island, Yangjiang. The total weight of the caisson and its tray out of water was up to 5, 400 tons, thus to relocate this “huge monster” from the temporary pier to “Crystal Palace”, Guangdong Marine Silk Road Museum, was the last stage of the “No. 1 Nanhai” overall salvage project.

After careful comparisons and selections, the overall salvage scheme adopted the gasbag-relocation method for the onshore relocation. The relocation process selected 16 super-high-pressure gasbags, 15 meters in length and 1 meter in diameter, to work simultaneously, using 3 groups, a total 6 150kN winches to pull the caisson and move it smoothly to the museum and succeed in relocating the 5.500 ton caisson 450 m. This stage of the project not only completed the important mission of delivering “No. 1 Nanhai” to the museum, but also created a new record for the weight and distance of a single heavy weight with gasbag-relocation both in China and abroad.

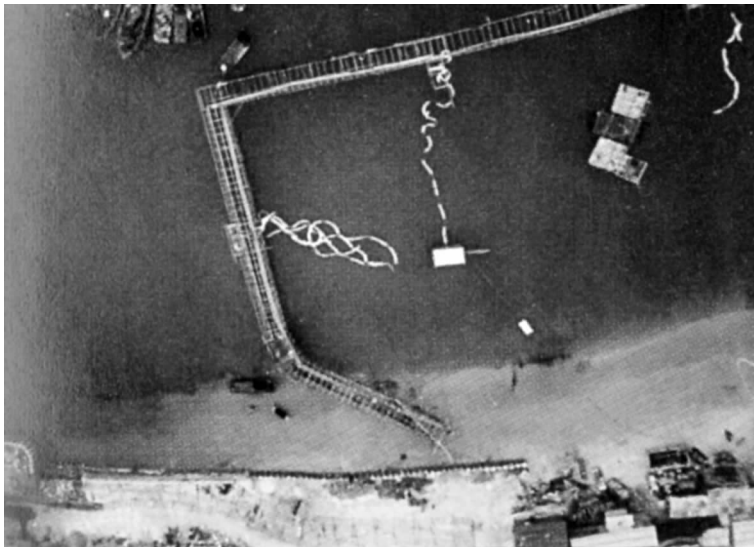


Fig 3 Caisson lifted off the sea floor

2.3 Institutional innovation. The overall design of the “No. 1 Nanhai” preservation project not only met the requirements of the World Cultural Heritage Preservation Convention in relation to “authenticity” and “integrity”, but also fully reflected the cultural heritage working principle of “preservation-oriented, rescue first, rational use and thorough administration,” and thus provided a new paradigm for China’s underwater cultural heritage preservation. The practice of multidisciplinary, multi-industrial and multi-sectional collaboration during this project served to break-down industrial and sectional barriers, therefore making it a positive trial for the institutional innovation of professional underwater cultural heritage preservation. The project programming and studies can be regarded as the result of multi-disciplinary work between experts of underwater archaeology, heritage preservation, rock-soil mechanics, marine salvage, underwater engineering, marine environment and hydro-meteorology, etc., who co-

operated closely, making technological breakthroughs together in the preservation of underwater cultural heritage. At the same time, the project comprehensively integrated the resources of cultural relics, transportation, salvaging, ocean, public security and weather government sectors as well as universities, scientific and research institutions, international diving service agencies, news media and other groups. This not only guaranteed the successful salvaging, scientific excavation and effective preservation of “No. 1 Nanhai” but also provided a successful model for China’s underwater cultural heritage preservation in the future.

The success of the “No. 1 Nanhai” overall salvage project is a milestone in domestic and international underwater cultural heritage preservation, and an innovative model of modern historic relic preservation. Concurrently, the success of the overall salvage project has played a positive and motivational role in the preservation, utilizing and development of underwater cultural heritage- “No. 1 Nanhai”. Firstly, the relocation of “No. 1 Nanhai” to the museum and ex situ preservation by means of overall salvage preservation was able to reduce costs while significantly increasing security. In order to better preserve “No. 1 Nanhai”, the Guangdong Provincial Government allocated 200 million RMB in funds and custom-built the Guangdong Marine Silk Road Museum. This museum covers an area of 120, 000 m<sup>2</sup>, the building area is 17, 000 m<sup>2</sup> and consists of five different spaces (Figure 4).



Fig 4 The exterior of No. 1 Nanhai Museum

Among them, the “Crystal Palace” is located in the No. 3 arch, is the center of the museum and exhibits a giant display pool (length 60m, width 40m and depth 12 m). Placing “No. 1 Nanhai” within the museum and conducting long-term preservation served to protect this

precious underwater cultural heritage relic from damage by natural factors-ocean currents, living life, etc. -and human factors-production operations, illegal stealing and salvaging, etc. -and has solved the challenge of in situ preservation of underwater cultural heritage, which would have involved numerous difficulties and high costs. To preserve the ancient shipwreck of “No. 1 Nanhai” in “Crystal Palace” by means of water environment regulation, compared with the internationally common PEG preservation method, the preservation cost would be much lower. Carrying out follow-up archaeological excavation in the museum environment not only saved the high ship-renting and logistical support costs required for open sea operations, but also allowed for the conducting of high standard preservation of the various types of out-of-water relics, thus the transportation and preservation costs were significantly reduced.



Secondly, the scientific quality of the underwater archaeological work has been improved. The basic working method of underwater archaeology worldwide hasn't changed significantly since the 1980s, especially in relation to understanding archaeological excavation methods for muddy or low-visibility waters. The ex situ excavation of “No. 1 Nanhai” by means of overall salvage has radically improved the original excavation conditions and provided important ideas for breakthroughs in this subject. The environment has changed from uncontrolled to controlled; the impact of the current, hydraulic pressure, visibility, climate and other natural environmental factors on the underwater archaeological work has been excluded; shipwreck archaeology has changed to a precise “laboratory” excavation conducted over a long period of time; the likely damage to the historic relic and loss of information in the zero-visibility environment of the traditional underwater excavation method was avoided; the “integrity” and “au-

thenticity” of the relic’s historical information could be preserved to the largest extent; and, more comprehensive material could be provided for scientific research and relic preservation. Of course, with research becoming more thorough and the progressive perfection of preservation technology, it is important to continuously optimize archaeological excavation methods in order to better understand archaeological preservation and research and the retaining of a sustainable and valuable working platform.

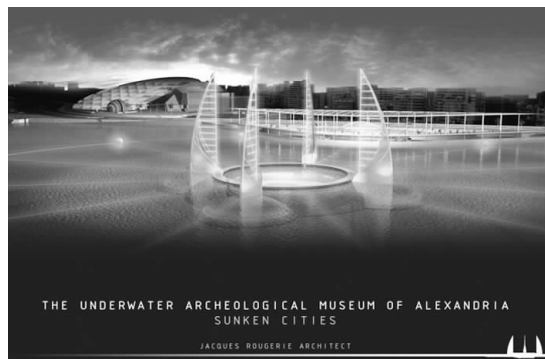
Thirdly, the overall salvage and ex situ display of “No. 1 Nanhai” has had significant social and economic benefits and is conducive to the long-term sustainable development of underwater cultural heritage. The “No. 1 Nanhai” preservation project, of which the shipwreck and its environment was completely salvaged and relocated to an artificial environment to implement post-preservation work, has provided important historical materials for research of the Maritime Silk Road, discussions of the Pacific and ancient shipbuilding, navigation and handicraft production technology of its surrounding areas. During the course of the implementation of this project, more than 80 domestic and international groups conducted follow-up reports, which in turn has made this project a key focus for China, and the world, and has assisted in improving community concern about underwater cultural heritage and preservation awareness. Simultaneously, the ex situ preservation of the ancient shipwreck of “No. 1 Nanhai” provided an opportunity to hold a leading role in the local tourism industry and for the public to gain close contact with underwater cultural heritage and underwater archaeological excavation.

# The Alexandria Museum of Underwater Archaeology *Project*- “Sunken Cities”

Ariel Fuchs

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Coordination Internationale SeaOrbiter*

The Bays of Alexandria and the neighbouring Abukir Bay in Egypt house some of the most important submerged archaeological remains worldwide. They encompass the relics of one of the Seven Wonders of the World, the Pharos lighthouse, relics of the ancient Ptolemaic palace, of three sunken cities, of wrecks, among others from Napoleon’s fleet, and of colossal port structures. Their discovery and investigation have made worldwide headlines.



The project to present at least a part of these remains in a partly submerged museum has been advanced at several occasions by scientists and was supported by UNESCO as well as the Egyptian Supreme Council for Antiquities.

A 2006 international meeting in Alexandria resulted in a close cooperation of the Egyptian authorities, of archaeologists working in Alexandria as well of the French architect Jacques Rougerie, specialized in cultural, science and sea centres and internationally renowned for its realizations, towards the organization of a feasibility study for this museum.



A project proposal has been developed by Jacques Rougerie, which will serve as a work basis. This architectural design proposal stands out for its artistic courage, illumination and extent. It will be here presented as an example for an ‘underwater world’ in which the sunken city of Alexandria, as it once was, can relive in the public’s imagination. This project is for the moment of course only a suggestion and draft, to be verified against the realities in the Alexandria Bay during the feasibility study.

## 1. The Context-the Sunken Traces of Ancient Alexandria

Alexandria’s ancient sources were above all the remarkable influence of two of the greatest cultures of antiquity, the Egyptian and the Greek civilisations. The city is said to have been founded by Alexander the Great, but the Pharos Island is already mentioned in Homer’s *Odyssey*. Many historic events and the impact of trade and exchange formed it subsequently. It became famous as the place of Alexander’s burial, for its library, for its scholars, for its lighthouse and-last but not least-for the tragic stories of its rulers including the legendary Cleopatra. Much of the ancient charm and attraction has been forgotten over the centuries, but efforts are made to re-inspire the urban life and the city’s outside appeal. The rebirth of the current city of Alexandria follows in a direct line the genius of the bygone civilizations that thrived on the banks of timeless Egypt. The urban development of the city has already seen considerable advances, first of all through the construction of a new library building, but much more revival is intended. Whole quarters of the city deserve a restoration effort and that not only in the thousand year old parts of the town, but also in the area of its Turkish houses and the areas close to the ancient port.

It was in this context logical that the discovery of submerged archaeological relics in the

Bay of Alexandria and in close by Abukir Bay found an enthusiastic welcome. The leadership of modern Alexandria chose to dare the adventure to give form to a unique cultural space under water. A museum should make it possible in future to visit the bottom of the sea, as an exceptional way of discovering one of humanity's outstanding cultural sites.

The background of this daring enterprise is formed by three main considerations.

One is of course that the attraction of a true submerged museum will help to attract and deviate the main visitor streams from the Cairo based Giza Pyramids also to other places that are located along the way to Alexandria as well as to Alexandria itself. The city has a very peculiar charm and metropolitan flair that is well worth experiencing for a foreign visitor. It features also many precious cultural sites. But only a true 'city under water' would prove a strong enough appeal for stressed and hurrying travellers of today to choose Alexandria instead of Giza.

A second consideration is that the installation of a museum under water will allow raising support for the restoration of the rest of the historic quarters and would chase of industrial construction projects that threaten to disfigure the bay.



A third consideration is of course the concern for the preservation of the authenticity and historic value of the relics found at the bottom of the Bay (s).

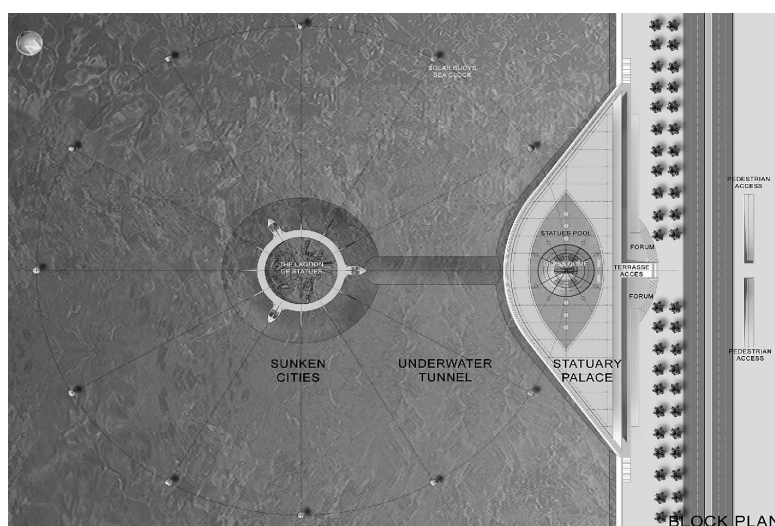
A fourth consideration is of course the need for the city of Alexandria to include the construction of the museum and its touristic and economical perspectives in a vast developing plan for the city-infrastructures, education, communication network, jobs, housing, environmentally wise health and life conditions...-and the global welfare of its population towards a modern future.



## 2. The Museum Project

There are several possibilities for the construction of an underwater museum or a partly submerged museum in the Bay of Alexandria. The final choice, which direction and approach to take will have to be decided by the planned feasibility study. Some issues that are to be taken into account can however already be easily named:

A first, main issue is the exact location of the museum building. There are various options possible and they will have to form therefore a part of the considerations of the envisaged feasibility study.



One option would be to avoid placing any building or structure on or above any historical relic in order not to damage the ‘Pompeii under water’ that is the bottom of the Bay of Alexandria. The location could accordingly be chosen directly opposite the new Bibliotheca Alexandrina in the Eastern Bay and in a close connection to this cultural centre. It would thus be placed beside the relics of the Ptolemaic Palace in which once Cleopatra, the famous VIIIth one, held residence, and be located approximately a kilometre away from the relics of the lighthouse on the outer part of the Bay. The drawback would be that no authentically placed objects would be shown. All exhibited relics would come from a location different from that finally attributed in the exhibition space. The museum would recall their original submerged position, but would displace them. The advantage of the location would be the relative protection of the building from the influences of bad weather and storm, as it would be located in the pro-

tected Bay. In addition there would be no superposition of the building over historical spaces. A problem might be that the Bay is currently highly used by the local fishing industry, which might of course suffer from the closure of large parts of the Bay in favour of the museum construction. Problematic may also prove the high pollution of the Bay's waters, which would make it necessary to create the museum as a kind of closed and artificial aquarium.



Another location-option would be to place the museum above the most visible historical relics of the Bay, the remains of the lighthouse, in order to present them *in situ* and in their authentic context to the visitor, completed by the exhibit of the artefacts from other sites in an 'artificial' location. This would be obtained by placing the submerged part of the museum structure in the outer part of the Bay and by connecting it to the Quait Bay Fort. This Fort is currently empty and recognized as having been constructed on the original foundations of the Pharos lighthouse. Much speaks therefore for its inclusion in the project. The relics of the lighthouse itself, which tumbled down in an earthquake, lie on the seabed in approximately 8 m of depth on the outer part of the Eastern Bay. They are very large and square and would therefore be very easily seen from any passing underwater tunnel or any overarching aquarium structure. Further advantages would be that not only the Quait Bay Fort would be valorised but also the nearby Turkish quarters. In addition the water in the outer part of the Bay is cleaner than in the highly polluted interior of the Bay and the site would be, as far as the lighthouse remains are concerned, authentic. A problematic issue might be the stronger impact of the waves outside the protected harbour. This could prove challenging, as the huge wave breakers protecting the Bay and artificially placed in front of it have of course a reason of being. Diffi-

cult might also be the protection of the site from the surrounding navigation.

An issuedifferent from that of location and to be considered in the planning of the museum project would be the form of the underwater visit offered. This form could range from a simple glass bottom boat tour over the remains of the Pharos to underwater tunnels, like the one in the Swedish Karlskrona museum, or to no-pressure arches like in the Chinese Baiheliang museum, to even further reaching solutions like the exclusion of water or its purification by a blockade of the whole of the Eastern Bay of Alexandria.

These choices made, the museum has to face many further immovable environmental conditions, which have to be taken into account in the construction. A main issue will of course be the instability of the soil of the Bay, which makes it difficult to support a heavy structure. But there are also the issues of pollution, visitor safety, water pressure and many more.

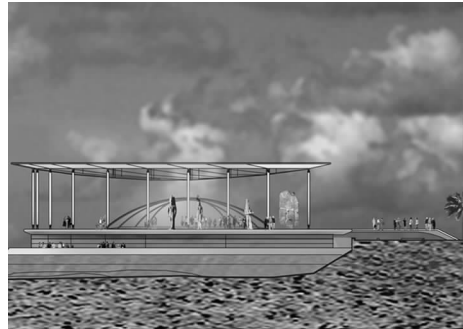
### 3. The Current Proposal

The current architecture projectproposed by J. Rougerie for the museum in Alexandria Bay alternates between aerial flight above the water, symbolizing the city’s historical and cultural influence on the world of philosophy and literature, and underwater spaces recalling the distinctive environment where the artefacts were found.

It is for the moment foreseen to be built in a three-fold structure: A land-based coastal garden of statues, immense sails of stylized feluccas surging from the water in the middle of the water and covering a huge submarine exposition hall and an underwater tunnel connecting both.

In order to prevent the sinking of the underwater structure into the soil a floating construction has been conceived. It will be held in its place by the up-drift of the underwater space.

The wholesould be read more as a journey of initiation than as a monumental building of overwhelming splendour. It is designed as a symbolic space made up of references and signs in



symbiosis with the site and the history which it amplifies—a voyage invoking human’s position in time and space, a voyage of reflection, transcendence and mystery.

The museum shall also become a reference point where scientists, tourists, students, younger generations from all over the world come to reflect and study and, by going back through past centuries, can better understand the world of today and tomorrow.

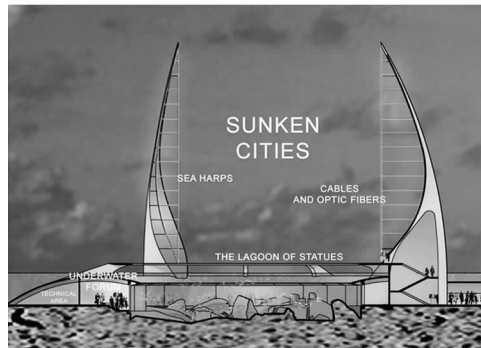
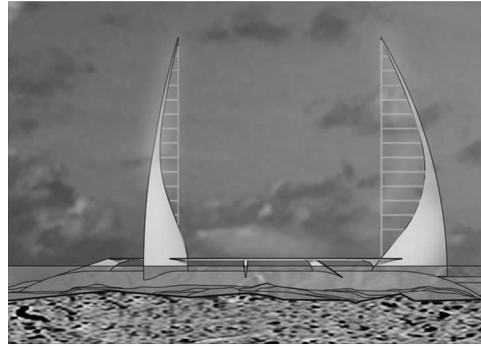
### 3.1 Structure

Three principal features are at the current moment planned to define the museum space.

- Onland the aerial, timeless structure of a Palace of Statues with, at its centre, a glass eye where the underwater descent into the past commences. This eye, a dome of light, will show midday on the clock of time.
- On the sea a similar clock will be placed on the waves, and its hours will be made up of luminescent buoys placed in a circle in the bay. They also mark the security perimeter of the area and underpin the nets which prohibit access to the “Sunken City” from the sea.
- Above and below the surface, in the centre of this sea clock, shall emerge three great ‘harps’ with sensitive strings which will mark the limits of the space from which the imaginary halo of the sunken underwater city will emanate and that will recall felucca sails or a pharaonic headdress.

### 3.2 The Palace of Statues

According to the current design concept, the visitor will first see a large sail in the air, a canopy of screen-printed glass and steel built against the sea front, right next to the new building of the Great Library. This sail, which unfurls towards the open sea, shall give the impression to be suspended by a series of fine colonnades sealed in a great slab of marble with at its centre the eye, an expanse of water whose retina, the glass dome, shelters the forum, the heart of the construction. This immense slab, where the colossal statues, excavated from the



bay, will once again challenge the horizon and time, will itself be supported by pilasters from the lower level.

This will be the place where the reception area, the restaurants, the children's teaching area, the shops, the meeting rooms, and the multimedia library are located. The entrance is also planned to be located at this level. A helical ramp is then envisaged to lead under the surface of the sea to a great forum, a 600-seat lecture hall where the great gallery of statues is located.

This is planned as the starting-point for the scenic tour, which shall take the visitor from the Nile delta to the harbours of Alexandria and the Mediterranean. On the sides of the gallery shall be located an aqua-terrarium which will show the flora and fauna of the Nile delta and an aquarium which shall provide, through a panoramic opening, a striking view of those of the Mediterranean.

It is at this point that the visitor is according to the current design invited to take the path to the sunken city by the use of an underwater tunnel.

### 3.3 The Underwater Tunnel

The envisaged itinerary continues for 80 meters through a setting of columns of water and light which will hold the archaeological elements of this quest of initiation. Two moving carpets on either side of the tunnel and in both directions will assist this forward progression, which finally opens into the "Sunken City" space.

### 3.4 The Living Museum of the Sunken City

At a depth of 7 meters under water, the wide plate glass windows of an underwater ring-shaped gallery are planned to be constructed to surround a lagoon with a diameter of 40 meters, where the archaeological finds, discovered in Abukir Bay and in Alexandria Bay, will be arranged in filtered water in order to guarantee continuous visibility. They are supposed to give the impression of a living crypt whose venerable figures watch today's passers-by with a disturbing serenity.

An additional component may be divers swimming in the water area. They may be in charge of maintenance or demonstrate archaeological work under water.

Three themes are suggested to follow one another:

The ' *Commercial Harbour*' with the reconstituted reminder of the merchants' business: amphorae, pottery, and all kinds of artefacts which the sea took from man over the centuries

and which were rediscovered today.

The ‘ *Palace of Cleopatra*’, exposing the relics of the ancient Ptolemaic palace, the statues of the Timonium, and some stones recovered from the Pharos shall evoke the Egypt of the Pharaohs, of the Greco-Roman era and of all the bygone sunken glory.

The third part, the ‘ *Port of the Wrecks*’ shall show the important remains of ships wrecked in Alexandria and Abukir Bay.

All the invaluable artefacts, lit up behind a plate glass window, will provide an insight into centuries of history and legends, whilst just above the reflection of the present day can be seen at the surface.

There, above the water, three great harps are envisaged in order to remind the visitor of the eternal symbols in the architectural language of today. Recalling the headdress of Cleopatra and the sails of feluccas they shall become great vibrating instruments which match their silent arpeggios to the chords of the bay. Their strings are designed to be sensitive fibre optics, traversed by iridescent waves, varying in shade and intensity in accordance with the codes sent to them by some thousand sensors. The waves, the tides, the wind, the movements of visitors, the weather and seismographs will form the notes and the tempo of their infinite scores.

### 3.5 Project Safety

The safety system of the current museum project has been researched with particular detail given to the unique character of the planned building. It will be designed to be completely secure both in terms of waterproofing and fireproofing. In the underwater area, the *Sunken City*, three safety exits will lead off from a circular ring. The underwater tunnel shall have watertight airlocks at each end and the land-based *Palace of Statues* is planned to have evacuation systems which comply with the current safety standards.

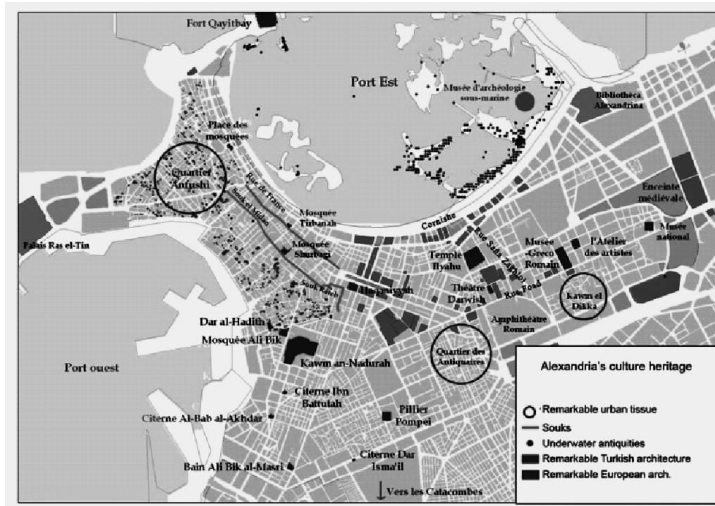
The whole project is for the moment designed to accommodate 5, 000 persons simultaneously i. e. 3, 000, 000 visitors annually.

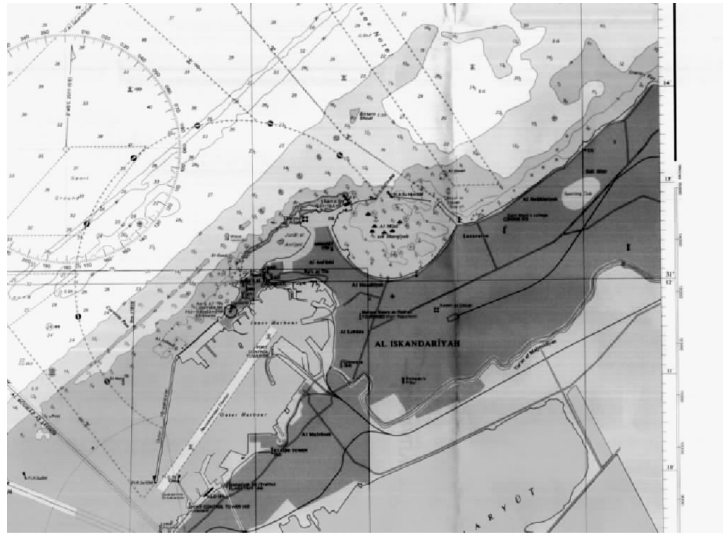
# Underwater Archeology Museum of Alexandria: An Integrated Sustainable Development Role

Naguib Amin

Architect/Planner Specialist of Cultural Heritage Management Jaques Rougerie Architect team

Twenty five years or so of intense archaeological research in the Eastern Harbor Bay of Alexandria have revealed the existence of significant ancient sites, constituting the “Portus Magnus” from the Ptolemaic period, not far from the current Library of Alexandria. This part of the city was destroyed and submerged, following a rise in sea level and coastal submersion. In this zone, an area of about 600 hectares has been surveyed, from which thousands of objects were discovered and identified. Maps, based on observation analysis and detailed survey of the site and the interpretation of ancient texts have been reconstructed to provide an image of “Portus Magnus” as they have been more than 2200 years.





An international exhibition, held in a number of countries, dedicated to the discoveries of the Eastern Harbor Bay of Alexandria and entitled “Egypt’s Sunken Treasures”, has met considerable success, showing international interest in these extraordinary findings. In addition to Berlin and Madrid, this exhibition has come to Paris, where it has been welcomed by over one million visitors, making it one of the busiest exhibitions of France in recent years.

In order to give these sunken treasures a home and a haven worth of their priceless value, the construction of the Underwater Archaeological Museum of Alexandria was proposed by the Egyptian Supreme Council of Antiquities (SCA) and UNESCO, and was met by wide national and international support.

The project is meant to play a main part in the revival of modern Alexandria and the assertion of its role “at a crossroads” of ancient civilizations, present and future, around the Mediterranean and beyond. It will develop the tourism potential of the city and be integrated into a comprehensive plan for the development of city tourism based on a valorization of its cultural and historical heritage which has been identified in numerous studies as one of the strategic factors of local economic development of the city.

In other terms, creating the Underwater Archaeological Museum, whose first mission is to protect and present the findings made in the Alexandria East Harbor Bay and to enhance the value of cultural assets of the city, will also be a pillar of local development and economic growth of the city. The Museum is planned to be an integrated development facilitator to fight poverty and social exclusion, a source of employment, wealth and enjoyment in addition to

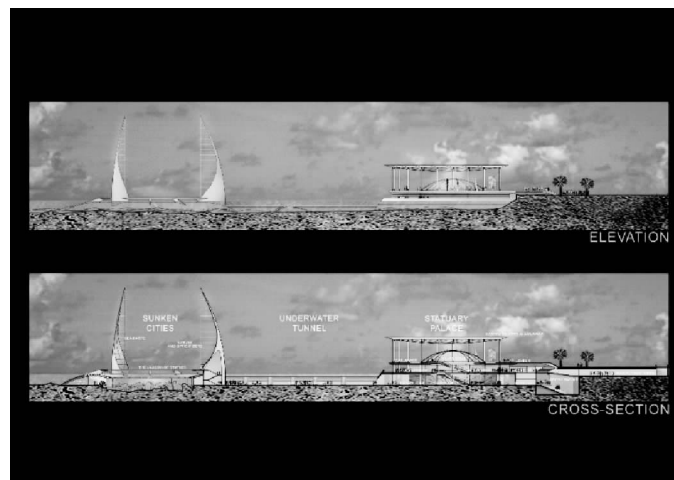


being a spearhead organization to strengthen cultural heritage management and develop the new cultural identity of Alexandria.

Alexandria is a nowadays rich City of Culture, with old history and monuments dating way back from Antiquity on extended vestiges sites up to modern unique the 20<sup>th</sup> Century, both underwater and on main land. The safeguard and sound management of this heritage is crucial to Egypt economy and identity, in addition to its value as worldwide legacy.

While significant and valuable, Alexandria heritage, including underwater archeological heritage, is at risk, threatened by a variety of persistent factors starting by sheer neglect, lack of documentation and efficient protection measures, urban expansion on historical sites, destruction of architectural heritage that deserves to be safeguarded, lack of maintenance and restoration of monuments, and most essentially destruction by landfills on underwater monuments and archeology objects.

The Museum cannot stand alone and could not be sustained if it does not take part and stimulate the establishment of solid base for an integrated cultural resources management system in the city of Alexandria and for underwater archeology in Egypt. Its role will therefore be to proactively protect and enhance the value of this heritage both physically as a museum and as an institution that will spearhead, adopt, propagate and apply protection and sustainable heritage management actions.



Training and individual capacity building will be applied at all levels starting by the Museum conception, design and construction and during its operations. The objective is to train and prepare the required highly competent staff of various disciplines: designers, managers,

curators, divers and archeologists, who will be members of highly competent State of the Arts organization and will be responsible for the complex technical functions of the Museum.

The Museum will integrate a Training and Research Center for Underwater Archeology sciences and management, where Egyptians and international professionals will learn, exchange and master know-how and spearhead pilot actions for improved practices in the field Egypt and abroad.



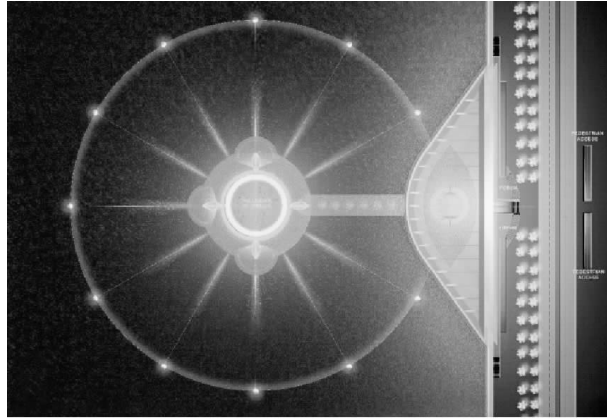
The Museum will also be designed and established as popular destination and meeting place far beyond its archaeological exhibition and research role, a gathering and cross point between land and sea; past and present; history and modernity; Egypt and the Mediterranean; the city and its history.

The integrated development role of the Museum lies in its role as a Center for improved cultural policies and strategies, a knowledge Center of underwater archeology management; A Center of Excellency and a Training Center in the field.

The construction of this museum will accompany and support efforts already made by the Egyptian Government and the SCA for the thorough documentation and sustainable site management of archaeological and historical sites, whereby the Museum will include a specialized Documentation Center of underwater archeology in Egypt, which in addition to the Mediterranean sites, will document the abundant sites in the Red Sea and within the Nile river course.

Featuring one of the largest Mediterranean ports and two international airports, the city of Alexandria occupies a key economic standard is also one of the most prosperous and dynamic in Egypt, with large investments in infrastructure related to tourism.

However, tourism potential of Alexandria, is only partially exploited, despite significant comparative advantages including long cornice along the sea containing important architectural

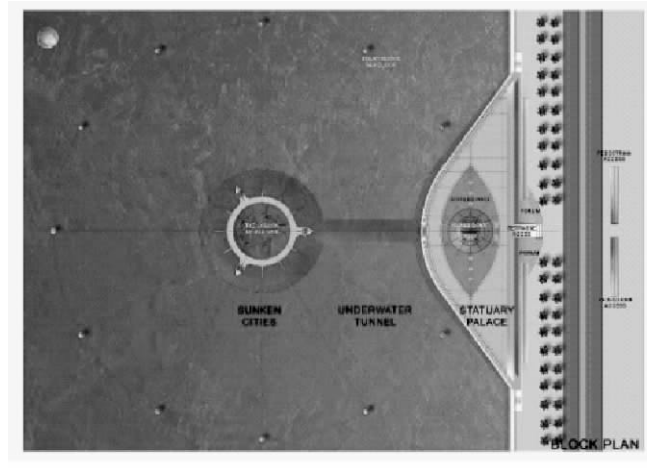


buildings such as the fortress of Qaitbey, the Library of Alexandria, the Montazah Palace, the immense archaeological and architectural heritage, a strategic position on the north coast of Egypt and still preserved beaches stretching westward for hundred of kilometers.

In order to develop the full potential of the city of Alexandria and strengthen it as a Mediterranean hub pilot city in Egypt, many programs are currently ongoing following a strategy based on three pillars: local economic development in enhancing the comparative advantages of the city (including heritage and tourism advantages) and improving the business environment to attract investors; improving participatory urban planning and support regeneration, which should enable dwellers to be actors and beneficiaries of local economic development, the cleanup of Lake Mareotis (west of the center of Alexandria; and the development of its surrounding area, all implemented through several actions.

Since the inception of these programs, many projects have started and are being implemented. The project of the development of the East Harbor Bay Port is an initiative driven by the Library of Alexandria. It aims to restore and protect the entire East Bay, developing Silselah Peninsula (that extends near the site of the Library opposite the proposed Museum site), recreating the Lighthouse of Alexandria, valuing archaeological research conducted in the east harbor bay, creating a museum at Fort Qaitbey, improving pedestrian areas, promoting activities related to the sea (fishing, sailing, water games . . .) and setting up the project “cultural routes for Alexandria”, an action whose objective is to create walks and detailed tourism plans of Alexandria that guides to its architectural heritage and historical sites.

Directly related to this Plan, and among the projects in the pipeline, that of an underwater archaeological museum made its way over the past ten years by the Supreme Council of



Egyptian Antiquities (SCA), which will have a central role in its creation and management and as the organization in charge of all projects concerning museum and the management of historical sites in Egypt.

The Governorate of Alexandria will also be particularly involved in the museum project, as it is responsible for municipal development, local implementation of the policy defined by the central government, and the execution of the development policies and actions of within the city.

The visit of the Alexandria Underwater Museum (whose site is likely to be located on the edge of the Bay of Alexandria) is sought to be part of a circuit that starts from Tahrir Square in Cairo where the historic Egyptian Museum is situated, to continue westwards to Giza Pyramids and Memphis World Heritage Site; the new Grand Egyptian Museum (GEM) to Alexandria via the Desert Road, visiting on the way Wadi al Natroun Coptic Monasteries before reaching World Heritage Site of Abou Mina Coptic City and to the city of Alexandria.

From the city Alexandria the cultural and historical heritage itinerary will continue eastward along the coastal route with a first stop at Aboukir and its submerged treasures, to the Ottoman city of Rosetta and its unique houses on the eastern embouchure of the Nile, then along the extended palm tree groves lying between the Mediterranean sea and the Great Lakes of Burulus and Manzala with their unique fishing and sailors communities and numerous archeological sites, passing by the wetland protectorate of Ashtum Al Gamil before reaching the Suez Canal entry on Port Said City in Africa, with its unique architectural and maritime heritage, possibly crossing to Asia and visiting North East Sinai extended heritage sites.

The Museum will be located in the heart of Alexandria city center. Its visit will be part of a pedestrian itinerary that will include the adjacent Bibliotheca Alexandrina, Greco Roman Museum, the National Museum, the Medieval Ramparts, the famous Roman Amphitheatre and its extended site, Pompeii Pillar, the Catacombs, the Ottoman quarter and its unique houses, and along the Cornice with its exceptional turn of the century architecture to reach the fishing port, the fort of Qaitbay, site of Alexandria Lighthouse, where diving may also be considered to explore the sunken treasures of this 7<sup>th</sup> wonder of the world.

Funding the Museum building and its costly operation enterprise is a challenge, especially considering that the Government of Egypt cannot at this stage directly provide the required funds even if there is a full insurance on investment return.

The funding plan consists of a Private Public partnership whereby investors will build, exploit and share revenues of the Museum with the Egyptian Government, than once a reasonable return of their investment is assured after a set time period, the Museum will be fully handed over to the Egyptian Government.

Funds will also be initially raised from revenues of international exhibitions and will be continuously raised from multiple cultural activities (special displays, paid events, souvenirs sales, all in addition to the traditional ticket revenue and donations. Funding will also rely partly on a share in the real estate development near the Museum prime site, with full respect to human dimension and as integrated to the planned non invasive urban design and architecture of the site.

In other terms, the Museum will generate income both directly and indirectly without being a burden on the limited resources of the city.

The creation of the Museum will lead to direct benefits in terms of employment (managers and workers involved in its construction, the personal of subcontractors and suppliers). After its creation, direct benefits will include the creation of jobs to operate and maintain the Museum (the Museum staff, curators, tellers, security guards, personnel of suppliers and maintenance).

A project of this scale will also generate indirect benefits, in terms of consumption through various services (restaurants, hotels, transport, construction, maintenance).

As indirect effects, as it is likely that the investment in the museum will encourage other investors to invest in the development of the neighborhood (development of hotels, services, infrastructure, entertainment, cruises, guided tours, weekends organized to combine Alexandria, north east and west coasts to Alamein or to Port Said and the Suez Canal.

The urban integration design of the museum will be part of a new urban and land use planning approach envisaged for both the city and north coastal zone areas in order to assure better safeguard of its cultural heritage and natural resources and to stop chaotic urbanization in the city and along the Mediterranean.



The creation of the Museum of Underwater Archaeology also falls over in an ambitious national plan to create more than 20 archaeological museums all over the Egyptian territory. The objective is for Egyptian authorities to provide exhibition sites worthy of the rich archaeological heritage and making national centers of attraction of the highest quality. After the recent creation of the Luxor Museum, the creation of the new Grant Egyptian Museum, the refurbishing of the Islamic Museum and the Coptic Museum in Cairo, the Museum of Alexandria is now the next priority of this program.

The design of the Museum will include a sustainable environmental development component, with the construction being based on the "Environmental Quality Label". This is intended to promote environmental protection practices with local authorities and raise public awareness on this subject. In fact the creation of the Museum will have to tackle, and help solve the problems of the bay jointly with local authorities. These problems include and result in sedimentation; pollution caused by discharges of urban waste water; and polluted untreated industrial wastewater, which all have the effect of accelerating the process of coastal erosion and air pollution. Therefore the design and operations of the Museum will integrate and be related to plans to control wastewater treatment and limit discharges in the Bay, noting that the city of Alexandria rejects in the sea about 18 million m<sup>3</sup> of wastewater per year from sewage and industrial waste.

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Control of pollution is essential and has a direct impact on the protection and exhibition of the archeological heritage submerged in the bay. The creation of a Museum will have to have an international environmental protection stature, joining efforts with all environmental cleaning actions of the Bay in order to assure the protection of underwater habitat of sunken heritage.

# Role of Active Tectonics on the Development and Demise of the Ancient Settlements of Western Anatolia

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About 90 ancient settlements have been located along the coastal zones of western Anatolia, Turkey. Some of them are now situated quite far away from the present seashore, while it is known from historical and archaeological records that they were coastal cities during their peaks. In the same region, however, particularly along the coastal zones of southwest Anatolia, there are other ancient coastal cities which are presently submerged under the sea. Demise and destruction of these ancient settlements are closely connected with tectonic movements and the consequent on-going deformation of western Turkey.

## 1. Anatolia and its Tectonic Background

Mainland Anatolia in Turkey is a major wedge-shaped, discrete tectonic entity bound by the North Anatolian Transform Fault (NATF) and the East Anatolian Transform Fault (EATF) (fig1). This tectonic unit is known in the geological literature as the Anatolian Plate. This plate is escaping westwards from the point of convergence in the Karliova region of East Anatolia with a rate of about 20 mm per year. This generates a North-South extension in the Aegean-Western Anatolian region. Figs. 2 and 3 display the morphology of western Anatolia and the eastern part of the Aegean region formed under the North-South extensional regime. As seen on the maps, the region is characterized by a number of almost East-West trending, sub-parallel, normal fault zones, which border a swarm of grabens (depressions) and interrupting horst blocks (highs) (fig 3). As a consequence, there occurs an intense seismic activity, evidenced by a number of instrumentally recorded earthquakes, roughly encircling the active faults (fig 2). Motions on the faults also confirm an extension in North-South direction. Therefore the western Anatolian and the Aegean regions have long been known to repre-



sent a broad zone of extension stretching from Bulgaria in the north to the Hellenic trench in the south ( Yilmaz et al 2000 ).

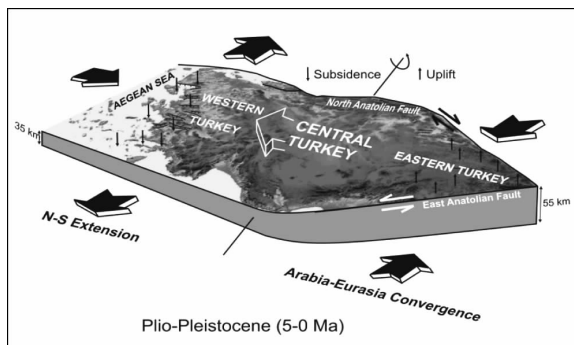


fig 1

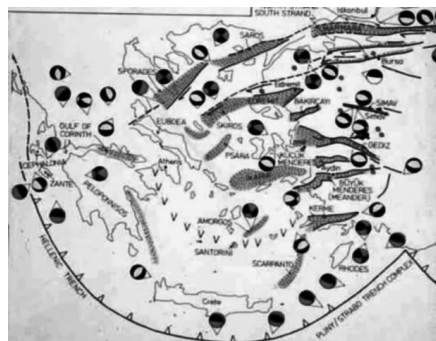


fig 2

The grabens close eastwards and enlarge westwards ( fig 3 ). Some of them are onshore while others extend offshore into the Aegean Sea. The resulting geomorphology dominates the landscape of western Anatolia and controls the major west flowing drainage system. The major rivers of the west Anatolia, the Menderes ( ancient Meandros ) and the Gediz ( ancient Hermos ), are placed within these depressions ( figs 3 and 4 ).

There are about ten approximately East-West oriented grabens in Western Anatolia. The best developed grabens are about 100 ~ 150 km long, and 5 ~ 15km wide. In each of them one margin is characterized by steeper topography, associated with surface breaks, which occurred during historical earthquakes. On the footwall margins block-bounded, planar faults are easily observed.

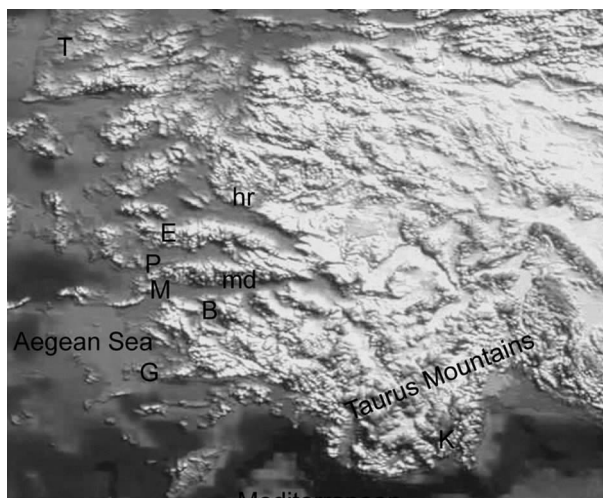


fig 3

Along the Mediterranean coastal zone the role of the active tectonic forces is reflected in different way. It induces the elevation of the Taurus Mountains (fig 3), which has been continuing since the end of Miocene. As a consequence of their uplift these mountains have reached up to 2.5 km average heights, and their rapid elevation has caused physical instabilities leading to block faulting particularly along the southern flank lying sub-parallel to the Mediterranean coast. Some of these fault-bounded blocks are subsiding steadily together with the ancient settlements located above them, which have therefore been gradually invaded by the sea.

## **2. The Role of Tectonic Forces on the Development of the Ancient Settlements**

Often ancient settlements have been located along the coast for the obvious reasons of easy transit and trade by the sea. However there appear a number of additional factors for their creation and location among which the tectonics are at the forefront. They may be listed as follows:

1-The fault-bounded graben depressions, along which flow major rivers westward to the Aegean Sea, transport great amount of alluvial materials. These are deposited along the valley floors and around the delta plains and form fertile soil, which together with the river water is an essential component for a productive agriculture.

2-Plenty of springs, sipping along the fault zones provide a favourable natural environment for a sustainable settlement.

3-The occurrence of hot or warm springs serves recreational and health uses.

4-Formations of travertine deposits associated with the carbonate saturated spring water sipping along the fault zones provide light and easily carved building materials.

5-The fault systems and the accompanying ground water circulation lead to the development of mineral deposits. Gold, silver, iron, copper and some other precious minerals are known to have been extensively excavated and mined in the region during the historical periods (Wagner et al 2003).

## **3. The Role of Tectonic Forces on the Demise of the Ancient Settlements**

The role of tectonic forces on the demise of the ancient settlements can be separated into

the roles of rapid and of slow motions of the earth crust.

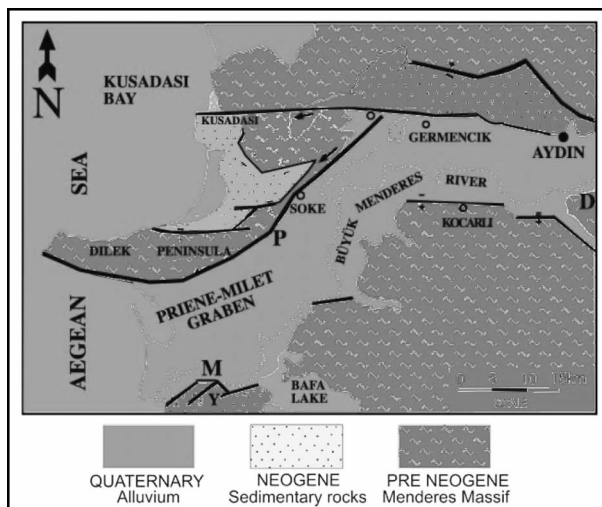


fig 4

### 3.1 The role of the rapid motions of the earth crust

Rapid motions of the earth crust are mainly associated with big earthquakes that cause a number of fatal events due commonly to instantaneous displacements of the earth crust. They generate tsunamis, floods, liquefactions and landslides and cause damages and casualties. An example of this may be given from the city of Troy of northwest Anatolia. Each one of the 9 cultural layers of the ancient city of Troy has been destroyed either by earthquakes or fires or both (Yilmaz 2011). Through the years such events are known to have caused the inhabitants to change the building techniques. In some other cases the ancient settlements have either been forced to migrate to safer places or they have abandoned their locations. The oldest farmers of western Turkey lived in Yenikapi by the Marmara Sea's coastal zone of Istanbul, now subject to large scale scientific excavations. It was totally flooded by the sea about 8, 200 years ago, and the farmers were forced to move to an inland location (Algan et al 2010) possibly under the influence of an earthquake induced flood or tsunami.

Liquefactions of weak grounds also strongly affect settlements along costal zones as exemplified by the recent Marmara earthquakes in 1999 particularly in Golcuk town in the southern Marmara sea region, where the coastal settlements were flooded extensively by the sea and were partly submerged into the softened ground.

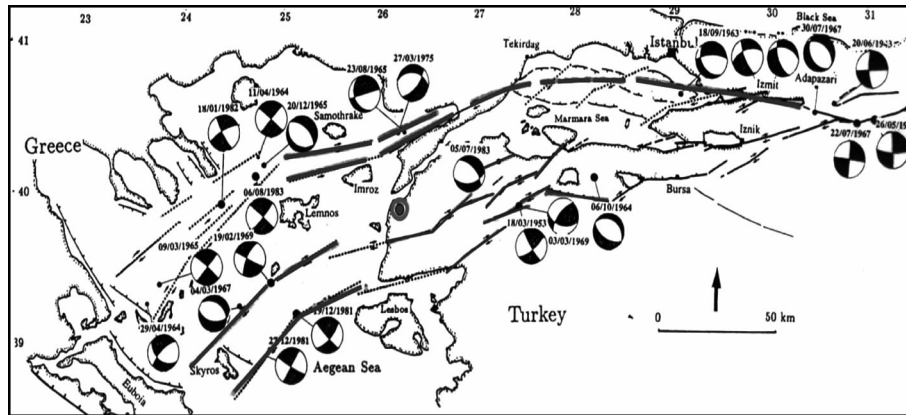


fig 5

### 3.2 Role of slow motions of the earth crust

The role of slow motions of the earth crust in the demise of ancient settlements is observed particularly along the ancient coastal cities of the western Anatolian-Aegean region, where the connection between the North-South extension and the development of the present landform is very strong.

The cartoons in figure 6 display consequent stages of the structural developments of the region under the on-going North-South extension. The extension generates normal faults (fig 6A). As it continues the fault zones are enlarged and thus new gaps are generated (fig 6B). In order to fill these gaps, the fault-bounded blocks are forced to rotate backwards (back tilting) along the curvilinear fault planes (fig 6C). As a result the footwall moves upwards, while the hanging wall moves downwards (fig 6C), and the elevated lands become sites of supply of erosional materials. From the elevated fault blocks the erosion also produces lateral fans. These alluvial materials are added to the alluvium transported by the rivers draining inland Anatolia towards the Aegean Sea (Figs 4). Collectively these alluvial deposits fill the coastal zones. As a consequence the sea retreats steadily from the coast. Gradual retreat of the sea and consequent westward migration of the shore lines are exemplified by the cases of the ancient coastal cities of Troy (Troia), Miletus and Priene (Bruchner 2005, Bruckner et al. 2006 and Kayan et al. 2011). Nowadays these antique cities are 6, 7 and 15 kilometres away from the seashore respectively.

Along the two edges of the extensional regions of the western Anatolia, particularly along the southern coastal zone and in the southern front of the western Taurus Mountain a situation

appears where the mountain is elevated, while the fault-bound southern blocks subside. This subsidence leads to invasions by the sea as seen in the case of the ancient cities of Mydos (Gumusluk), Simena (Kale-Ucagiz), Koycegiz and Heraklia (Bafa) (fig 3).

## 4. Conclusions

From the above it appears that the Western Anatolian coastal region is severely affected by ongoing tectonic movements. The resulting faults have determined major features of morphology. The mode of deformation implies a complex form of extension leading either to the elevation or the subsidence of the fault bounded blocks.

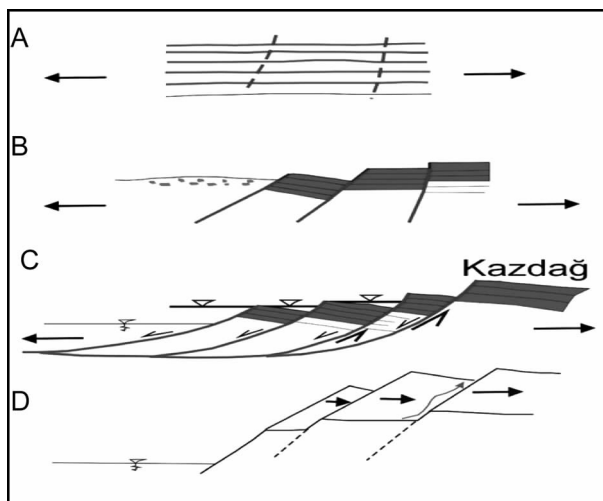


fig 6

These extensional tectonics have generated fault-bounded depressions (grabens), interrupted by highs (horsts) leading to the development of a ragged topography. The major rivers, which transport alluvial materials derived from the elevated lands to the Aeagean Sea, are placed along the graben depressions, where they have filled the valley floors and the areas at their mouth, causing a steady retreat of the sea from the land. As a consequence many ancient coastal cities have been gradually left further away from the sea shore. They lost their character and identities as coastal settlements. Others have been submerged due to the subsidence or erosion of the soil.

It can therefore be concluded that active tectonics occurring continuously at all scales affected the settlements and civilizations favorably at their initial stage of development, but be-

came unfavorable at later stages.

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## FIGURE CAPTIONS

Figure 1-Tectonic map of Anatolia, displaying the Anatolian plate bounded by the North Anatolian Transform Fault and the East Anatolian Transform Faults. The compressional stress field of the Eastern Anatolian region (converging arrows) creates a westerly escape in the Anatolia plate which is accommodated in western Anatolia by a N-S extensional regime (diverging arrows).

Figure 2-Seismotectonic map of western Anatolia. Dotted yellow areas are the graben depressions filled by alluvial materials. The little balls represent the earthquake locations and their seismic analyses (fault plane solutions) of the faults which have generated the earthquakes in these locations (modified after Eyidogan et al 2008).

Figure 3-Morphology and bathymetry of the western Anatolia and the surrounding seas.

Abbreviations:

B, E, G, M, P and T correspond to approximate locations of the famous coastal antique cities of western Anatolia ; Heraklia (Bafa), Ephesus, Myndos (Gumusluk), Myletus, Priene and Troia respectively.

hr and md are the ancient names of the rivers of Hermos (Presently Gediz) and Meandros ( Presently Buyuk Menderes).

Figure 4-Tectonic map of the Mendere Graben (Priene-Milet) of the western Anatolia.

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Abbreviations; P and M correspond to locations of the antique cities of Priene and Miletus.

Figure 5-Seismotectonic map of the north-westernAnatolia. Green and red lines are the branches of the North Anatolian Fault system. The balls are the fault plane solutions of major earthquakes. The red spot indicates location of the ancient city of Troy (Troia)

Figure 6-Scematic block diagrams displaying consecutive stages of the graben development as exemplified from the Kaz dag mountain (ancientIda Mountain).

# **Session 3 Underwater Cultural Heritage Conservation**



# Advances in Conservation-Restoration of Cultural Marine Heritage

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## 1. Introduction

Seawater is a complex and aggressive medium that acts on materials due to a multitude of parameters and interdependent elements that play a role in the alteration of archaeological remains: water, dissolved salts (mainly chlorides), dissolved gases (including oxygen  $O_2$ ), pH, temperature, pressure, biological activity, suspended solids and sediments as well as ocean currents (Memet 2007).

The minute a boat wrecks physical, chemical or biological degradation processes start acting on the objects or groups of objects that are corrosion of metal, infiltration of salt, breaking of glass and ceramics, hydrolysis of organic material and many more. Depending on the specific conditions of immersion, these processes cause the alteration of the object. However, each material tends progressively towards a state of relative stability vis-à-vis its environment.

The removal and return to the surface of an immersed archaeological object inevitably causes a rupture that can be fatal to the object unless protective measures are implemented. The passage from aqueous medium to ambient air activate alteration or initiate new physicochemical as well as biological processes due to oxygen and light on the one hand, but on the other hand,

due to the fact that the objects have been waterlogged and impregnated with salts.

Thus, when a ferrous metal object is raised in the course of underwater excavations, the salts present (mainly based on chloride ions) in the corrosion layers and sometimes even the core will react with moisture in the air (the hydrogen in particular) to form hydrochloric acid (HCl). This is a natural and self-sustaining phenomenon, but if left unchecked, it causes the destruction of the metal, that is to say, the destruction of the object and the irretrievable loss of technical, historical and epistemological information inscribed in the object's original surface.

Upon excavation it is essential to apply emergency measures, referred to as preventive conservation, comparable to the first aid offered to an injured rescuer. Once this first step is carried out properly, one can consider the stabilization and eventual restoration of the finds. In this respect significant technological developments have emerged in recent years, particularly for the treatment of sensitive materials originating from underwater excavations, such as metal or wood.

## **2. The Importance of Preventive Conservation**

The objects found on wrecks provide evidence of daily life on board and relate the adventures for which these boats had been constructed. If these objects appear to have transcended time without damage, the reality is quite different. Physicochemical processes leading to slow internal changes have more or less degraded the constituent materials. The different mechanisms of material degradation in submerged environments are relatively well described in the literature (MacLeod, Davies, 1987; Pearson, 1987; Robinson, 1998): metals corrode and are covered with patina or more or less protective coating, ceramics soak up salt, glass is subject to deconstruction through percolation (Huet et al., forthcoming) and organic materials that conserve well in wet conditions, undergo a dissolution of certain constituents, such as cellulose and collagen, which are replaced by water.

These structural changes, often invisible, require a methodology that is specific for each material in order to limit dramatic changes occurring upon the recovery of the objects from the underwater environment. These major challenges should be taken into account right from the start of the excavation and the removal of objects. It is essential that in each major excavation a logistics manager is designated to support the entire process from locating a site to restoring artefacts at the laboratory, as well as to ensure that appropriate means be provided for this purpose (Reboul 2011). This stage of preventive conservation can provide first aid, anticipate the

treatment of these objects and their study.

Appropriate equipment must be provided for the lifting of the fragile, bulky, heavy or composite material that should ensure their maintenance, handling and recovery in full safety but also their storage in transit to the archaeological base camp. Each object must, at least, be kept immersed (ceramics, glass, lithic furniture, bone, metals, wood, composite objects) or humid (fabrics and ropes, leather, basketry). Without taking into account the specificity of these materials, items are often carelessly exposed to air, which results for metals, iron and copper type, in the dramatic acceleration of corrosion, for ceramics in peeling of the surface due to crystallization of salts (Fig. 1), and for organic materials in drying and thus in the cracking of surfaces and the deformation of the original form. In later steps, after cleaning from sediment, the heritage will be inventoried, drawn, photographed and studied, which requires the provision of treatment according to the artefact's fragility. For some materials, such as ceramics, unaltered glass and bones, desalination can be started and even finalized using tap water while regularly monitoring the removal of salts (Berducou 1990). For other materials, storage should be considered in terms of long-term storage because it can last from several weeks to several months or even years. It is preferable for metals, if possible, to store them in a basic medium (Fig. 2) and organic materials to anticipate regular maintenance and thus store them in cold storage in order to limit the development of microorganisms.



The peculiarity of these materials, which in underwater environment appear intact though being object of advanced deterioration, makes it so important to ensure their conservation from

the very beginning. Before beginning an operation of underwater archaeology it is therefore essential to simultaneously provide for research equipment and for the human as well as material resources required for the preservation of the finds.

Since January 2010, the DRASSM has a unit in charge of preventive conservation and collections management that counts on two specialists for the conservation of maritime cultural heritage. In addition to assisting in DRASSM expeditions or delicate removals of heritage, the unit is charged with educating members of excavation teams, professionals or volunteers, in the conservation of materials. It also aims to ensure continuity throughout projects from research to recovery. It has to make up for 40 years, in which objects have often fallen into neglect after their first study and have been abandoned in various deposits under less than ideal storage conditions.

### **3. Advances in Conservation-Restoration**

In France, several laboratories are involved in conservation-restoration treatment of cultural objects raised from the sea. Three of them-Arc'Antique, ARC-Nucléart et A-CORROS - regularly undertake basic research in view of advancing treatments for the safeguarding of these materials under stress during and after their immersion.

This section discusses some of the programs that have been elaborated in recent years or that are under development:

- Treatment of large objects composed of waterlogged wood,
- Techniques of dechlorination of ferrous metals with subcritical fluids,
- Computer controlled electrolysis of metal objects and
- In-situ conservation of shipwrecks metal.

Before addressing such advanced techniques, it is useful to recall the basic steps of the conservation process of archaeological objects retrieved underwater.

#### **3.1 The different stages of conservation treatment and restoration**

After storage and upon arrival at the restoration laboratory, four steps mark the conservation and restoration of underwater archaeological objects (Memet 2008):

- Stabilization,
- Removal of concretions,
- Restoration and

- Finish for a long-term preservation.

If the sequence for organic materials follows the outline described above, the peculiarity of the degradation mechanism of wood and its treatment will be more described in section 2. 2.

Stabilization, the longest stage of the process aims at making the object stable vis-à-vis its new environment and thus greatly limiting or completely stopping the process of alteration. For metals, this step is usually called dechlorination, while for ceramics and glass the term used is desalination. The aim is to extract the salts accumulated in the object during the centuries of burial in different environments (sea water or brackish water but also fresh water and soil). Stabilization is a step referred to as " passive" because the stabilization treatment for metals used today consists in the immersion of objects in a chemical solution (usually alkaline, soda-based), while for ceramics and glasses a simple bath of fresh water is sufficient. Despite correct stabilization of the object (extracting up to an estimated 90% of the chloride ions) the major drawback of these treatments is their duration, since according to the nature of the object and its environment (fresh water, sea water), it can take several months to several years for metallic objects (up to 3 years for electrolysis stabilization of cast iron objects from seawater). This length generally takes up 90% of the total processing time of the object.

The removal of concretions is another step in the process that is carried out by the restorer usually applying mechanical tools and using chemical baths or for ferrous objects electrolysis. According to the materials and processes used rinsing can be done before or after stabilization, in the case of large objects, like cannon or anchor, even simultaneously with the stabilization stage (Fig. 3).



Restoration being thus the active phase of the process is carried out by the restorer with special tools similar to those of a dentist. Micro-drills, micro-milling cutters, micro-lathes, micro-scalpels, micro-chisels and micro-sandblasters will allow the conservator to reconstitute the original surface of the object that carries the archaeological information, that is to say the surface that holds decorations, motifs and inscriptions in order to allow for typological, historical or epistemological analysis of the object. It is also a stage at which fragments of the same object can be reassembled, resulting in more or less consistent consolidations.

The finish will consist in the application of surface coatings, supposedly reversible, which confer to the object resistance to the atmosphere in which it will be placed (on display in museums or outside for large objects). This is usually the case for metal objects (wax, resin or varnish) or some glasses.

### 3.2 The treatment of large objects of waterlogged wood

Organic materials rapidly degrade under normal conditions due to biological agents (insects and microorganisms). Underwater environments with low oxygen rates (anaerobic) are more favourable to their preservation despite the irreversible damage done to their physicochemical internal structure resulting in the dissolution of certain constituents in water (cellulose for wood, collagen for leather). Waterlogged organic materials that are soaked up with water are stable as long as their place of burial or disposal is not changed, but once exposed to air, they are deformed. Drying without precaution leads to their destruction. As has already been mentioned in paragraph 1, the right conservation treatment ensured upon excavation is most important in order to ensure long-term preservation and optimal treatment.

The most delicate phase is the drying of these materials since their structure is particularly degraded. Prior to drying it is therefore necessary to imbue these objects to their core with a consolidant that will reinforce the mechanical properties of the structure. The state of degradation of the object, its dimensional and future of the collection will determine the choice of treatment methods (Clermont-Joly, 2006). The duration of treatment can vary from months to several years according to the method used.

ARC-Nucléart is one of the leading laboratories in the treatment of waterlogged organic materials (Bernard-Maugiron et al., 2007). In face of the discoveries of recent years, such as the boats discovered at the Park Saint Georges in Lyon, the team specializes in very large wooden waterlogged objects and has made several technical innovations enabling it to carry out their treatment. Thus, apart from tanks that allow conventional impregnation of small objects or

pirogues with polyethylene glycol (PEG), a modular processing in pools allows for the consolidation of large vessels by fogging them with PEG (Fig. 4). After this impregnation with different grades of PEG, the drying can be done in function of the size of the object either by lyophilization or by controlled drying. For the first case, the laboratory is equipped with two large capacity freeze dryers, one with a diameter of 1m for a length of 5m for the drying of pirogues, and the other with a diameter of 1.7 m for a length of 3m. For bigger objects such as boats measuring up to ten meters it is only possible to provide for controlled drying in an air-conditioned chamber. For instance the pirogue of Gueugnon that is 9m long and dates from the Carolingian period underwent impregnation for almost 2 years followed by a year of controlled drying. For this kind of operations it is essential that a suitable support is created at the time of excavation in order to facilitate its handling throughout the process. At last, a significant operation is the design of the support used for public display and thus the re-assembly of dispersed fragments. This support should follow the contours of each piece sustaining the most fragile objects and those subject to mechanical stress, while being very visible. For boats that are in dozens of pieces, the design phase may require several weeks of reflection and various trial assemblies (Fig. 5).



### 3.3 Subcritical fluids as a new technique for the stabilization of archaeological objects

Conventional techniques for stabilizing metals involve the re-immersion in appropriate chemical solutions, generally basic or in absence of alternatives in water. Basic solutions (soda for ferrous, sodium sesquicarbonate for copper) have the advantage of stabilizing corrosion but the downside of acting very slowly. It will take more than 5 years to stabilize bulky items like guns or anchors in a traditional chemical bath. In the 1980s electrolysis was first introduced to treat this type of object. Electrolysis reduces the processing time by half, but the process is

still very long. In the 2000s a new technique has been gradually introduced as a promising process for stabilizing ferrous archaeological material, the use of subcritical fluids.

Subcritical fluid properties have been studied in France for over 40 years. The first applications have been developed for cleaning sheet metal in the metallurgical industry. Although these subcritical fluids are increasingly used in many industrial fields ( pharmacology, filtration, cleaning and etching, etc. ), it was not until 2001 that Mike Drews, researcher in materials science at the Clemson University ( South Carolina, USA ), together with a team of conservators led by Paul Mardikian had the idea of applying this process for the first time for the stabilization of metallic archaeological objects. A prototype chamber of small capacity ( 0.75L ) was rapidly built and the first tests were launched. It was very quickly realized that this process drastically decreases the processing time for the stabilization of archaeological objects. After nine years of research, published examples confirm that the stabilization time is reduced between 20 to 30 times, thus for small items from several months to several days ( 4 maximum ).

Clemson University has launched its second machine in a pre-industrial phase, with a 30L tank. The first treatments were carried out on archaeological artefacts yielding results that exceed all expectations and thus confirming the contribution of this new technology to the profession.

### 3.3.1 Working Principle

A fluid in subcritical state has the physical properties between liquid and gas, thus preserving its quality of a liquid while acquiring the properties of a gas ( high diffusivity, low viscosity, reduced density and very low surface tension ).

The archaeological object placed in a tank is immersed in a chemical solution under pressure and heated beyond the boiling point. Once the solution attains the subcritical status the corroded object is immersed causing an almost instantaneous reaction that extracts the salts. The solution is monitored in real time. It can be renewed once, twice if necessary. Once the object does not release any more salt, the tank is emptied and the stabilized object can be collected.

First tests at Clemson Conservation Centre ( CCC ) have confirmed that this process can significantly reduce the extraction time of chlorides, which are the main agents of the active corrosion of metals. The CCC has given the example that an object that is usually stabilized in 3 months can be processed in 72 hours with subcritical fluids.



### 3.3.2 An Innovative Use

This new technology opens up very promising future perspectives in significantly decreasing stabilization time, minimizing the stabilization solution volume and redefining the stages of treatment.

Currently, when an archaeologist discovers an archaeological object in metal, he rarely has the budget at hand that would allow for immediate conservation and restoration of the artefact, this being in particular the case for underwater excavations. Consequently the objects are stored in depots or centres for conservation and education (CCE) awaiting their examination in the course of which a decision will be taken on the conservation and restoration. This can take years and every month spent without treatment directly translates into the inexorable and irreversible loss of archaeological, historical and technical information carried by the surface of the object. In the past many conservators, archaeologists and collection managers have stood passive witnesses to the complete disappearance of some collections that had not been stabilized.

The development of this new technology may lead to two major changes in preventive conservation and conservation-restoration:

- Opportunities for mass treatment at the site of excavation or at the storage of collections, that will allow for the stabilization of metal objects until restoration and study. Once the objects are stabilized and thus "saved", they can be stored in appropriate conditions for long periods while not running any danger of degradation or destruction.
- Possibility to stabilize items in the underwater environment at the time of recovery and thus before the removal of concretions. The subsequent dry storage of objects would thus allow skipping the stages during which metal objects are stored in tanks filled with storage solutions, that are always expensive and difficult to manage from a practical point of view but also taking into account biological contamination.

By the end of 2011, the corrosion laboratory in Arles will be equipped with the first machine of this kind in Europe with a treatment tank of 200L that represents the largest processing capacity in the world.

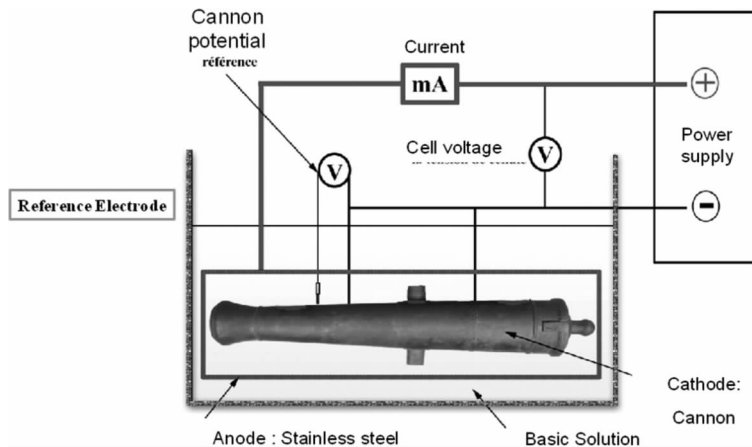
## 3.4 Electrolysis treatments controlled by internet

Treatment of large metal objects from underwater discoveries, such as cannons and anchors, is often more problematic (treatment technique, handling, transportation, space, etc.). The effective stabilization of such objects can be obtained by electrochemical techniques that are essential for long term conservation. This step is long since the full electrochemical ex-

traction of chlorides takes depending on the metal on average between 1 to 5 years and requires the mobilization of substantial areas of treatment.

#### 3.4.1 Principle of electrolysis

The application of electrochemical methods allows among others for the acceleration of the extraction of chlorides and thus the reduction of the processing times (North, MacLeod, 1987; Lacoudre, Degrigny, 1999; Degrigny, Spiteri, 2004). By creating an electric field between a cathode (the object to be processed) and an anode (an inert metal usually stainless steel) the electrochemical treatment (Fig. 6) provides protection for the metal while extracting the chlorides from the object to the electrolyte (a basic solution). This treatment is "controlled" by the potential of the object and the two other parameters of electrolysis which are the current and the cell voltage (voltage between anode and cathode). This treatment allows in a first step for the removal of concretions without causing damage to the object, and secondly for the completion of the dechlorination. The parameters as well as the sample of the immersion solution should be monitored weekly in order to assess the amount of chloride extracted. Based on these assessments the treatment baths shall be regularly renewed in order to optimize the extraction time of chloride, which is still in the order of a few years.



#### 3.4.2 Kraken; Remotely Conducted Electrochemical Treatment

The increased demand for the restoration of such heritage in the national territory and abroad have incited the Arc'Antique to propose for ten years treatments performed at the site of discovery or storage through the training of local partners (Baron et al., forthcoming). Advances in the field of information technology and communication (ICT) now allow considering remotely monitoring these interventions and interacting in function of the parameters transmitted

over the Internet (Guilminot et al. 2007, 2008 Memet). On this basis, Arc'Antique in collaboration with specialized companies has developed over 5 years a remote control apparatus for these treatments called Kraken in view of exchanging data and controlling parameters in real time via GPRS, Wifi or Ethernet (Fig. 7). Full automation facilitates the daily operation (monitoring of electrolyte parameters, continuous data tracking, mixing and upgrade solutions, technical alarms, etc.) and ensures safety and reliability of treatment. The use of this equipment serves primarily to limit the transport and logistics but also to achieve an on-site treatment and so set up heritage valorisation activities for the public. The first treatments have confirmed that the parameters quickly stabilize and that the treatment is therefore accelerated by several months. This tool is currently undergoing further studies to reduce processing times.



Conceived for dealing with objects near the sites of discovery, this equipment can also be used for educational purposes to provide skills via remote assistance to foreign colleagues in order to optimize treatment of artefacts.

### 3.5 In situ conservation: an alternative treatment

Between the discovery of a site, the first survey, the research, the recovery of objects and collection budgets for the treatment of collections often elapse months or even years. For this reason preventive conservation in situ has grown over the years (Alves 2008, Manders, 2008) according to several approaches:

- Preventive conservation of sites and their conversion into underwater archaeological parks,
- Preventive conservation of objects in preparation of their excavation or long-term conservation,

- Probing, studying and excavating sites, then reburying them for the benefit of future generations.

Three approaches have been identified by archaeologists that can be classed according to the materials being protected: an organic object approach favouring post-examination reburial of a wreck and the monitoring of its evolution over time ( Moss Project 2004 ); the built heritage approach privileging the valorisation of heritage under water through the creation of underwater archaeological parks - including the restoration. Note also in the field of preventive conservation in situ, the Italian approach, initiated by R. Pettriaggi and B. Davidde ( Davidde 2002 ) exemplified by the restoration of the underwater site of Baia in Italy. This project allowed for the development of new intervention methodologies and new tools to carry out underwater restoration activities equivalent to those conducted for architectural ensembles on land. Finally, the metal wreck approach constituting a compromise that emphasizes study and cathodic protection of wrecks ( Nordgren 2007 , McLeod 2006 ) as well as the opening of underwater parks. On this last point that we emphasize.

Metal in marine construction first appeared in the form of copper or iron nails and then expanded over the centuries to various forms ( lead and copper to protect the wood from attack by marine borers, etc. ). But starting from the end of the nineteenth century metal was used extensively for the construction of metal vessels.

Today metal wrecks are a heritage in danger if nothing is done. In theory, the corrosion rate of steel in the marine environment is of 0. 1 mm per year. This figure is of course an average value used by any civil engineer in charge of the construction of a dock or a platform, but it is also the result of feedback on the aging of steel in seawater for over 50 years. A loss of 0. 1 mm per year means that in a century a metal originally 10mm thick disappears. The thickness of sheet metal that make up the majority of the boats first and second world wars usually amounts to 10mm. From this arises the importance of diagnosis and of safeguarding this heritage at risk and our future monuments.

Metal wrecks are emblematic places threatened by the corrosion of their hulls. Visit to wrecks constitute an attraction factor for the dive clubs located on our shores that in turn have a significant value for tourism. Corrosion leads inexorably to the loss of historical or epistemological information, not to mention the economic loss ( if the wreck disappears, all dive sites are lost ). More problematic, it can cause the collapse of the main structure of ships that could in fact threaten the life of visiting divers. Finally it can also cause an ecological disaster due leakage of cargo ( fuel tanks, chemicals such as mercury, etc. ).

The elaboration of a theoretical preservation strategy for wrecks is not reasonable sufficient. Archaeologists and conservators must meet at sites to estimate in a first time corrosion rates of metal ship hulls, and in a second time, invent the best protection for the most emblematic wrecks. We must therefore follow the Australian example led by I. Macleod that consists in a precise and detailed analysis of the thickness of residual metal, of the electrochemical potential of the wreck, as well as of the wreck's influence on sediment and living environment. First studies in situ have determined that the average corrosion rate in open water was about 4 times lower than the theoretical speed (around 0.025 mm/year) but the rate of corrosion of metal assemblies was on the contrary 3 to 4 times superior due to galvanic coupling upon immersion.

The 21st century will inscribe the metal wrecks of the first and second world wars to the inventory of the archaeological heritage. This is imminent. In situ preservation of underwater remains is therefore today increasingly important, and especially since it encompasses the historical, epistemological, economic and sustainable development. The first exemplary wrecks for long-term assessment and monitoring should be selected on the basis of these elements.

## 4. Conclusion

With the progress of underwater archaeology to great depths and the increasing discoveries of remains, the preservation and restoration of underwater cultural heritage is changing. Conservation and restoration are essential vehicles for the protection, recovery and transmission to future generations of this maritime heritage and as such they turn to the public. Gone are days when objects were excavated without consideration for their future conservation, gone are the days where everyone was acting within the strict framework of his discipline. Today archaeology, conservation, restoration and enhancement of heritage are closely linked even to such an extent that more and more programs designed to bring the diver, the history buff or the curious to the deep water, in reality or virtually. For the objects preserved in situ or in museums, it is essential that the best measures are taken for their conservation upon discovery.

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# An Analysis of the Soluble Salt of Jingdezhen Blue and White Porcelain Excavated from the No. 1 Nan'ao Shipwreck

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## 1. Introduction

One of the main problems that porcelains discovered underwater from seawater is the threat of salt infiltrated into the interior of porcelains. Understanding the initial condition of these porcelains, especially the distribution of soluble-salt in the porcelains, may improve the reliability of relevant experiment and analysis in research on conservation and take relevant protective measures in later stages of conservation. We conducted an analytical investigation on the salt in Jingdezhen blue and white porcelains from the Wanli Period of the Ming Dynasty (1368-1644) discovered underwater, which have textures that are markedly different in the No.1 Nan'ao, as observed through microscope, Energy Dispersion X Ray Fluorescence (EDXRF), laser ablation inductive coupling plasma analysis of emission spectrographic (LA-ICP-AES) and DX-600 Ion Chromatograph. The main conclusions of the investigation are as follows: porcelains with good glaze, salt content decreases progressively from the surface to the inside; but porcelains with poor glaze, salt mainly gathers at the point where the body and glaze combine.

## 2. Analysis of Jingdezhen Blue and White Porcelain Samples

### 2.1 Selection of Samples

Three pieces of blue and white porcelain fragments of Jingdezhen from the Wanli Period,



Ming Dynasty, discovered underwater in No. 1 Nan'ao were chosen for the research. The sea-floor where the samples were discovered underwater is exposed earth. After salvaging the samples, they were simply washed with seawater and dried without other treatment. For a convenient comparison, two of the chosen pieces of blue and white porcelain fragments of the Jingdezhen Guanying Kiln were selected as references, which were unearthed in the stratum of the middle period of Wanli. The results in relation to appearance observed are shown in Table 1, as follows:

**Table 1 Basic Information of Samples**

No. of Samples	Source	Age	Appearance Observation of Samples
NA-1	No. 1 Nan'ao	Wanli Period, Ming Dynasty	White and loose texture; glaze with big and turbid bubbles
NA-2	No. 1 Nan'ao	Wanli Period, Ming Dynasty	Thin and white texture, slightly loose; blue and white color a little too dim
NA-3	No. 1 Nan'ao	Wanli Period, Ming Dynasty	Dense texture; bright glaze surface; fine bubbles
GYG-1	Jingdezhen Guanying	Middle Period of Wanli, Ming Dynasty	Dense texture; bright glaze surface; fine bubbles
GYG-2	Jingdezhen Guanying	Middle Period of Wanli, Ming Dynasty	Dense texture; bright glaze surface; fine bubbles; glazing color a little too green

## 2.2 Method and Analysis

A stereo microscope was employed for micro observation and an Aigo digital viewer GE-5 for the photography, with an amplification factor of 60.

For the analysis and Imagery of Energy Dispersion X Ray Fluorescence (EDXRF), XGT-7000 X ray fluorescence analysis microscope of HORIBA STEC, Co., Ltd. were used, which are property of the School of Archaeology and Museology, Peking University. The microscope has a 30kV accelerating voltage, a 1mA current and has no optical filter. It uses a vacuum mode that enables the detection of Na to U. The spot analysis spot size is 1.2 mm, acquisition time 100s and surface imaging spot size 50 $\mu$ m. The sections of the samples should be taken far from the edge. Use a carborundum wheel to cut the samples into strips, then break them and the fresh sections must be analyzed immediately. The section should be as smooth as possible and perpendicular to the surface of porcelain. During the process of sample-making and sample introduction, contact with matters of high Cl element, such as sweat,

must be strictly avoided.

Use a Prodigy type for all spectrums direct reading emission spectrum of the School for Laser ablation inductive coupling plasma analysis of emission spectrographic (LA-ICP-AES). ICP power 1.1kW, cooling gas Ar, flow 20L/min, and pressure of nebulizer 45psi. Laser ablation sample introduction system is UP266 Macro type of New Wave Group. Laser crystal Nd: YAG, wavelength 266 nm, exciting power 14mj, ablation diameter 610 $\mu$ m, frequency 10Hz, sampling time 30s; carrier gas He; flow 1320ml/min. Fresh sections of the samples should be prepared (as in the method described above) for analysis. For glaze texture analysis, blue and white and the surrounding part of white glaze should be measured separately, and laser ablation employed once in advance before collecting data in each test point in order to remove surface contamination, if any.

DX-600 type Ion Chromatograph of DIONEX Corporation of Analysis and Testing Center, Beijing Normal University, was used for soluble salt. For anion analysis, use AS14 separation column, flow 1.2ml/min and 3.5 ~ 1.0 mmol/L NaCO<sub>3</sub> isocratic elution. The detector is ECD ASRS-ULTRA automatic electrochemistry suppression circulation mode, suppression current: 40mA. For cation analysis, use CS12A separation column, flow 1.0 ml/min and 20 mmol/L mesylate isocratic elution. Detector is ECD CSRS-ULTRA automatic electrochemistry suppression circulation mode, suppression current: 40mA. Take about 1g of the test sample, and smash it to larger than 80 meshes. Add 5.00mL hyperpure deionized water after accurate weighing. Lixivate for 72 hours at room temperature. During the process, once every 8 hours shake and blend. After finishing, centrifugally separate the insoluble substance and take supernate for ion chromatography analysis.

### 2.3 Analysis Results

#### (i) Microscopic Observation

Under a 60  $\times$  lens, we see that two pieces of the Jingdezhen Guanying porcelain in the matched group have a transparent glaze layer and distinct bubbles without sediment. In contrast, the glaze layer of NA-1 is indistinct and there is substantial white slat crystallization; NA-2 has a similar phenomenon but the degree is slightly less; there is little sediment in the glazed layer of the NA-3 sample.

#### (ii) Analysis of Glaze Component

To develop a further understanding of the object of study, LA-ICP-AES was used to analyze the elements of the glazes of 5 samples-refer to Table 2 and Table 3 for results.

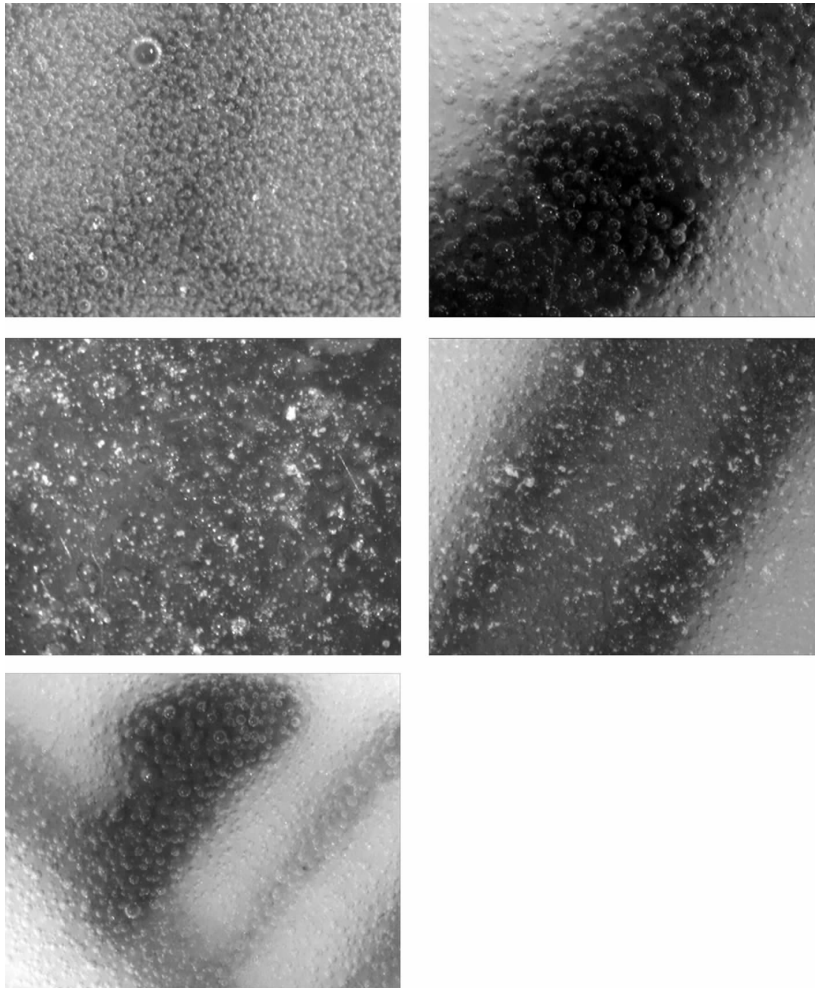


Figure 1; Photomicrographs (60 ×) of ceramic chips indicates the salt deposit in the glazed layer; no deposit of GYG-1/GYG-2; there is a quantity of salt deposit (white plaque) in glazed layer; salt deposit in the NA-2 glazed layer is slightly less; only a minute quantity of white spots in the NA-3. Scaleplate in the figure refers to 500 $\mu$ m.

Based on the analysis result of infiltrated soluble salt by ion chromatography, the quantity of sodium and magnesium in soluble salt will not have an obvious influence on the result of sodium and magnesium in the body and glaze.

**Table 2 Chemical Composition of Porcelain Body (LA-ICP-AES method, w/w%)**

No. of Samples	NA-1	NA-2	NA-3	GYG-1	GYG-2
SiO <sub>2</sub>	74.59	75.37	75.82	75.10	78.06
Al <sub>2</sub> O <sub>3</sub>	20.29	19.73	18.76	18.62	17.23

续表

No. of Samples	NA-1	NA-2	NA-3	GYG-1	GYG-2
Fe <sub>2</sub> O <sub>3</sub>	0.99	0.77	0.87	0.72	0.69
MgO	0.19	0.16	0.18	0.22	0.15
CaO	0.20	0.45	0.64	0.58	0.09
Na <sub>2</sub> O	0.83	0.81	0.84	1.69	1.20
K <sub>2</sub> O	2.79	2.66	2.83	3.02	2.52
TiO <sub>2</sub>	0.11	0.05	0.05	0.06	0.06
P <sub>2</sub> O <sub>5</sub>	0.02	0.04	0.04	0.05	0.04
MnO	0.08	0.06	0.05	0.03	0.07

**Table 3 Chemical Composition of Porcelain Body and Blue and White Sections  
(LA-ICP-AES method, w/w %)**

No. of Samples	NA-1		NA-2		NA-3		GYG-1		GYG-2	
	Blue and White	White Glazed	Blue and White	White Glazed	Blue and White	White Glazed	Blue and White	White Glazed	Blue and White	White Glazed
SiO <sub>2</sub>	62.29	70.03	70.44	71.47	67.40	67.02	68.29	68.73	66.81	71.75
Al <sub>2</sub> O <sub>3</sub>	17.81	15.22	13.28	13.84	16.59	15.76	15.06	15.48	17.40	14.26
Fe <sub>2</sub> O <sub>3</sub>	1.94	1.39	1.41	1.53	1.07	1.59	1.02	1.53	0.99	1.22
MgO	0.34	0.29	0.18	0.14	0.28	0.25	0.35	0.23	0.26	0.26
CaO	7.31	7.96	8.19	9.92	7.43	8.55	6.52	6.15	3.91	5.06
Na <sub>2</sub> O	1.52	1.24	1.56	1.30	1.86	1.86	2.54	2.81	2.78	2.60
K <sub>2</sub> O	2.72	3.42	4.09	3.42	4.00	4.42	3.89	4.66	3.13	4.48
MnO	2.06	0.11	0.47	0.10	0.72	0.10	1.51	0.08	3.23	0.10
CoO	0.436	0.006	0.042	0.000	0.134	0.000	0.306	0.000	0.678	0.000
P <sub>2</sub> O <sub>5</sub>	0.075	0.044	0.126	0.122	0.070	0.239	0.113	0.115	0.086	0.119
TiO <sub>2</sub>	0.109	0.061	0.038	0.042	0.076	0.051	0.074	0.074	0.101	0.050
Sb <sub>2</sub> O <sub>3</sub>	0.017	0.007	0.005	0.002	0.028	0.005	0.038	0.006	0.000	0.004
CuO	0.038	0.014	0.006	0.010	0.025	0.009	0.019	0.009	0.064	0.013
PbO	2.913	0.051	0.002	0.002	0.029	0.007	0.036	0.002	0.037	0.008
BaO	0.110	0.045	0.023	0.019	0.041	0.035	0.049	0.029	0.037	0.019
SnO <sub>2</sub>	0.035	0.010	0.009	0.007	0.070	0.008	0.027	0.011	0.136	0.011
SrO	0.011	0.011	0.007	0.007	0.011	0.012	0.012	0.014	0.011	0.014
ZnO	0.039	0.009	0.000	0.001	0.000	0.006	0.000	0.003	0.000	0.000
B <sub>2</sub> O <sub>3</sub>	0.066	0.041	0.032	0.034	0.060	0.060	0.026	0.039	0.073	0.014
V <sub>2</sub> O <sub>5</sub>	0.033	0.011	0.012	0.014	0.044	0.007	0.048	0.013	0.112	0.014
NiO	0.057	0.022	0.066	0.007	0.046	0.011	0.034	0.005	0.094	0.014
ZrO	0.030	0.003	0.003	0.002	0.000	0.002	0.000	0.002	0.000	0.006

To analyze the composition of body and glaze and the proportion of blue and white pigment, the body formula, glaze formula and ratio of MnO/CoO are calculated in accordance

with literature method [ 1 ], and the results are in Table 4 and Table 5.

**Table 4 Body Formula of Samples**

No. of Samples	Body Formula
NA-1	$\left. \begin{array}{l} 0.216R_2O \\ 0.042 RO \end{array} \right\} \cdot 1.0Al_2O_3 \cdot 6.238SiO_2 \cdot 0.047 R_xO_y$
NA-2	$\left. \begin{array}{l} 0.231R_2O \\ 0.062 RO \end{array} \right\} \cdot 1.0Al_2O_3 \cdot 6.482 SiO_2 \cdot 0.035 R_xO_y$
NA-3	$\left. \begin{array}{l} 0.237R_2O \\ 0.086 RO \end{array} \right\} \cdot 1.0Al_2O_3 \cdot 6.858 SiO_2 \cdot 0.039 R_xO_y$
GYG-1	$\left. \begin{array}{l} 0.325R_2O \\ 0.087 RO \end{array} \right\} \cdot 1.0Al_2O_3 \cdot 6.846SiO_2 \cdot 0.034 R_xO_y$
GYG-2	$\left. \begin{array}{l} 0.272R_2O \\ 0.032 RO \end{array} \right\} \cdot 1.0Al_2O_3 \cdot 7.689SiO_2 \cdot 0.038 R_xO_y$

From the body formula, we can see that NA-1 and NA-2 need a higher firing temperature than other samples. Meanwhile, observed from the surface of samples, the vitrification degree of NA-3 is the highest, NA-2 is the second and the NA-1 the worst. Vitrification degree of NA-1 is not high with a little underfiring.

**Table 5 Glaze Formula of Samples and the Ratio of Blue and White MnO/CoO**

No. of Samples	Glaze Formula	Blue and White MnO/CoO
NA-1	$\left. \begin{array}{l} 0.275 R_2O \\ 0.725 RO \end{array} \right\} \cdot 0.726 Al_2O_3 \cdot 5.674 SiO_2 \cdot 0.066 R_xO_y$	4.55
NA-2	$\left. \begin{array}{l} 0.241 R_2O \\ 0.759 RO \end{array} \right\} \cdot 0.571 Al_2O_3 \cdot 5.004 SiO_2 \cdot 0.058 R_xO_y$	9.30
NA-3	$\left. \begin{array}{l} 0.327 R_2O \\ 0.673 RO \end{array} \right\} \cdot 0.656 Al_2O_3 \cdot 4.734 SiO_2 \cdot 0.066 R_xO_y$	4.77
GYG-1	$\left. \begin{array}{l} 0.451 R_2O \\ 0.549 RO \end{array} \right\} \cdot 0.722 Al_2O_3 \cdot 5.439 SiO_2 \cdot 0.067 R_xO_y$	4.65
GYG-2	$\left. \begin{array}{l} 0.481 R_2O \\ 0.519 RO \end{array} \right\} \cdot 0.752 Al_2O_3 \cdot 6.418 SiO_2 \cdot 0.062 R_xO_y$	4.65

From the result of the ratio of manganese and cobalt of blue and white, except NA-2, the other four samples are very close.

## (iii) Distribution Analysis of Soluble Salt

Given that the major components of sea salt are NaCl, XRF was used to analyze Cl content in the research, in order to represent salt deposits. Since Cl elements have low detection sensitivity, and as the relative content is not high in the samples, the detected signal is weak. Relative content calculated with a ratio of peak area integral may have large errors, so the intensity of the X-ray of Cl elements were used directly under fixed condition as a reference quantity. Results are listed in Table 6.

**Table 6 Intensity of X-Ray of Cl Element in Different Parts of the Sample Sections (cps/mA)**

Sample No.	Middle Part of Glaze Layer	Joint of Body and Glaze	Middle Part of Glaze Layer
NA-1	48.91	54.83	48.28
NA-3	57.40	24.54	0.33
GYG-2	5.28	0.00	0.00

It can be seen from the table above that the salt content of porcelain discovered underwater is obviously higher than samples unearthed in Jingdezhen and different distributions appear in different samples. To study the distribution in a more visual and overall way, XRF section scanning technology was used to scan Cl element content and form an image for sections of each sample (see Figure 2).

Clearly, among the 3 scanned pictures, NA-1 is the “hottest”, its curve reflects the highest Cl element content; both the image temperature and curve of NA-3 and GYG-2 indicate low Cl element content. Furthermore, Cl element in each curve shows a certain trend as depth changes, which illustrates that Cl element concentrates on the surface and several areas inside. Since Cl element content is near the fix quantify limit of instrument, the error of measurement is large. To overcome this, 256 lines of pixel near each picture was chosen as a scanning line. Then, the intensity of each spot line by line was added to reach the sum of Cl element at each depth, after which the depth was drafted (see Figure 3).

Cl content of the three samples tend to decline as depth increases. Cl content of NA-1 is high on the whole, and the decline to depth is not obvious. What's more, at the depth of joint of body and glaze, the peak of Cl content appears. Cl content of NA-2 glaze is high, but Cl content rapidly declines as depth increases and closes to GYG-2 inside the body. Cl content in GYG-2 is low and only concentrates in the thin layer of the surface. In the sample of NA-1, salt gathers in the joint of the body and glaze, which does not mean that distribution of salt in

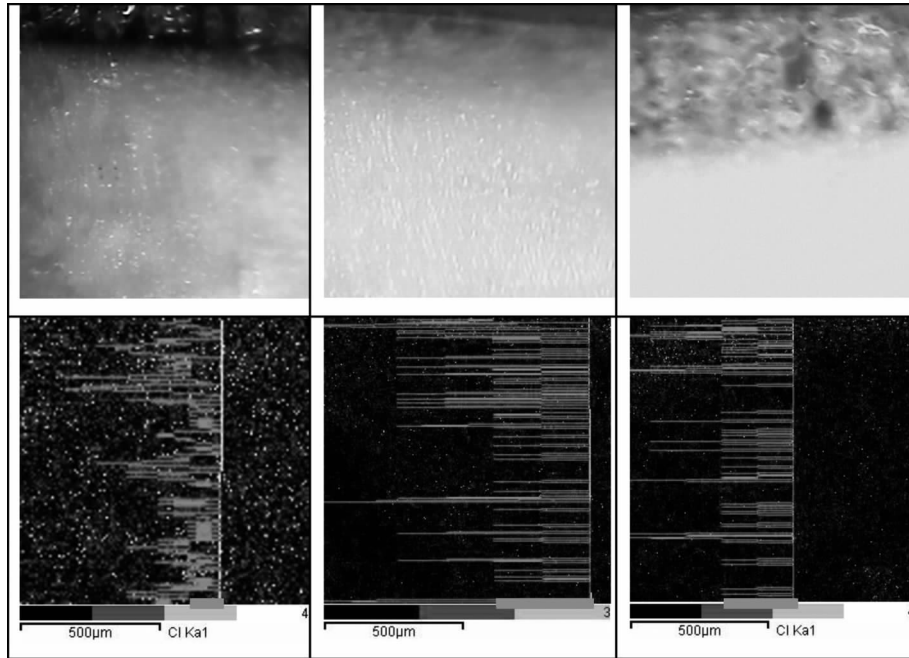


Figure 2 Cl Element Content Distribution Picture of Sample Section. The upper picture is a micrograph, and lower picture is the result of element scanning. Cl element fluorescence X-ray intensity is expressed by pixel temperature. Purple curve is 8 pixel accumulative signals around scanning line. Note that the unit heights of three curves are different (blue strip indicates 1 unit).

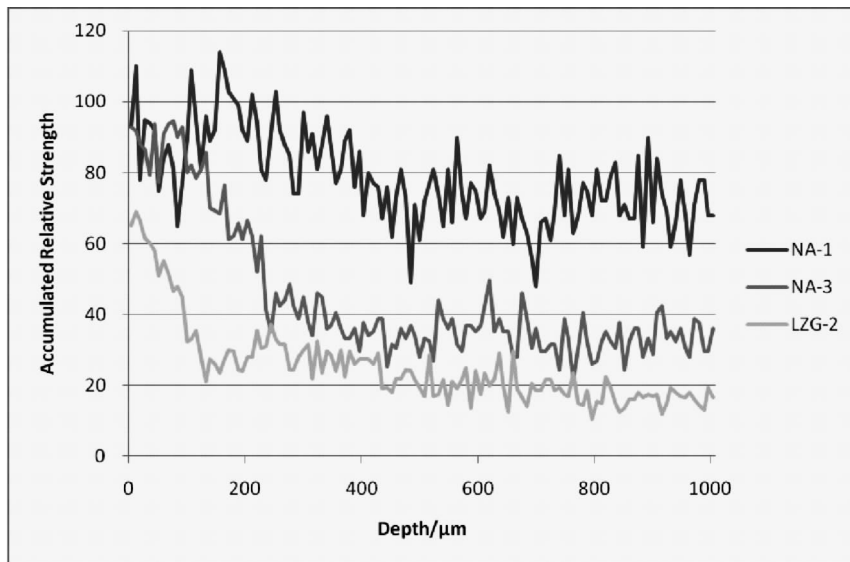


Figure 3 Cl Element Content Distribution at Different Depths

seawater is the same. Since the sample was exposed to air and slowly became dry after being salvaged and its texture is loose, salt in the body part could have moved to other areas quite easily. In the process of water volatilization and alternation of wet and dry affected by environmental factors, salt moved to the direction of the porcelain surface and blocked by dense the glaze layer and gathered beneath the glaze layer. The gathering of this kind of salt may threaten the safety of porcelain, in particular those with a low vitrification degree will always exhibit a phenomenon where the glaze in fact will peel off.

(iv) Component Analysis of Soluble Salt

Analysis results of soluble salt ion chromatography are shown in Table 7, as follows:

**Table 7 Main Soluble Salt Ion Content in Samples (IC method, w/w × 10<sup>6</sup>)**

No. of Samples	Na <sup>+</sup>	K <sup>+</sup>	Mg <sup>2+</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup>	NO <sub>3</sub> <sup>-</sup>
NA-1	175.0	13.4	19.1	285.8	54.9	0.4
NA-3	32.1	6.2	1.3	41.3	26.1	0.6

It can be seen from this table that Na<sup>+</sup> dominates soluble cation and Cl<sup>-</sup> dominates anion in the porcelain samples discovered underwater. Salt content in NA-1 is notably higher than that of NA-3, which is about four times more than the later.

### 3. Conclusion

From the analysis above, we can preliminarily come to the following conclusions:

1. Although Jingdezhen porcelain is of outstanding quality, salt is still able to permeate into the porcelain.
2. For porcelain of good body and glaze, salt content distribution decreases progressively from the surface to the inside;
3. For porcelain with a lower vitrification degree, salt gathers at the joint of the body and glaze;
4. Salt content of porcelain with a lower vitrification degree is higher than porcelain with a good vitrification degree.

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- [1] Chen Yaocheng, Guo Yanyi & Zhang Zhigang, "Studies on Porcelain and Blue Pigment in History," *Journal of the Chinese Ceramic Society*, 1978, (4): 225.



# Conservation of Shipwrecks in Korea

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**Abstract:** Beginning with the Shinan ship excavation in 1976, there have been 18 underwater excavations. Through these 18 projects, 2 Chinese shipwrecks and 8 Goryeo shipwrecks were salvaged. The conservation procedures of these shipwrecks can be seen as the following: 1) investigation of the pre-conservation status and determination of the best conservation method, 2) model construction, 3) cleaning and desalination, 4) impregnation with conservation consolidants, 5) drying and surface treatment, 6) restoration, and 7) management of the conservation environment. The polyethylene glycol (PEG) 2-step method was used to treat the timbers. The Shinan ship and the Wando ship which are both on display after conservation treatment are forming iron corrosion compounds on their surfaces and PEG is leaching out due to the effects of their respective display environments.

## 1. Introduction

With the first 1976 underwater excavation of the Shinan ship, Korea has proceeded with 18 projects up to 2010. These projects yielded ceramics, metal artifacts, wooden artifacts, bones, and a multitude of different relics of different materials. Among all the salvaged goods, the one that has drawn the most attention is the ship itself. The National Research Institute of Maritime Cultural Heritage, the only underwater excavation institute in Korea, has alone salvaged 10 such shipwrecks through the course of 35 years. Among these, 2 have been treated completely and are on display, 1 is being restored, 1 is being dried, 2 are undergoing dimensional stability procedures and 4 are being desalinated. This paper aims to introduce the conservation and post-conservation management of the shipwrecks excavated from Korean seas.

## 2. Conservation of Shipwrecks in Korea

### 2.1 Shipwrecks in Korea

Through the course of 35 years, Korea excavated 4 shipwrecks between 1976 and 1995 and 6 shipwrecks between 2003 and 2010. They were able to salvage every single shipwreck that was excavated. The Shinan and Jindo ships were Chinese whereas the Wando, Dallido, Sibidongpado, Anjwa, Daebudo, Taeon, Mado 1, and Mado 2 ships are all from the Goryeo dynasty (918 ~ 1392 A. D. ). All the shipwrecks salvaged in Korea are named after the areas in which they are found.

### 2.2 Preservation Treatment of the Shipwrecks

Underwater excavation projects are carried out in many countries around the world. Likewise, conservation treatment after salvaging the shipwrecks is also taking place. Sweden's *Vasa*, England's *Mary Rose* and China's *Nanha No. 1* were all salvaged as one intact piece. However, the Korean approach is different. We first make an initial study of the sunken shipwreck while underwater, give each part a number and then salvage the entire shipwreck, piece by piece. All ten shipwrecks were salvaged in this manner. As soon as the pieces are taken out of the water, they are given initial conservation treatments to prevent them from drying too quickly are wrapped and taken to the research institute's desalination facility for treatment as soon as possible.

Conservation treatment is carried out in the following order: 1) investigation of the pre-preservation status and determination of the best conservation method, 2) model construction, 3) cleaning and desalination, 4) impregnation with conservation consolidants, 5) drying and surface treatment, 6) restoration and, 7) management of the storage and display environments. The detailed procedures are as follows:

- Cleaning and Desalination

In order to prevent the timber from drying too quickly, causing it to distort due to the evaporation of the moisture and to remove the sea salt from it, the shipwreck timbers are immersed in water. The water is replaced at intervals of 1 to 2 months. This process continues until the salt concentration released from the shipwreck is identical to the salt concentration of the water it is immersed in. Depending on the state of the timbers and the availability of the

right facilities, this process can take between 3 to 7 years. Cleaning procedures also take place while the timbers are being desalinated. The purpose of the cleaning process is to remove the substances that have developed on the outer surfaces as well in the inner parts of the timbers. All kinds of brushes and small tools are used in order to remove metallic substances from the inner parts of the timbers. The best conservation treatment method is investigated and construction of a model of the ship are also carried out simultaneously.

- Study of Pre-treatment Condition and Conservation Method

The experiments of dimensional stability take place after studying the species of the wooden material, degradation characteristics and the change of the vessels properties. During these experiments, the plans for the most appropriate conservation treatments are designed by examining a number of different possible treatment methods and chemicals. The invasion of all kinds of underwater organisms and microorganisms is mostly limited to the surface of the shipwrecks and the inner parts of the timber are generally amazingly fresh as if the wood was still alive. Based on the results of the experiments, we applied the PEG 2-step method in which we first impregnated the shipwreck timbers with a low molecular weight of PEG, followed by a higher molecular weight PEG in increasingly higher concentrations.

- Model Construction

The scale model construction of the wrecked ship is based on the resulting blueprints from research and related literary sources. The purpose of model is to determine the accurate structure, research the techniques necessary for restoration and determine the possible problems that may occur after the conservation treatments and during the restoration process.

- Impregnation with Conservation Treatments

The PEG 2-step method was used to treat the timbers, using PEG with molecular weights of 400 and 4000 respectively. The PEG concentration was raised gradually, step-by-step, in an injection tank 40°C. The concentration was raised in 5% increments from 5% to 20% for the PEG 400 and 25% to 75% for the PEG 4000. In the case of the Shinan ship, the Wando ship and the Dallido ship the PEG 4000 was increased to 70% while in the case of the Jindo ship the concentration of the PEG 4000 was only raised to 45%. These levels of PEG were sufficient for the dimensional stability.

- Drying and Surface Treatment

While the substitution of most of the water content in the shipwreck timbers, with PEG lessens the possibility that the shipwreck timbers will distort when they are dried, they are still unstable. To reduce the risk of drying damage carefully controlled drying was used to dry the

timbers by slowly lowering the humidity levels in the drying chamber. A constant temperature and humidity system was not available to help us carry out the controlled drying method under ideal conditions. Therefore, after the timbers were removed from their impregnation tanks they are laid out and covered with plastic sheets in order to prevent water from evaporating too quickly and for the humidity to gradually decrease. This method was used to dry the Shinan, Wando, and Dallido ships.

Because the Jindo ship was made of logs, there was a high danger of it distorting during the drying treatment. We prevented this by reinforcing the structure with Fiberglass Reinforced Plastics (FRP) and prevented the inner water content from inflowing into the outer parts. In addition, we controlled the humidity of the reinforcements and placed 40 holes for drying in order to provide a method of slow release for the humidity. We then filled it with urethane foam to do a secondary reinforcement. The Jindo vessel, which started drying in December of 2008, is still slowly drying.

The end of the drying procedure isn't the end of the entire process. The PEG that was used solidifies and turns white on the surface of the shipwreck timbers. This must be removed by either using heat or organic solvents. The PEG is removed by wiping with cotton cloths that are dampened with water at 40 ~ 50°C and then dried. The colour of the sound wood can be brought out if you use the organic solvent trichloroethylene to remove the clustered PEG but because this is only a temporary phenomenon, we do not use it for the initial surface treatment procedures.

- Restoration

Reconstruction of the disassembled shipwreck is the final step in the overall conservation process. By constructing a smaller model, we decide on the method and order of the reconstruction process. Currently the Shinan ship and the Wando ship have been reconstructed and are on display. Only the surviving parts of the Wando ship were used in the reconstruction but the Shinan ship was done slightly differently. The Shinan ship also did not have everything intact. For the missing parts of the shipwreck, a frame was added to fill in, even for the parts that were lost after the reconstruction process. This frame allows us to infer the entire structure of the Shinan ship and also gives the displayed shipwreck itself more stability.

### 2.3 Conservation Management and Consequent Changes

The conservation of ICOM cultural heritage objects includes the application of direct and appropriate conservation treatment and the provision of a appropriate environment. Both are

designed to prolong the life of the heritage objects for as long as possible. The appropriate environment in this definition a “preventive conservation” method is just as important as direct conservation treatments of the heritage object itself for conserving it and is an incredibly important concept, especially for cultural heritages ions, such as the Shinan and Wando ship, which are currently being displayed after going through the hands-on and direct conservation procedures.

At present we are displaying the two ships in an open gallery space rather than an enclosed area. For the management of the two ships we collect data on humidity and room temperature every 30 minutes and apply the necessary changes to the exhibition hall. We were able to learn through this data that the natural climatic conditions of Korea—namely, the high humidity and temperature during the summer and the low humidity and temperature in the winter—affect the exhibition hall itself and in the end cause problems for the long-term conservation and management of the ships.

The Shinan ship reached the point it is at now after 14 years (1981 ~ 1994) of conservation treatment and 10 years (December 1994 ~ 2004) of restoration/reconstruction. Including the time for reconstruction, it has been on display for about 17 years. During the drying process, iron nails were used and then removed before the preservation treatments but they weren't removed completely and so was exposed to high humidity during the preservation treatment procedures and the exhibition period resulting in oxidation. These kinds of corrosion compounds are visible to the naked eye and can be divided into three main colors: white, yellow, and reddish brown.

An X-Ray Diffractometer (XRD) analyses identified the white and yellow powders as both rozenite and melanterite while the reddish brown deposits were rozenite, quartz, and pyrite. These compounds are similar to those found also in the Vasa and the Mary Rose timbers. They are results of iron corrosion compounds entering into the wooden material being exposed to high humidity and oxidizing in-situ. In addition, PEG has leached out from some of the timbers in certain places.

The Wando ship went through 12 years (1983 ~ 1994) of conservation treatment and 1 year (December 1994 ~ 1995) of restoration and reconstruction before being displayed. Like the Shinan ship, it has been on display for 17 years including the restoration period. Metal nails weren't used for the Wando ship with wooden nails used instead to maintain its shape and structure. Although some metallic substances were introduced into the wooden material through exposure while on mud flat, these are very limited in amount. As such, we do not see the

kinds of acid wood problems that we witness with the Shinan ship.

### 3. Conclusion

In Korea, the PEG 2-step method was used to treat 4 shipwrecks and 2 are still in progress. In addition, there are 4 shipwrecks currently being desalinated and we are currently making great efforts to integrate all kinds of scientific methods to study the current state of degradation, the characteristics of the disassembly and the conservation treatment methods in order that we can the most appropriate treatment related to the relevant characteristics. Furthermore, we are making efforts to provide the right environment for conservation once the treatments are complete.

The oxidation that was seen in the Vasa and the Mary Rose are currently occurring in the Shinan ship as well. Our conservation laboratory is collecting data about humidity and temperature every 30 minutes. We are also monitoring the sections in which the oxidation is taking place to detect changes. Furthermore, we are studying the reasons for oxidation as well as trying to determine the best method for controlling it.

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# **Meeting Recommendation**

# Chongqing Recommendation on Strengthening the Preservation of Underwater Cultural Heritage

We, delegates from China, Canada, Egypt, France, Great Britain, Korea, Sweden, Turkey, and the United Nations Educational, Scientific and Cultural Organization (UNESCO), attended the “International Meeting on the Protection, Presentation and Valorization of Underwater Cultural Heritage” held in Chongqing, China from 24 to 26 November, 2010, at the invitation of the Chinese Academy of Cultural Heritage, Chongqing Administration of Cultural Heritage and UNESCO.

We experienced first-hand China actively preserving underwater cultural heritage following the philosophy of preserving in-situ (as the Beiheliang Underwater Museum) and as a whole (as the Maritime Silk Road Museum in Guangdong or Nanhai 1). We saw the value of excavating and preserving underwater cultural heritage scientifically and presenting it effectively. We also saw the public and the government working hard for the preservation of underwater cultural heritage. In order to enhance the preservation of underwater cultural heritage, we recommend that the governments of other countries and societies take concrete action on the preservation of underwater cultural heritage, and with this understanding we recommend the following:

1. The preservation of cultural heritage should be further intensified. The investigation, registration and research of underwater cultural heritage should primarily be improved to pinpoint the location, characteristic and embedding of underwater cultural heritage sites, which may lay a firm foundation to protect heritage operationally and by law. We especially appeal to governments from all over the world to take effective and concrete action to firmly fight against illegal salvaging and smuggling, and the commercial salvaging of underwater cultural heritage, to ensure the safety of underwater cultural heritage.

2. Capacity building of underwater cultural heritage preservation should be improved. Key points are the education and training of professionals, team building and establishing special-



ized and specific agencies. We especially call for the support of team building, techniques and other aspects of underwater conservation for developing countries. Hence, we suggest that collaborations between UNESCO and relevant countries serve to establish training and research centres for underwater cultural heritage preservation.

3. The preservation of sites in situ, especially through underwater museums, should be encouraged and the idea of preserving underwater cultural heritage should be emphasized throughout society and awareness be raised. The public shall learn about and actively participate in underwater archaeology and underwater cultural heritage preservation through museum exhibitions, publications, websites, social media as well as targeted activities in communities, dive parks and trails.

4. The importance of international cooperation must be stressed. The preservation of underwater cultural heritage involves a wide range of disciplines, high technology and budgetary investment. It is necessary for all countries to be involved in global cooperation, especially concerning the concept, conservation, technology of underwater archaeology methodology and prevention of illegal salvaging and smuggling of underwater cultural heritage.

5. The 2001 Convention of the Protection of the Underwater Heritage should be studied further. Additional countries are strongly encouraged to ratify the Convention in the near future.