The Shinan Shipwreck

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1. Introduction

On the 20th of August, 1975 six pieces of Chinese ceramic ware were accidently caught in the net of fishing boat which was working in the southwestern sea of Korean peninsula. This discovery launched a series of full scale underwater excavations which drew the keen interest of archaeologists around the world and led to the advent of underwater archaeology in the history of Korean archaeology. Maritime archaeological research has been actively carried out in Korean waters since then. This paper will introduce the Shinan shipwreck. This ship is believed to have plied the 'Silk Road of the Sea'.

2. The Shinan Excavation

The Shinan excavation was continued over nine years, every summer from 1976 to 1984. The project was conducted under close cooperation of the research group organized by the Korean Cultural Properties Maintenance Office belonging to the Ministry of Culture and a supporting group dispatched from the Korean Navy.

In a preliminary investigation, divers succeeded in ascertaining the existence of a wooden hull and voluminous cargo in water 20 meters deep. While half of the hull was corroded and had lost its shape, the cargo had remained undisturbed, buried in the seabed.

Due to the tidal current running at about 5 knots among islands facing the Yellow Sea, however the excavation work could be carried out for less than an hour a day while the tide stood still. A complete absence of visibility made the work more difficult than expected.

2.1. Excavation Method

Under these unfavorable conditions, the grid method, which was simple but effective, was recommended. Metal grid frames, divided into two-meter squares, were installed directly over the shipwreck. Buoy lines were attached to points on the frames so that divers could follow them down to the bottom through the pitch dark water and find the grid square assigned for excavation.

In this way, the recoveries and other archaeological information could be recorded exactly and mapped on ship board. The initial research found that the surviving part of the ship buried in the seabed was about 28.4 m long and 6.6 m wide and 1ay with its bow to the northeast (323 degrees), tilting about 15 degrees toward the starboard.

2.2. The Recoveries

As the result of excavation, 20,664 pieces of ceramic ware, 729 metal objects, 43 stone objects, 28 tons of Chinese coins, 1,017 pieces of red sandalwood (each about 1-2m long), and 1,346 other objects (including the crew's daily necessities) were recovered. The Shinan ship may be the richest ancient

shipwreck yet discovered, yielding a massive amount of archaeological data which can illuminate the cultural milieu of the period.

After the salvage of the cargo, the hull was dismantled or cut up underwater so it could be raised. Altogether, pieces of ship's timbers were savaged. They varied in size from a keel member 12.7 m long, 71 cm wide and 50 cm thick, to small-sized planking of one meter or so. They were estimated to be approximately 41 m in volume.

This ship was identified as a Chinese vessel of the early 14th century (Yuan dynasty) by deciphering a chronological notation written on a wooden tag.

2.3. The Ship Structure

In 1981, the Korean government authorities established the Mokpo Conservation Institute for Maritime Archaeological Finds in Mokpo which is near the excavation site. The Shinan ship is being reconstructed at the institute.

On the basis of a 1/5 scale size model, the ship's original dimensions are presumed to be approximately 32 m in length, ca. 10 min breadth, ca. 3.5 m in depth at amidships. The cargo capacity is estimated at about 200 tons. her structural characteristics are as follows, 1) V-shaped cross section with true keel, 2) 7 parts of bulkhead for cross strength, 3) rabbeted-clinker joints, 4) a blunted stem and transom stern, 5) over two masts for sailing (at least), 6) a thin wooden sheathing against the marine insects, etc.

3. Conservation

Wood found at archeological sites in the sea, and from river, lake and swamp sites are usually over-saturated with water. This wood is called waterlogged wood. Waterlogged wood looks hard and able to retain its own shape, but if exposed to air it can severely warp and shrink in a short time. It may have been damaged by marine micro-organisms and lost its original-mechanical strength due to the loss of cellulose and hemicellulose, main constituents of wood.

3.1. Investigation of Wood Species

The Shinan shipwreck timbers were wholly submerged on the seabed for over 600 years and were severely attacked by marine organisms. These conditions precluded identification of the wood species with the naked eye; hence light and electron microscopy techniques were adopted. The wood species identified are shown in Table 1.

Table 1. The wood species of Shinan shipwreck timbers

Part/object	Wood species	Geographical location
Plank of hull	Pinus massoniana Lamb (Chinese red pine)	Southern part of China
Keel	-	-
Sheathing	Cunninghamia lancelolata Lamb (Chinese fir)	-
Bulwark stay	Cinnamomum spp.	Southern China, east coast of Korea, Japan, south-east Asia
Wooden box	Cunninghamia lanceolata Lamb	Southern part of China

Wooden tablet	-	-
Stiffener	-	-
Cargo goods (I)	Castanopsis spp.	Southern China, South coast of Korea, Jacan. India, Thailand, Burma
Cargo goods (II)	Dalbergia spp. (red sandalwood)	

The species of the Shinan ship timbers are distributed mainly in southern China: Chinese red pine and Chinese fir, in particular, are only found in southern China.

3.2. Diagnosis of Degradation

We could easily observe many tunnels in the inner part of the wood and burrow just under the outermost part, due to the action of marine borers (Limnoria spp. and Teredo spp.). The deterioration of the cell walls may be classified into three types: thinning of the cell wall, separation of the secondary wall from the compound middle lamella, and tunneling of the cell wall. Maximum moisture content of the Chinese red pine was 250-300 in the moderately degraded part and 400-600 in the heavily degraded part. The chemical composition of waterlogged Pinus massoniana compared with that of fresh samples is summarized in Table 2.

Table 2. Chemical composition of waterlogged wood and fresh wood of Pinus massoniana

	Waterlogged wood		Fresh wood
	Highly degraded (outermost)	Little degraded (inner part)	
Hot water extracts (H) ( )	7.80	3.0	2.79
1 NaOH solubility (A) ( )	18.73	12.58	12.67
Ratio of A to H	2.3:1	4:1	4.5:1.2
Ethanol-benzene Extracts	0.70	-	3.0
Ho1ocellulose (HC)	29.47	70.42	73.17
Lignin (L)	64.47	18.19	26.85
Ratio of HC to l	0.4:1	2.8:1	2.7:1
Ash	7.6:11.7	1.58	0.5-0.2

*Data from Chinese Woods, Chinese Forestry Publ. (1985).

3.3. Dimensional Stabilization

There are several methods of stabilization of waterlogged wood, e.g. freeze drying, controlled air drying, controlled kiln drying, bulking treatment with various reagents (salt, sugar, wax, and synthetic resin), etc. However, the most effective method to date for large waterlogged wooden objects is impregnation with polyethylene glycol (PEG).

PEG comes in a range of molecular weights and range from viscous liquids (e.g. PEG 200) to hard waxes (e.g. PEG 6000) at room temperature.

Recent research has shown that it is not sufficient to use one grade of PEG for the stabilization of differentially degraded waterlogged wood. Generally, low molecular weight PEG is good for stabilizing slightly degraded timber and high molecular weight PEG is better for heavily degraded wood. Since the timbers from the Shinan ship show differential degradation, it was decided to use PEG 400 for the slightly degraded parts and PEG 4000 for the heavi1y degraded parts (see section 4).

4. Conclusion

The Shinan project was the first underwater excavation in Korea. It was a large scale work which took 9,800 man-days and 3,500.hours of diving time.

After the conservation work is completed, the Chinese merchant ship of 14th century will be reconstructed and exhibited in the near future at a new maritime archaeological museum which has been under construction since 1989.