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## Shipwreck LSG4: interdisciplinarity to increase and renew knowledge

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### Abstract

The shipwreck was found during a rescue excavation before building an underground car park in 2004, and has been stored temporarily in a lake near Lyon for the past twelve years. Prior to treatment, the boat was dismantled and the nails were removed because of the high degree of pyrite contamination. It was a unique opportunity to collect a maximum amount of scientific data. To this end, we worked in close collaboration with the archaeologist and set up a scientific team with chemists, conservators and dendrochronologists. At each step of the process, this collaboration has permitted better understanding of the wreck and facilitated its care.

**Keywords:** Conservation; archaeology; interdisciplinarity; waterlogged wood; metal; LSG4

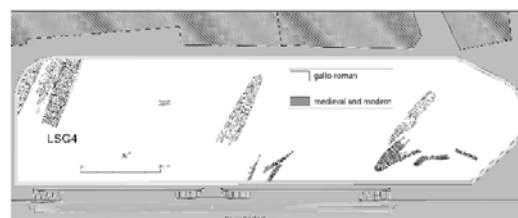
### Introduction

Prior to the construction of an underground car park in Lyon, archaeological rescue operations were carried out by the French Institute of Preventive Archaeological Research (Institut National de Recherches Archéologiques Préventives; INRAP) on commission of the Ministry of Culture. Field work, directed by Grégoire Ayala (INRAP), took place from October 2002 to June 2004 (Figure 1). The contents of a 4000m<sup>2</sup> cofferdam was excavated to a depth of 10m using traditional terrestrial archaeology methods, including:

- dredging the boxed sediments;
- manual excavation of the architectural remains;
- photographic recording and drawing (dimensions, architectural details etc.);
- systematic selection of samples (wood, cloth, coating, organic material etc.) for analyses;

Within a few months, 16 wrecks had been uncovered and documented under the direction of Marc Guyon (INRAP). Six of the shipwrecks

were Roman boats. This constituted a significant discovery as it doubled the number of Roman shipwrecks found in France and allowed archaeologists to better understand river navigation in the province. Three of these boats, including one designated Lyon Saint Georges 4 (LSG4), were lifted and stored in a lake nearby for later study and display. It was not possible to remove the ships in one-piece because of the construction around them. Therefore, the boats were cut prior to lifting (Figure 2). Every effort was taken to minimize the number of cuts. LSG4 was cut into six parts each of which were nearly 2.5m long.



**Figure 1:** The Lyon Saint-Georges excavation. The six Roman boats are in light-grey



**Figure 2:** A section extraction from the rescue excavation. The dimensions of the construction provided the dimensions to cut the shipwrecks to allow removal.

In 2013, the opportunity arose to treat and display one of the boats and LSG4 was selected. The boat was originally 28 meters long and 5

meters wide although not all of it had been preserved (Figure 3). At the time it was excavated, due to the severe time constraints imposed for the excavation and the number of ships found, it was not possible to fully record any of the wrecks.



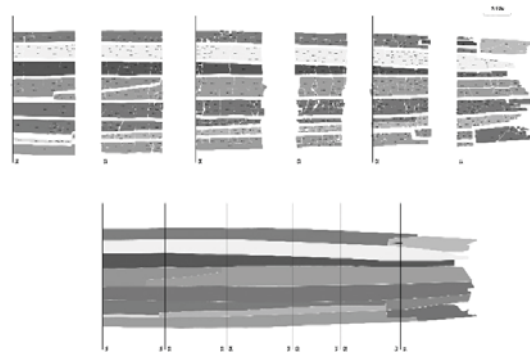
**Figure 3:** LSG4 as exposed at the rescue excavation.

The wreck was completely dismantled by ARC Nucleart during the first six months of 2014. Numerous nails were present and there was significant pyrite in the wood. A decision was made to remove as many of the 2100 nails as possible to facilitate the removal of iron and sulfur compounds from the wreck. Dismantling the boat provided a unique opportunity to understand its construction and to fully record the boat. In addition, it allowed an opportunity to better understand every step of the fabrication process, including how raw materials were prepared and supplied, how they were assembled in the shipyard and when, and how often, repairs were made to the boat.

### Planning

In preparation for the work at hand, we consulted the documentation made during the excavation stage and found that it did not meet the needs of the new undertaking. From an archaeological perspective, due to the minimal recording possible on-site, the plan of the shipwreck was basic. It contained few details. The new work permitted new plans to be drawn up at 1:10 scale. The complete dismantling of the wreck also permitted the production of a flat bottom plan (Figure 4), which had not been

possible earlier due to the placement of the frames. The information gleaned from the new plans allowed us to better understand where and when repairs had been made to the boat. Conservators, used the initial plans to help organize treatment logistics, including the transport of the parts of the shipwreck to Grenoble and the storage of the parts in a warehouse used to accommodate the dismantling and storage of the wreck (Figure 5). As the plans became more detailed, they were also used to help optimize treatment. At ARC-Nucleart there are two-freeze-dryers, one of which is five-meters long and one-meter in diameter and the other which is 2.8 meters long and 1.6 meters in diameter. The long, thin sides and frames were mainly freeze-dried in the long freeze-dryer while the flat bottom, short sides and ribs were dried in the shorter freeze-dryer. Using the plans allowed us to carefully organize the loading of the freeze-dryers and to complete the drying in 18-months.



**Figure 4:** Comparison between the original flat bottom plan drawn after rescue excavation and the new one after dismantling.



**Figure 5:** The storage warehouse in January 2014. Water was sprayed on the wood to keep it wet during dismantling.

## Dismantling

Dismantling work (Figure 6) was planned around the archaeologist's availability to prevent data loss and to prevent the conservation work getting too far ahead of the recording work. A dismantling map was created based on photos, which allowed every piece of the boat to be drawn and numbered (Figure 7) and it allowed the location of nails and repairs to be indicated (Figure 8). These drawings were then digitized with CAD. Dismantled elements were organized for review by the archaeologist and the dendrochronologist (Figure 9). Dismantling drawings were used to create general plans to track freeze-drying, dendrochronology work and archaeological work, but also allowed us to record measurements such as the thicknesses of timber on the flat bottom part and at the bilge angles. However, it was found that some details could only be seen after freeze-drying so it was necessary to carry out a secondary review of the plans at this point.



**Figure 6:** The removal of a frame during dismantling. After nail removal, wedges were placed to slightly push up the frame. Straps were used to fasten the frame to a new piece of wood. Then both were lifted with a crane.



**Figure 7:** An example of dismantling documentation based on photos, to record flat bottom timbers fragmentation and its numbering.

During dismantling, samples were also collected for later study. Nearly 23 meters of

caulking textiles were removed from the sides and the flat bottom. This will permit future research into the production of the cloth, its recycling and the way it was prepared for use on the boat.



**Figure 8:** After frame removal, nails from the under part of the timber appeared clearly. No less than 2,100 nails were removed from the 15 meters conserved shipwreck. Their locations could be precisely recorded.



**Figure 9:** Intervention of the dendrochronologist to survey repair pegs in the flat-bottom timber during dismantling. The archaeologist had identified a possible change of the frame.

## Freeze-drying

After freeze-drying, unseen elements became more noticeable. Repair pegs were highlighted by the slight shrinkage due to freeze-drying and the differences in wood grain. Less than half of them could be observed on waterlogged wood but after freeze-drying it was possible to see many more. The opportunity to turn the flat-bottomed timbers over for the first time and inspect them allowed us to record the used of caulking textile to repair historic cracks and to elaborate on the drawings of the underside's nail holes.

We began a new study with the dendrochronologist. Since she had seen most of the timbers when they were wet and then saw

them again after freeze-drying she is interested in comparing the results before and after to determine how freeze-drying does or does not impact the accuracy of dendrochronology.

Additionally, we 3D scanned a timber, before and after freeze-drying, to track deformations. We scanned both a whole section and also the individual elements. However, we were not able to get as much accuracy with this technique as we could with through the drawings and visual assessments carried out by specialists and the cost for the 3D scanning proved to be greater than for the traditional documentation techniques.

However, the dismantling documentation still was not as accurate as we would have liked due to the low definition of the photos, which made it hard to see some of the archaeological data. Furthermore, the working conditions didn't allow zenithal shooting and there were light problems. We decided to make a 1:1 scale drawing of each face of every element from the shipwreck. These were done on a transparent plastic film with different ink pens (Figure 10). Once done, this freeze-drying plan was digitized with CAD. This was done prior to coring because of the potential for archaeological data to be lost during this process. It was a relief for conservators to know that all the data was recorded before they had to core nails holes.



**Figure 10:** Each element was recorded after freeze-drying plastic film. It was then digitized to produce a plan used for conservation recording, follow-up plans and the archaeological survey.

### Conservation

Excavation plans were used to record nails left in-situ prior to treatment so as not to forget them because we wanted to remove them after freeze-drying. The freeze-drying plans allowed us to record on paper every conservation

intervention: cleaning, coring, consolidation, gluing, sebaçate application. This record was then digitized to note which areas may need to be checked during the follow up plan after conservation. It was a great challenge to record every intervention we made on the shipwreck. Conservators made trials and held discussions, with the goal of creating a simple map on the freeze-drying plan. The advantage, now that it is complete, is that we have a complete map of all our interventions on the boat at the same level of accuracy as that of the archaeological data.

### Support

The freeze-drying plan will be used to design and produce the metallic support. We considered maintenance during the planning and have asked to have access hatches in the support under the flat bottom to check the wood state and make some measurements. The sensitive areas were marked on the plan as the conservation progressed. We also asked for the possibility to work under the boat to access the hatches and also asked for a cupboard for maintenance supplies to be located near the boat and for there to be museum quality lights that are easily accessible.

### Conclusion

From this on-going experience, we demonstrated that archaeological survey can be carried out jointly with the conservation operation. For a 15-meter-long by 5-meter-wide shipwreck, approximately 230 m<sup>2</sup> drawings will be done to record every piece and to develop a complete plan. We realize that three plans were needed for archaeologists and conservators to deal with this shipwreck: the one created during the excavation for raising, transport and storage; the dismantling one; and the freeze-drying one for the archaeological survey, conservation and dendrochronological recording. We are now awaiting feedback from the dendrochronologist to learn about the impact of the freeze-drying on her results but also to learn about how many trees were used to build the boat, how they were chosen, and how many elements were made from the same tree.

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