# Excavation on site of wet archaeological large size objects

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Medieval canoe - Lyon, 2003-2004

# Specific problems for excavation of wet archaeological large size artefacts

- Very fragile object (physico-chemical and mecanical aspects)
- Weight (density > 1 g/cm<sup>3</sup>)

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Size (the cohesion of the whole structure could not be assured by taking the object in some points)

# Support

dimensioned for the structure cohesion of the object
 repartition of the support points to avoid marks, prints
 possibility to hydrate the object

#### **Different techniques of excavation**

• Per object

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- In block, motte
  Gallic sepulture, burial -Besançon
  - Classical (support following the profile of the object)

Roman period boat -

Toulon





By resin wrapping, shell

**Etruscan boat - Pise** 





## **Excavation in block or motte**

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The artefact is maintained by the surrounded sediment which is extracted by a structural support



Gallic sepulture- Besançon

# Extraction in motte (block) by steps

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Neolithic canoe- Paris, 1991-1992 excavations









#### « Classical » excavation

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Construction of a wooden frame support around the object

Medieval canoe – Lyon 2003-2004 excavations

# **Classical excavation by steps**

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# **Classical excavation by steps**

ARC-**nucle**ART



## **Classical excavation**

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## **Classical excavation**

ARC-**DUC**CART



# **Classical excavation by steps**

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# Excavation large size boat by sectioning

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Gallo-roman 30 meter boat – Arles June 2011

# ARC-**Dismantling of the sides**

Gallo-roman 30 meter boat – Arles June 2011

# Conservation of the gallo-roman boat

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Transfer of the section in the PEG solution for impregnation

# **Excavation by resin shell**

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The support is realized by a thermoset resin shell which is linked to a metallic frame



Etruscan boat - Pisa, Italy, 2000 excavation

# **Elaboration of the resin shell**

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# **Excavation by resin shell**

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**Etruscan boat - Pisa** 

# **Steps of resin shell elaboration**



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Etruscan boat - Pisa, Italy

# **Excavation by resin shell**

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Roman boats – Napoli, Italy

# Treatment of wet organic archaeological wood

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**Objects from the shipwreck la Lomellina (XVIième) – Villefranche-sur-mer** 

# The wood structure and its drying



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### **Collapse of the cell walls**

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Stresses generated by the evaporation of liquid water on the very degraded cell walls of the archaeological wood



Irreversible damage occured during some hours of natural air-drying with a very important volume loss

# Impregnation with Polyethylene Glycol (PEG) water-soluble resin

Consolidation of the cell walls and the vessels of the degraded archaeological wood by PEG



Osmotic exchange mechanism

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#### **Tanks for impregnation by immersion**

#### Impregnation of small objects

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The concentration of PEG is increased gradually in the aqueous solutions, up to 40 %

# Tanks for impregnation by immersion

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#### Tank for impregnation by immersion

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Arles section in 20% PEG solution, September 2011

# Facility for impregnation by fine particle spraying

#### Impregnation of large size objects

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Increasing the PEG concentration of the spray up to 80%

#### **Freeze-drying**

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# Evaporation of the ice : sublimation (solid ⇒ gaz).

Congélation à −30℃

Vide dans l'enceinte, (~ 0,2 mbar)



Solution of 30% PEG, 70% water

# **Freeze-drying facility**

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#### **Controlled air-drying**

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#### Slow decrease of the air relative humidity (95% RH ⇒ 60% RH)



Greek period shipwreck- Marseille

Impregnation by 80% PEG, 20% water

#### **PEG treatments : the alternatives**

Relative small objects Immersion impregnation up to 40% PEG (~6 months to one year) Freeze-drying (~one month) Partial consolidation

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- Large size objects
- Impregnation by spraying up to 80% PEG
  - (1 to 2 years)
- Air drying (one year)
- Important consolidation of the wood structure

# Naval archaeology : the pioneers

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Full impregnation by PEG 4000 (the 70's)

Viking ship – Roskilde Museum, Danemark

## **Naval Archaeology : the pioneers**

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Treatment by spraying (1962-1979) Vasa (XVII<sup>ième</sup>)– Stockholm- Sweden

#### **Naval archaeology : the pioneers**

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Maintime archaeologista removed the accurs PED and the Hansestic copbeat is now dry. Visitors can relic at the German Maritimo neil Bromsmavon. It took a team reologista anven yoars to tonasim to attan 2,000 individual wrackage to attan 2,000 individual wrackage tage PED impregention process

Treatment by immersion (1962-1979)

Medieval Bremen cogg German Maritime Museum – Bremerhaven, Germany

#### Naval Archaeology : the important treatments worldwide

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Treatement by spraying (depuis 1982)

Mary Rose – Portsmouth – England

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Impregnation by immersion – freeze-drying (1988-89)

**Medieval canoe - Charavines** 

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Carolingian canoe – Noyen-sur-seine

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Impregnation by PEG solution spraying – air drying (2002-2004)

**Greek period shipwreck - Marseille** 

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impregnation by PEG solution spraying – air drying

**Canoes (bronze and iron ages) - Sanguinet** 



**Gallo-roman boats** 

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Medieval canoe



Fish boats XVI<sup>ième</sup>

Conservation project for 10 wrecks from excavation of the parking Saint-Georges – Lyon, 2003-2004

#### Display of the 18th century boat at Lyon

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#### **Archaeological wood restoration**

- Cleaning of elements just after treatment Reshaping
- Assembling of elements
- Filling of gaps
  - Finishing

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**Packaging - Support** 

# **Cleaning after treatment**

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Element of the Greek period shipwreck -Marseille



Element of the shipwreck la Natière -Saint-Malo

# **Assembling of broken elements**

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Element of a parrel collar -La Natière shipwreck - Saint-Malo



Crutch or front timber (element of Etruscan shipwreck) - Le Grand Ribaud

# Shaping – Reassembling

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Small cask and bucket -La Natière shipwreck - Saint-Malo

#### Packaging for transport and storage

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Various furniture -La Natière shipwreck - Saint-Malo

#### Small objects – Plinth for museum display



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Animal's leg (element of sculpture)

Cylindrical box

Gallo-roman period- Aix-en-Provence





Element of Roman period shipwreck –Marseille

Crutch or front timber (element from Etruscan shipwreck) -Le Grand Ribaud







# Hvala vam na pozornosti !

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