

Branching Out: Using the Chemistry of trees to preserve archaeological wood

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The Oseberg collection and its current state



The Oseberg finds represent the world's richest collection of wooden objects from the Viking Age. The objects, found in a grave mound near Tønsberg, Norway, were part of a burial ritual in 834 AD for two women of high standing.



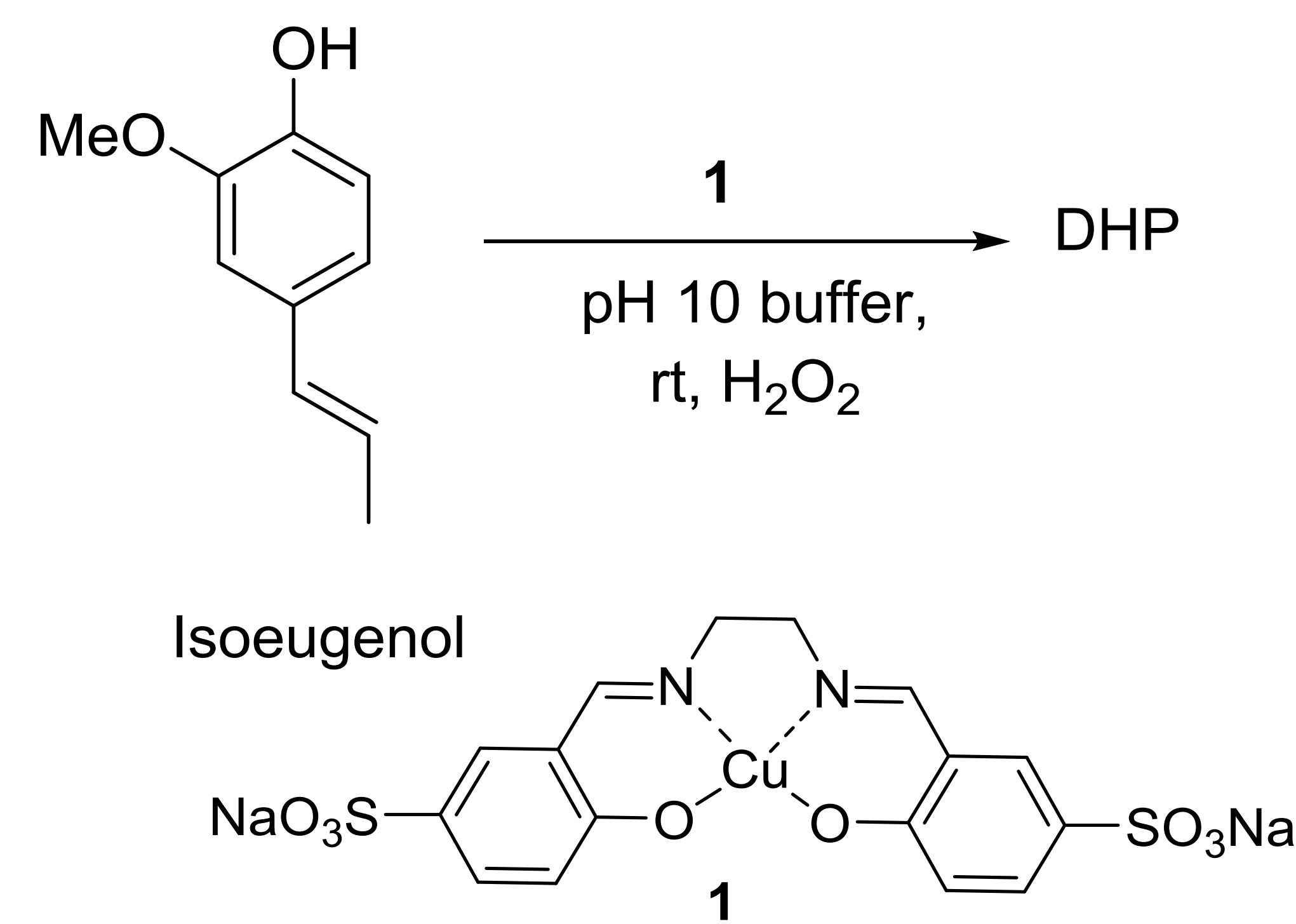
In 1904, the objects were recovered in a highly fragmented and waterlogged state. A significant number of spectacular surface carvings were carefully preserved. Many of the objects now displayed at the Viking Ship Museum, Oslo, were treated with Alum ($KAl(SO_4)_2 \cdot 12H_2O$.) Unfortunately, the salt did not penetrate well across the grain of the wood and cracks formed inside the objects. To make matters worse, the treatment has left the wood with a pH in the range 0-2. This acidic environment actively degrades the leftover lignin, so the treated objects are extremely fragile. Without a new consolidant many of the objects will soon degrade beyond recognition.

Can natural wood polymers inspire new materials for conservation?

The natural wood polymers have properties that match those required from a new material for consolidation of archaeological wood. Lignin is the most stable of the polymers in archaeological wood. It is chemically simple to synthesise lignin-like oligomers using non-toxic reagents.



Synthesis of lignin-like oligomers



Polymerisation was carried out for either 2 days or 5 days.

Analysis of lignin-like oligomers: Sedimentation Equilibrium

Polymerisation over 2 days (**DHP2d**) gave a weight-average molecular weight of 1.3 kDa and polymerisation over 5 days (**DHP5d**) gave a weight-average molecular weight of 1.6 kDa.

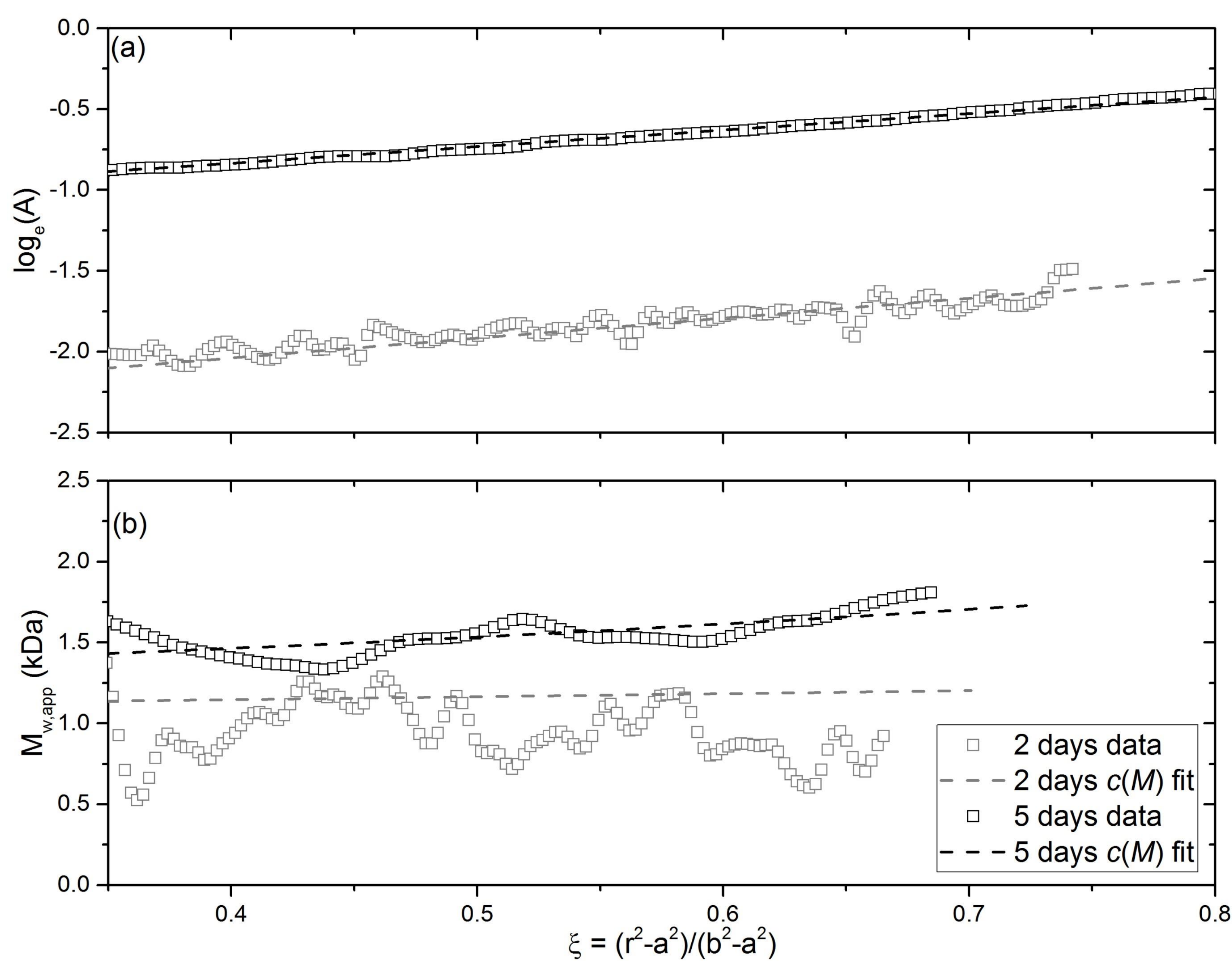


Fig: Results from sedimentation equilibrium AUC. Plot a) showing the logarithm of absorbance vs. the relative square radius (ξ) and plot b) showing the differential of plot a) to yield point average molar mass vs. ξ . Lighter data points show **DHP2d** and darker data points show **DHP5d**.

Consolidation of waterlogged archaeological wood

Waterlogged archaeological wood was impregnated with **DHP5d** in ethyl acetate (10 w/w%) for 14 days before being slowly air dried.

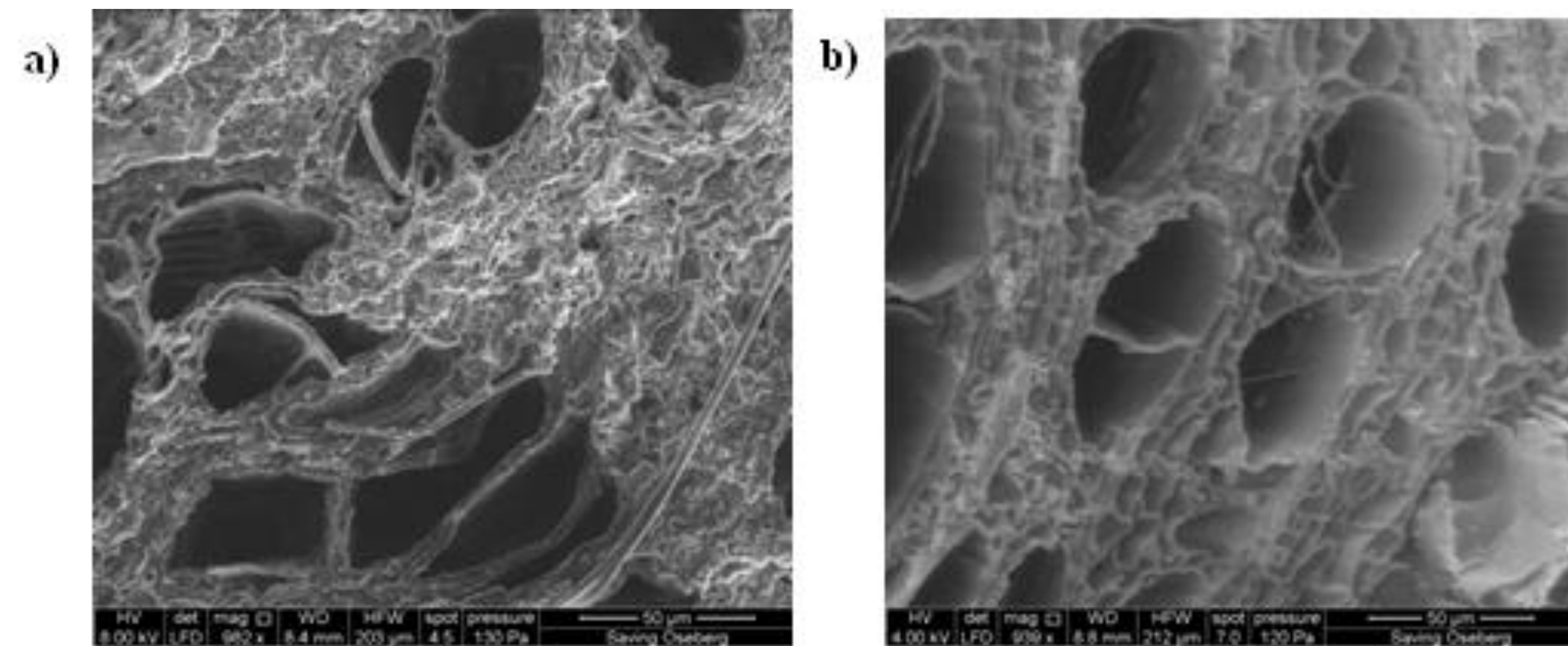


Fig: SEM image of waterlogged archaeological wood **a)** air dried untreated and **b)** impregnated with **DHP5d** and air dried.



Untreated air dried

Treated with DHP5d air dried

Treated with DHP5d air dried

The untreated air dried sample and the first treated sample had approximately the same dimensions before drying.