VIII Congresso Nazionale di Archeometria
Scienze e Beni Culturali: stato dell'arte e prospettive
Bologna 5 - 7 Febbraio 2014

THE HERCULANEUM CONSERVATION PROJECT: CHARACTERISATION OF ARCHAEOLOGICAL WATERLOGGED WOOD BY PYROLYTIC AND MASS SPECTROMETRIC TECHNIQUES

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Chemical characterization is crucial to assess the decay of archaeological or historical wood. Traditionally, wood analysis and determination of the content of lignin and holocellulose is performed by means of reagent- and time-consuming wet chemical methods, which require a large amount of sample. Recently, increasing attention has been given to instrumental analysis based on analytical pyrolysis and mass spectrometry applied to the characterization of archaeological wood.
The House of the Telephus Relief in Herculaneum (Bay of Naples, Italy) is a Roman domus buried in AD 79 by the eruption of Vesuvius. Parts of the decorated wooden roof were excavated in 2009 in the area of the Ancient Shoreline, in an extremely wet environment. Samples of archaeological waterlogged wood from the roof of the House were analysed and characterized in the frame of the Herculaneum Conservation Project, a Packard Humanities Institute initiative in collaboration with the Soprintendenza Speciale per i Beni Archeologici di Napoli e Pompei and the British School at Rome.

Wood fragments from the roof of the House of the Telephus Relief in Herculaneum (Bay of Naples, Italy)

The evaluation of the degradation state of the wood was performed by pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS), an analytical approach that achieves semi-quantitative results on the content of lignin and polysaccharides in degraded wood. The characterization was based on a comparison of pyrolysis profiles of archaeological wood with sound wood of the same species. In particular some specific parameters were compared,

including the H/L coefficient (holocellulose vs lignin ratio), which are indicative of the conservation state of the wood. This method provides information at a molecular level, avoiding the long wet-chemical procedures that are commonly used in wood analysis, and allowing a minimal sample size to be used.
The analysed samples show different kinds of degradation, such as degradation by fungi or insects. To group samples according to their degradation state, a multivariate statistical approach based on principal component analysis (PCA) was used, allowing similarities and differences between the samples to be highlighted.
A research was also undertaken to understand the painting techniques used by Roman painters to decorate the roof. GC/MS and Py-GC/MS were used to identify the binding media and other organic materials in paint residues. For this purpose, 18 micro-samples (less than 500 µg each) of paint materials were collected from 9 parts of the roof. The procedures allow to identify glycerolipids, natural waxes, terpenoid resins, proteinaceous and polysaccharide materials from a single micro-sample.
The analysis enabled us to assess the presence of egg proteinaceous materials in almost all the paint samples. One of them showed to contain casein. In two cases no proteinaceous material was detected. Some of the samples showed a lipid content with a fatty acid profile which confirms the presence of egg. Cholesterol, a biomarker of egg, was also identified in almost all samples.

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