Case study: **Reliquary box :** Coffret-écrin de la couronne-reliquaire de la couronne-reliquaire des saintes Epines, XIIIth century, Namur (inv. n°7)

Case study image:

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Introduction

A main concern within the fields of preventive conservation and cultural heritage management is the indoor air pollution and its effect on museums objects. Specifically, indoor-generated pollutants constitute a high risk to collections since they are in close and continuous proximity to the objects, which may promote degradation reactions in the materials and thus compromise their preservation.
One of the materials that produces indoor-generated pollutants is wood. Several studies have been published regarding the emission of volatile compounds from fresh and relatively aged wood, which detected emissions of formic acid and acetic acid among other compounds, although there are variations depending on several factors such as the tree species or storage conditions[1].
A number of papers have alerted about the degradation reactions that acetic acid can promote in museum materials. Previous research has documented the damage of gas pollutants to specific materials such as metallic objects[2–7], glass[5] or paper[8,9].

Objectives

The reliquary box is made of wood and it is normally kept closed, thus it is expected that the inside will contain a high proportion of VOCs emitted from wood. In addition, the inside contains textile, this material may I) react with the VOCs generated by wood leading to degradation and/or II) generate additional VOCs due to ageing and degradation processes.
Consequently, the main goal of this analysis is to identify the type and amount of VOCs inside the reliquary box, in order to recognize potential risks for the materials in the box as well as to detect potential markers of on-going degradation processes. This will ultimately help to define the most suitable strategies for the preventive conservation of this object.

Materials and methods

Measurements have been performed by means of solid-phase microextraction (SPME) coupled to gas chromatography with mass spectrometry (GC/MS).
The selected SPME fiber was a DVB/CAR/PDMS with a needle size of 23 ga (Supelco, ref. 548653-U). The reliquary box was minimally opened in order to introduce the fiber, which was exposed during 45 minutes. The blank was collected with the same type of fiber, which was exposed in the same room during 45 minutes at 2 m distance from the reliquary box.

Results and discussion

The comparison with the blank reveals that the main VOCs present inside the reliquary box are CO_2, acetic acid and different types of alkanes.
The presence of acetic acid has previously been related to wood ageing. This compound is known to cause the deterioration of museum objects, in this case it could contribute to the corrosion of the metallic parts of the box, as well as to the degradation of the cellulose leading to a decrease of the pH and strength of the fibers. [10]
The presence of CO_2 [11] is probably linked to the degradation of the organic parts of the box. This can be due to the reactivity induced by acetic acid but also to ageing process such as biodegradation (growing of fungi or other microorganisms). Indeed, the presence of biodegradation processes is in good agreement with the conditions found inside of the reliquary box (lack of light and presence of textile, which favors the condensation increasing the relative humidity).
Therefore, the detection of acetic acid and CO_2 indicates that the current conditions inside of the reliquary box are not ideal for the preservation of the materials.
The presence of alkanes could be related to the use of wax, although these compounds are considered relatively unreactive compounds and hence are not a concern for the preservation of the object.

Conclusion

The obtained results demonstrates that the inside of the reliquary box has volatile compounds that may damage the materials. From this point of view, it would be recommended to decrease the concentration of those compounds (for instance opening the box periodically).

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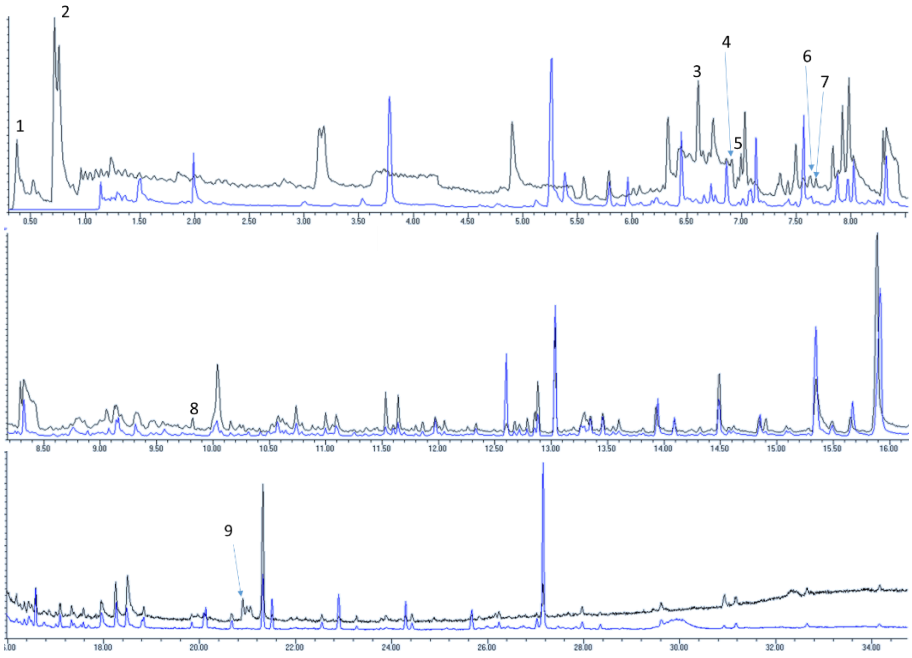
Tables, figures and graphics



-- background
-- extracted sample

Peak	Detected compound
1	CO_2
2	Acetic acid
3	Decane
4	Eicosane
5	Ethylhexanol
6	Alkane (not identified)
7	Alkane (not identified)
8	Alkane (not identified)
9	Alkane (not identified)