

Study of organic residues in vessels of archaeological origin with physicochemical analytical techniques

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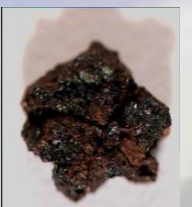


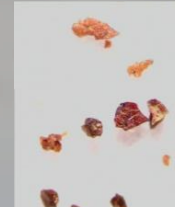

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Vessels & Samples

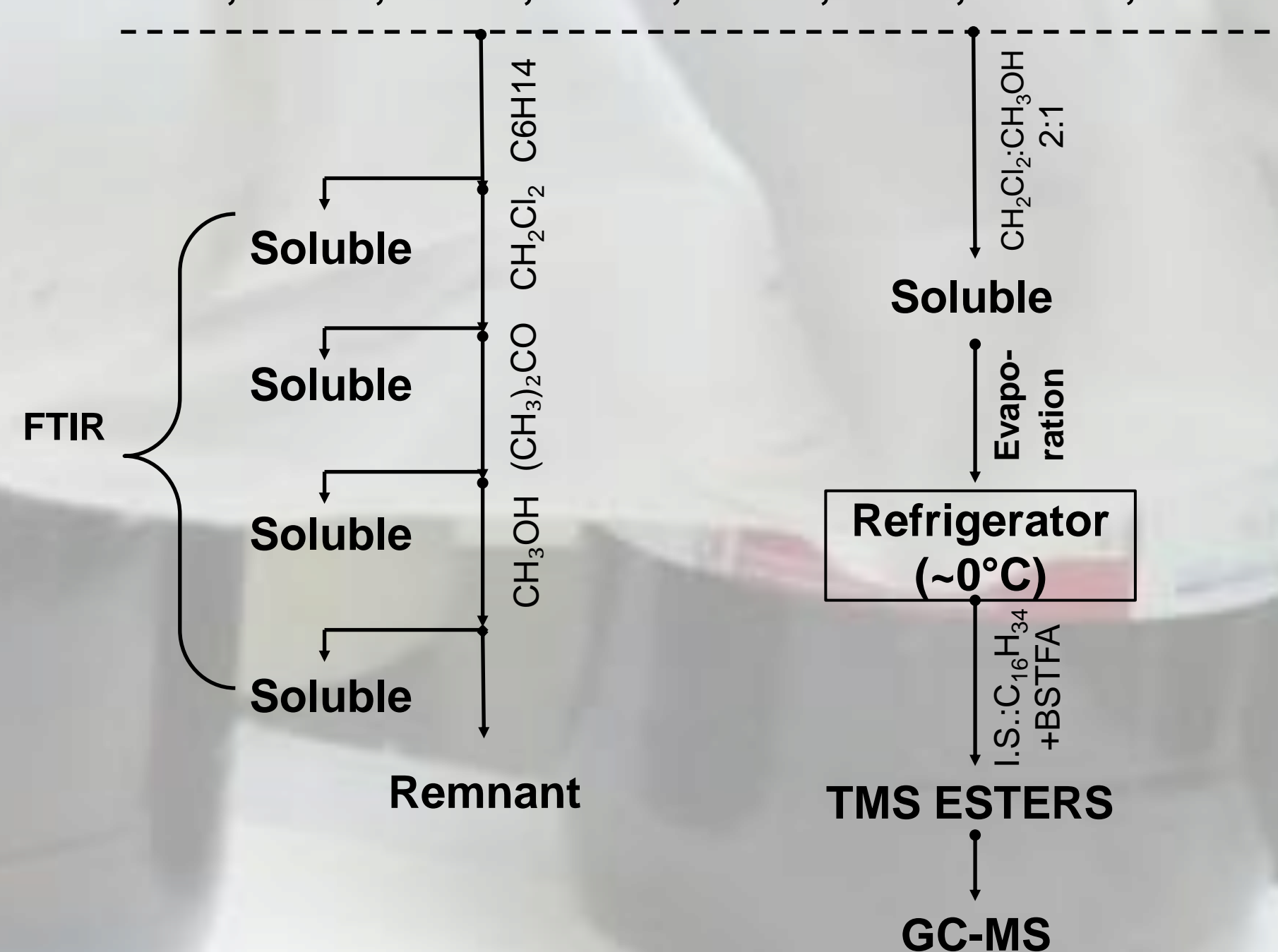
A number of copper alloy vessels were selected from the Byzantine Collection of the Benaki Museum in Athens (128 artefacts, purchased from Egyptian markets by the museum founder, A. Benakis, during the early 20th century)¹. As there was no archaeological record of these objects, all information listed in the table below originates from the Doctoral Thesis of Dr Drandaki², curator of the Byzantine Collection at the Benaki museum.

#	11544	11550	11551	11596	11598	11573	11622A	11633A
Vessel Type	Oil lamp			Tripod vessel	Spouted vessel	Small bottle	Stemmed bowl	
Relative Chronology	5 th – 7 th c. A.D.	5 th – 8 th c. A.D.	5 th c. A.D.	5 th – 7 th c. A.D.	5 th – 6 th c. A.D.		5 th c. A.D.	
Origin	Egypt	Unknown		Egypt				
Sample description	Vessels' inner surface					Surface edges		
Sample picture								

Methodology

The scheme below illustrates the experimental procedures for sample workup and analysis.

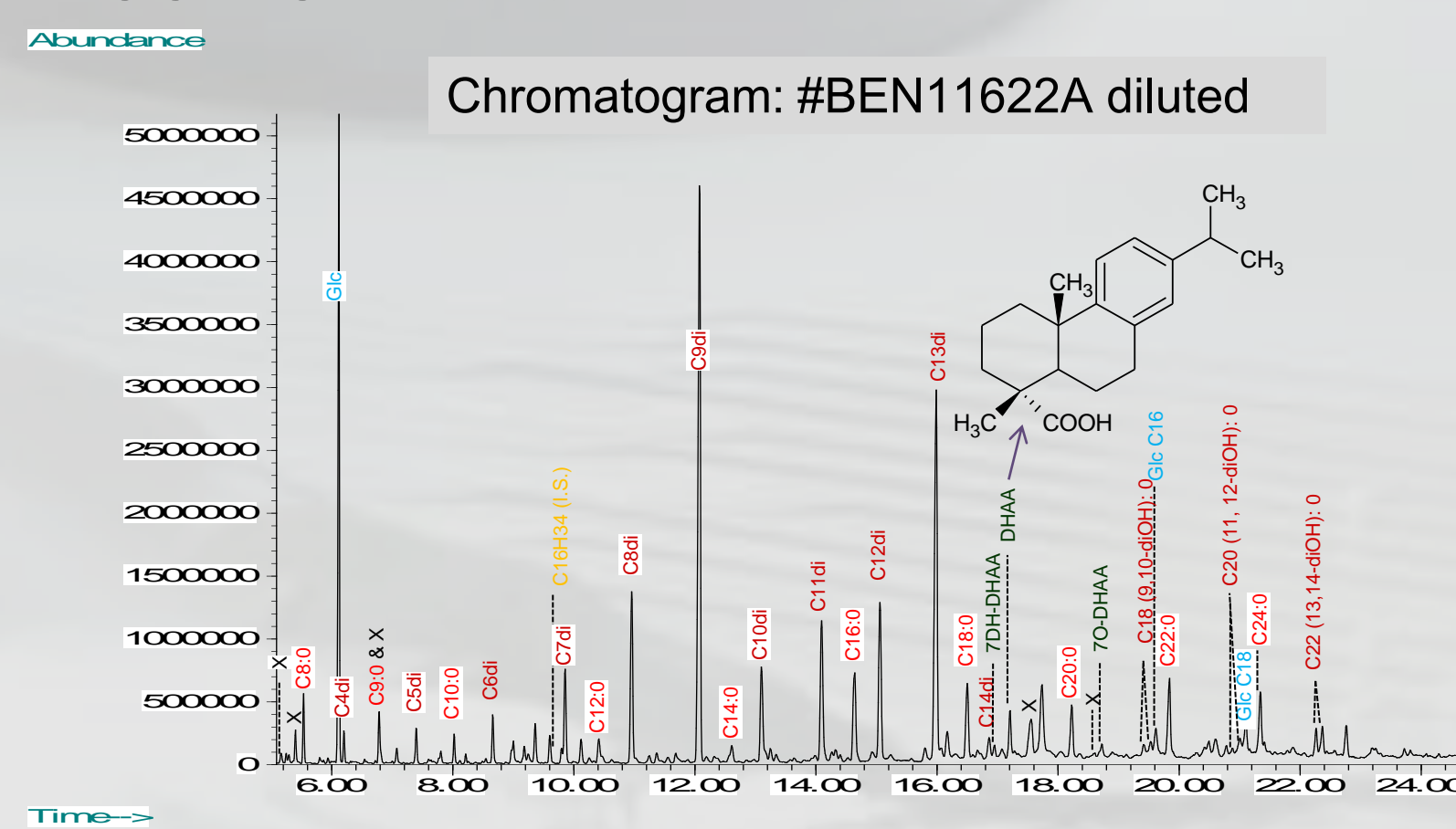
11544, 11550, 11551, 11573, 11596, 11598, 11622A, 11633A



Results

FTIR results				
#	C ₆ H ₁₄	CH ₂ Cl ₂	(CH ₃) ₂ CO	CH ₃ OH
11544	plasticisers	plasticisers & inorganic compound	fatty acids & esters	fatty esters
11550				fatty acids, esters & salts of carboxylic acids
11551	-	plasticisers	fatty esters	-
11573		plasticisers & inorganic compound		
11596		-		
11598	plasticisers	plasticisers & inorganic compound	fatty acids & esters	fatty esters
11622A				
11633A				

GC-MS Results

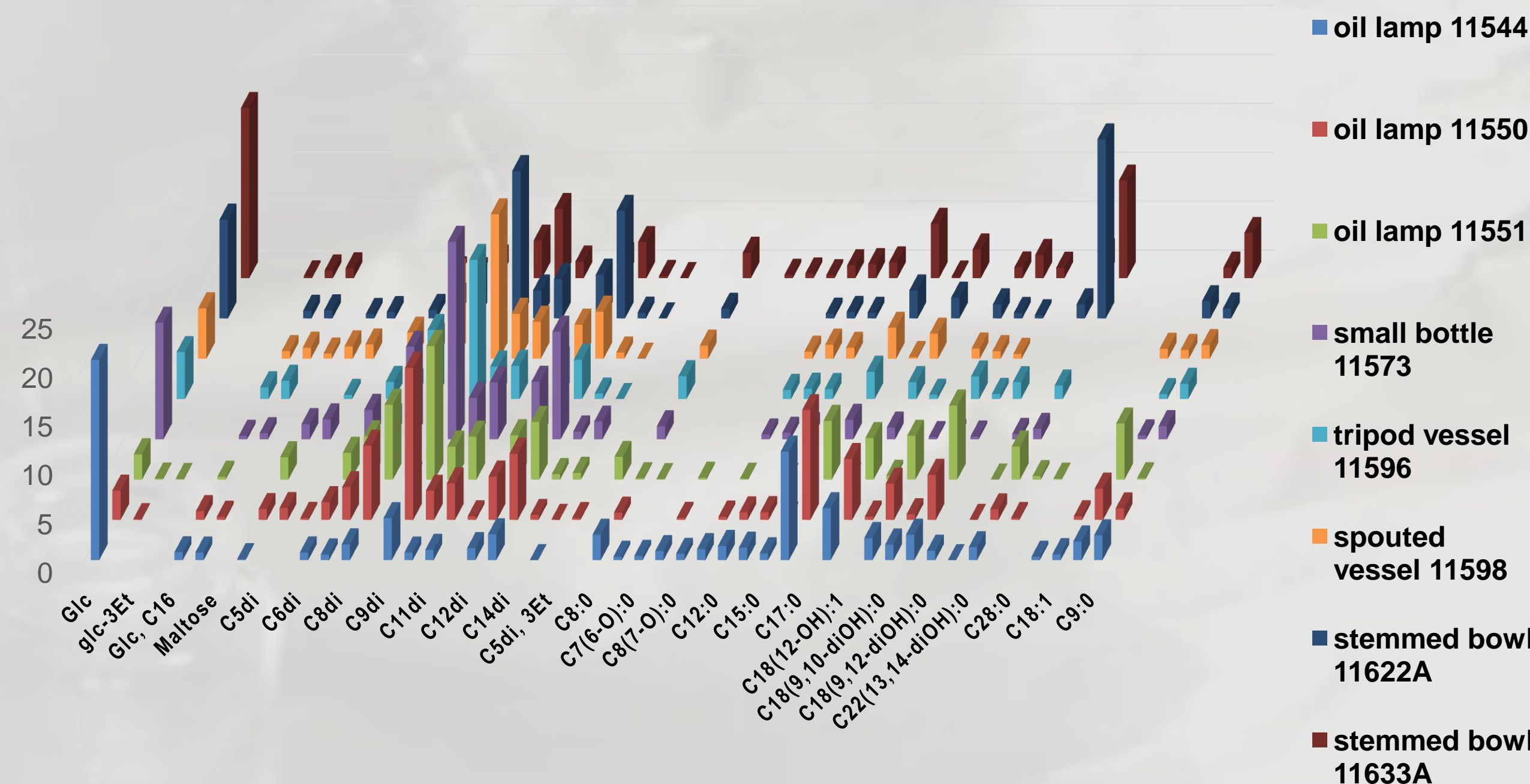
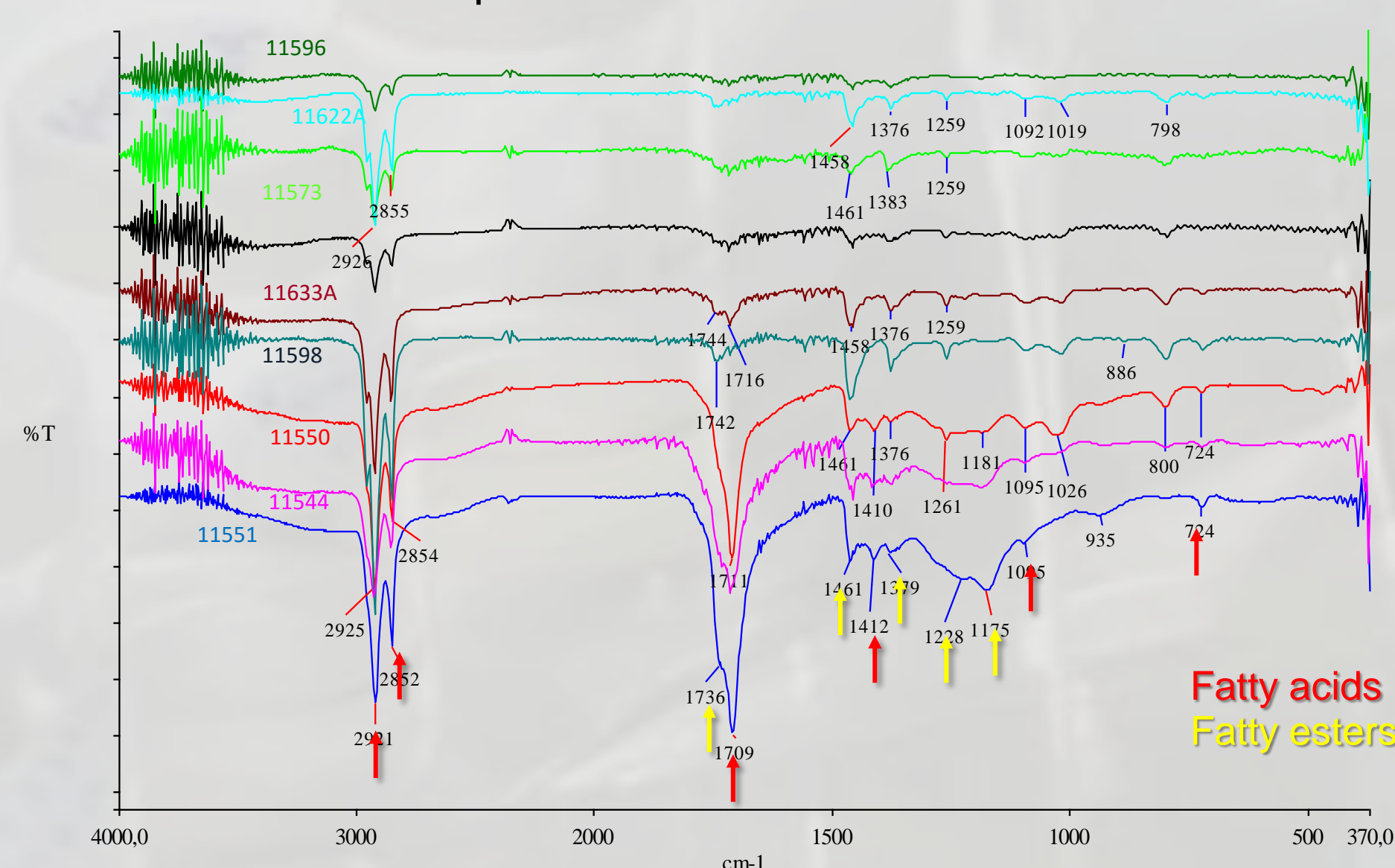


The identified main components using GC-MS analysis on derivatised samples are:

- glycerol along with C16 and C18 monoacyloglycerols
- a wide variety of even numbered saturated fatty acids ranging from C8 to C26, as well as two odd numbered saturated fatty acids (C9 and C15).
- hydroxy- and dihydroxy- fatty acids: 2-hydroxy-heptanoic (C7(2-OH):0), 9,10-dihydroxy-octadecanoic acid (C18 (9,10-diOH):0), 13,14-dihydroxy-docosanoic acid (C22 (13,14-diOH):0)

- a series of linear dicarboxylic acids, both even and odd numbered: C4 to C14.
- β -sitosterol is also present in a number of samples
- a wide variety of two different hydrocarbon types, $C_{v_1}H_{2v_1}$ and $C_{v_2}H_{2v_2-1}$, with v_1 ranging from 28 to 31 and v_2 ranging from 43 to 49 in some of the samples
- markers for oxidative degradation of pine resin: dehydroabietic, 7-hydroxy-/ 7-oxo -/ dehydroabietic, in sample 11622A⁷

Acetone : FTIR spectra



Conclusions

The compounds found in the samples were identified as

- Oils collected from plants of the *Brassicaceae* family in all samples^{3,4,5}
- Degradation products of castor oil³ in samples 11550, 11596, 11544
- Fats⁶ of unknown origin in sample 11544
- Pine resin biomarkers⁷ in sample 11622A
- The results provide considerable help for the conservator, in order to choose a suitable conservation treatment for the artifacts

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