

COMBINED RAMAN AND FTIR STUDY OF THECOTRICHITE AND RELATED EFFLORESCENCE

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THE PHENOMENON OF THECOTRICHITE



Ceramic oven tile from the Württemberg State Museum in Stuttgart, Germany. Thecotrichite was observed on the backside.



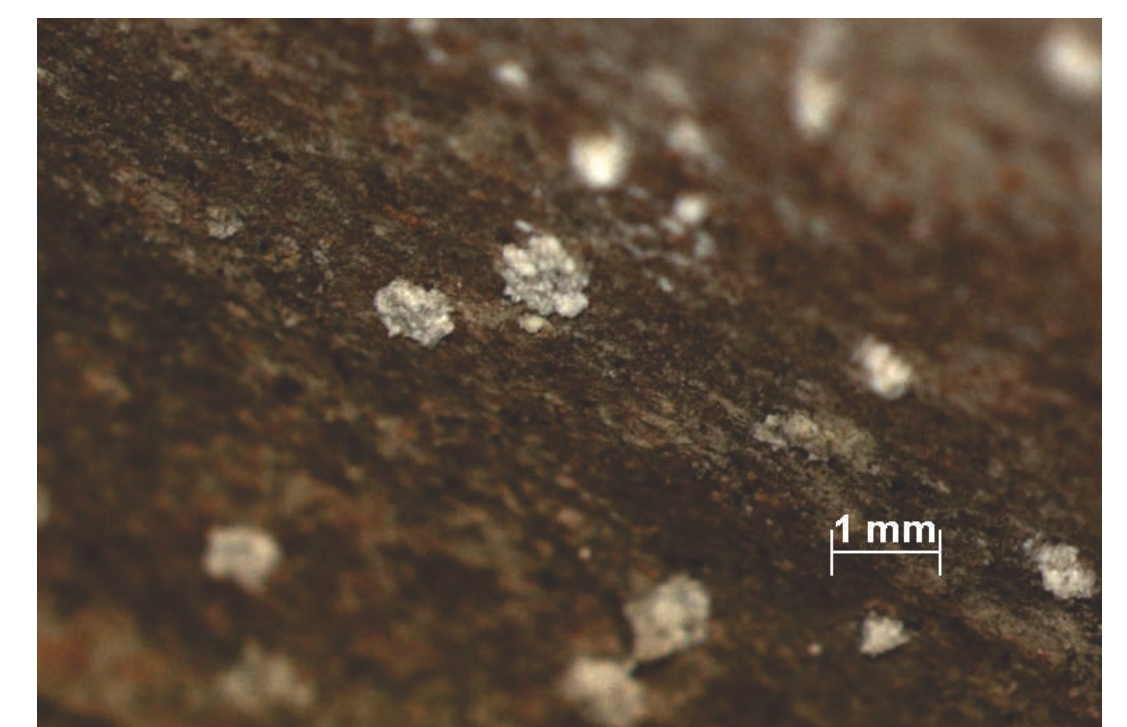
Intense deposit of fine needles were identified as thecotrichite $\text{Ca}_3(\text{CH}_3\text{COO})_3\text{Cl}(\text{NO}_3)_2 \cdot 7 \text{H}_2\text{O}$



The efflorescence occurred on calcium containing objects stored in oak wooden cabinets for a long period of time.

Formation of the efflorescence

Thecotrichite as well as related calcium acetate efflorescence were noted on art objects like ceramics, limestone, shells, mollusca, and other calcium containing materials. It is supposed that the acetic acid evaporates from wooden cabinets or sealing materials of show-cases. Nitrate and chloride salts may be contained in the object itself. Former cleaning procedures or contaminations during burial can be a source.



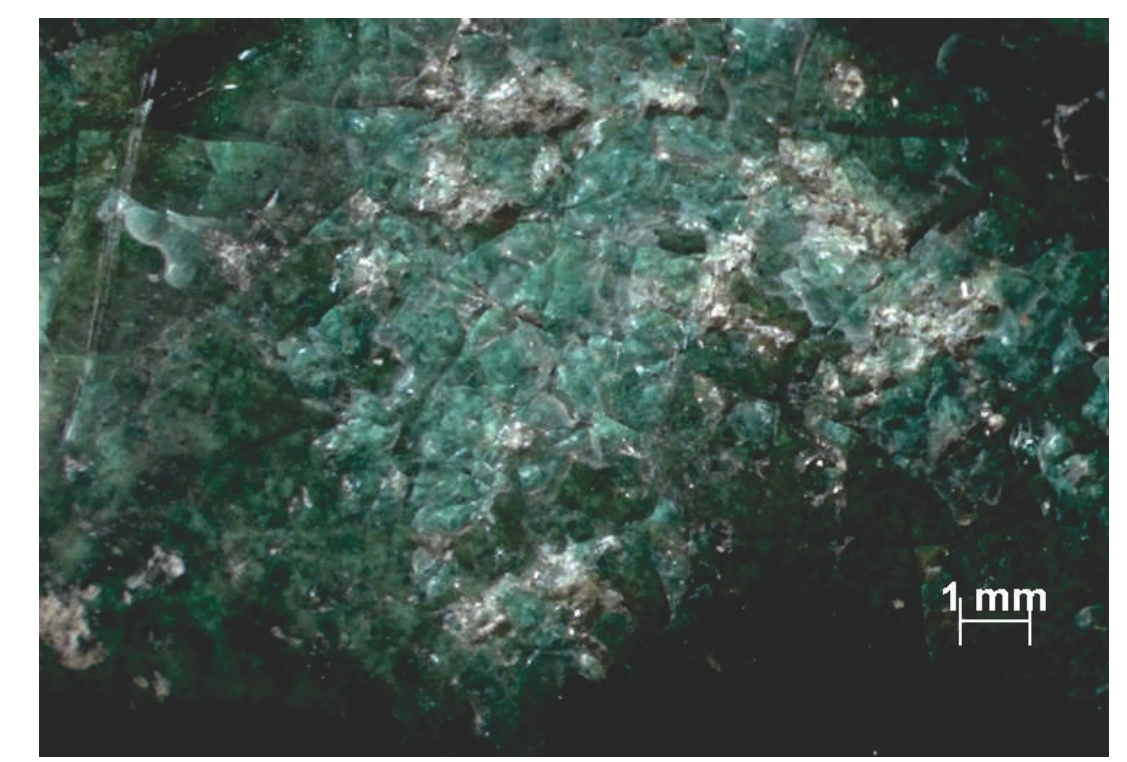
Another type of appearance of an efflorescence at a ceramic surface

(all photos by E. Sulzer/ Württemberg State Museum)

Compounds of the efflorescence

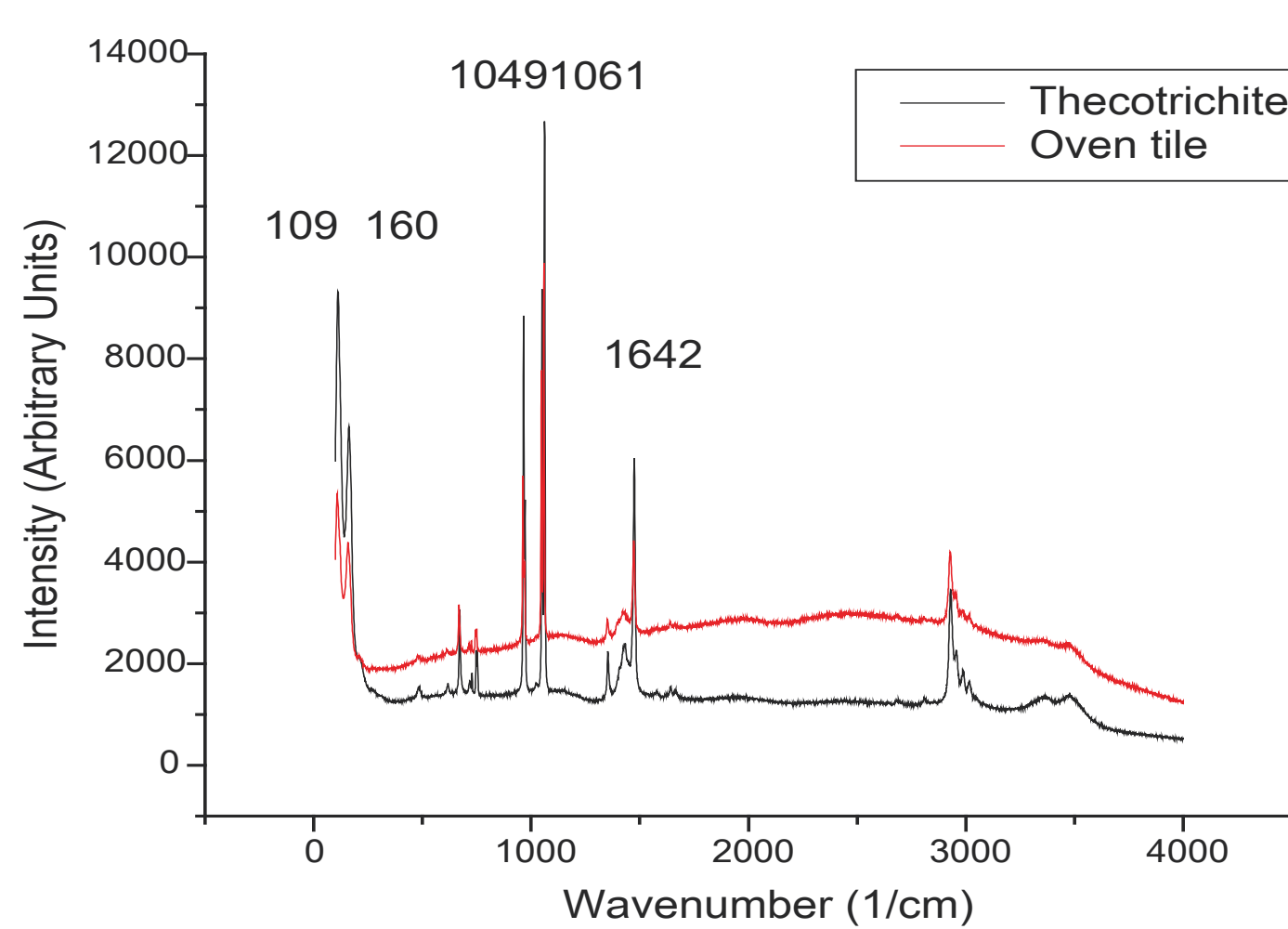
- Thecotrichite
 $\text{Ca}_3(\text{CH}_3\text{COO})_3\text{Cl}(\text{NO}_3)_2 \cdot 7 \text{H}_2\text{O}$
- Calciumacetatenitrate
 $\text{Ca}_2(\text{CH}_3\text{COO})_3(\text{NO}_3) \cdot 2 \text{H}_2\text{O}$
- Calcicite
 $\text{CaCl}(\text{CH}_3\text{COO}) \cdot 5 \text{H}_2\text{O}$
- Calcium acetate
 $\text{Ca}(\text{CH}_3\text{COO})_2 \cdot \text{H}_2\text{O}$

Further compounds of the system $\text{Ca}-\text{CH}_3\text{COOH}-\text{Cl}-\text{NO}_3$ may be found in future.



On the surface a green lead-containing glaze exists showing a loss of particles

ANALYTICAL DATA

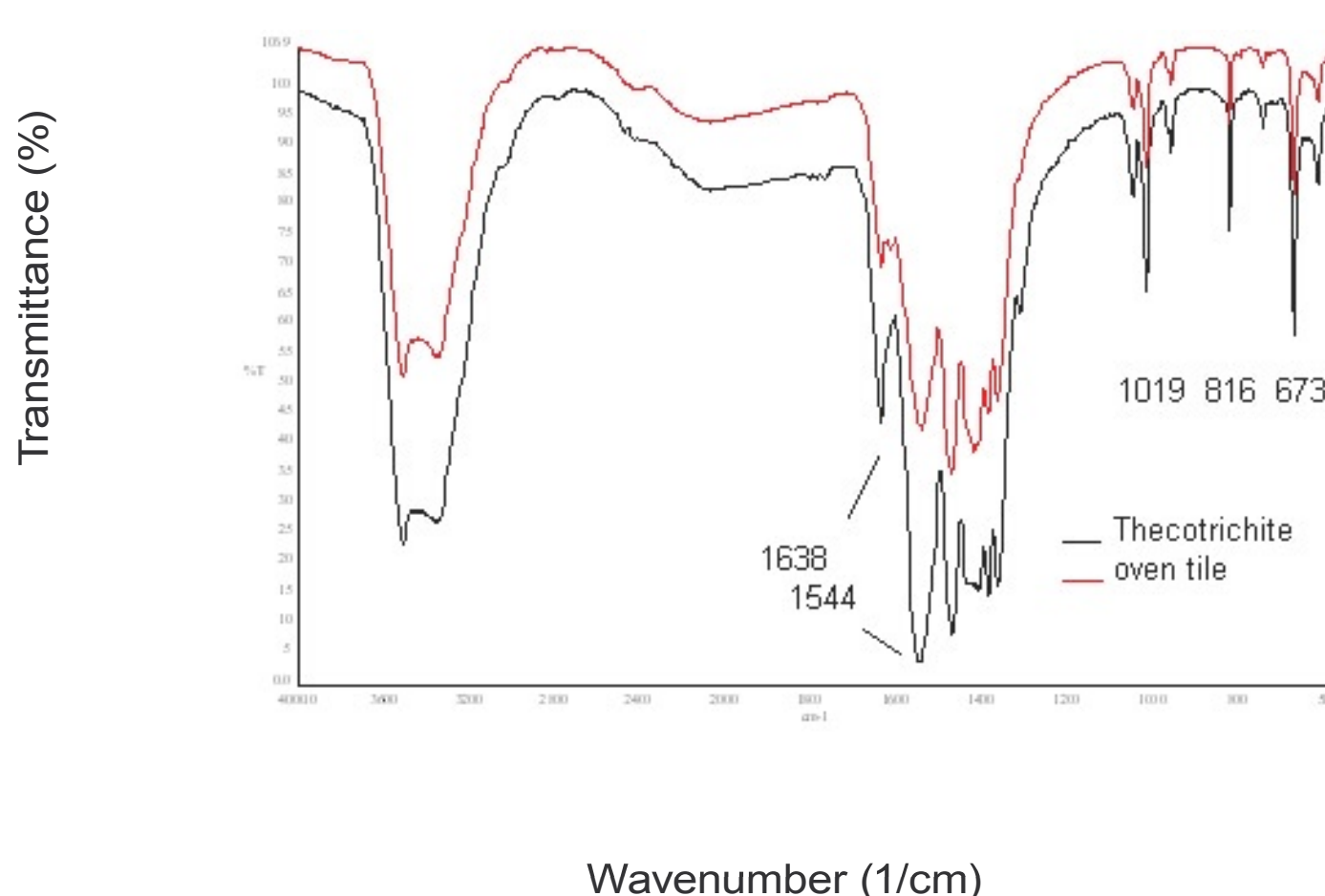
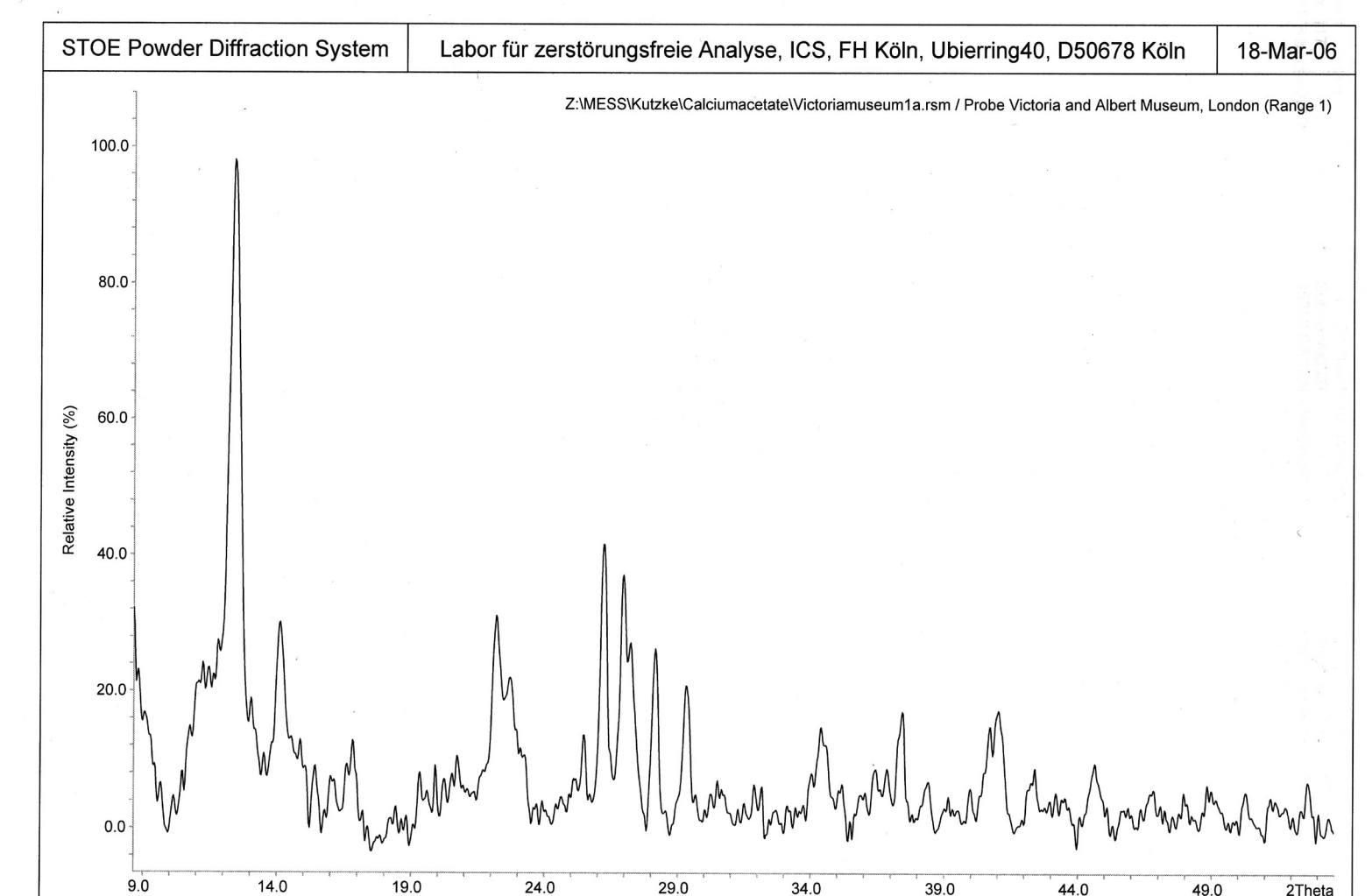


Raman

The Raman spectra of thecotrichite and an object sample provide both a pattern of sharp, very intense signals which are well separated.

XRD

In the powder X-ray diffractogram of an object sample the pattern matches with the XRD data of thecotrichite given by Tennant.



FTIR

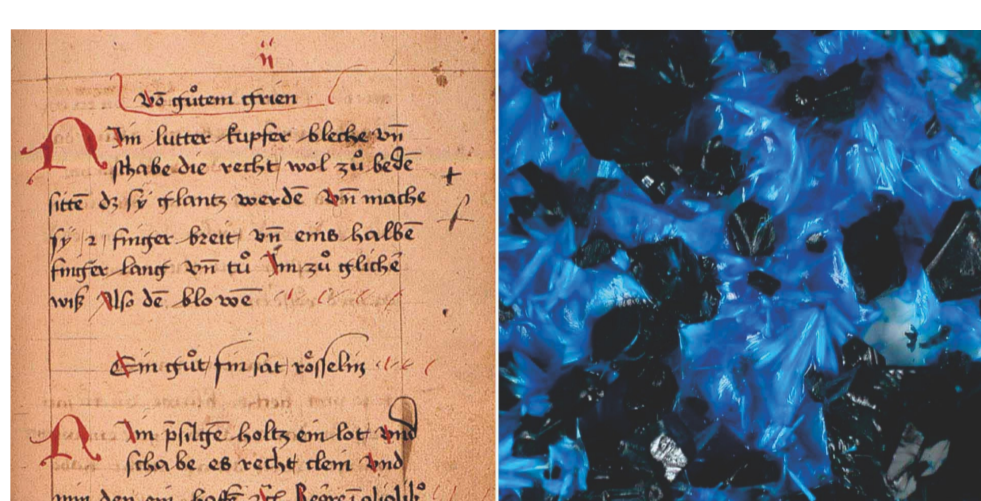
Infrared spectroscopy was performed as complementary method to Raman spectroscopy. The FTIR spectra give information about frequencies related to the present anions.

Conclusion

Raman spectroscopy is an excellent method for the examination of efflorescence of this group of compounds. It represents an alternative for the identification of thecotrichite to X-ray diffraction. The Raman spectrum of thecotrichite gives a characteristic pattern derived from vibrations of the acetate, nitrate, and chloride group. For this study reference compounds were synthesized for comparison. On this basis efflorescence on art objects were successfully identified.

Ref: N. H. Tennent, Th. Baird, The Deterioration of mollusca collections: Identification of Shell efflorescence, Studies in Conservation 30 (1985) 73-85

PREPARATION OF REFERENCE MATERIALS



Reference salts were synthesized by evaporation of solutions of salts in specific molar ratios. By the preparation of a medieval copper pigment a further modification occurred as minor product.

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- 2 Academy of Fine Arts Vienna, Austria, contact: a.schoenemann@akbild.ac.at
- 3 University of Applied Sciences, Cologne, Germany
- 4 Technical University, Vienna
- 5 State Academy of Art and Design, Stuttgart, Germany

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