SEEING RED: TOWARDS AN IMPROVED PROTOCOL FOR THE IDENTIFICATION OF MADDER AND COCHINEAL-BASED PIGMENTS BY FIBER OPTICS REFLECTANCE SPECTROSCOPY (FORS)

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INTRODUCTION:

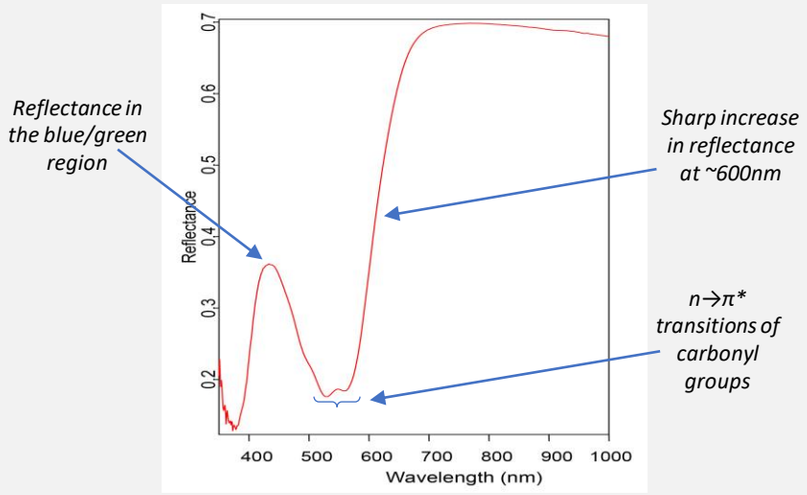
- Lake pigments based on madder root and cochineal insects are commonly found in works of art since Antiquity.
- These pigments are notoriously difficult to identify by non-invasive methods. High Performance Liquid Chromatography (HPLC) is the gold standard, but requires the removal of a sample.
- Fiber optics reflectance spectroscopy (FORS) is commonly used to non-invasively identify organic red pigments.

MADDER 

COCHINEAL 

- Significant shifts sometimes observed in the position of the diagnostic absorption features for red lake pigments can hinder correct interpretation of the spectra. To better understand these shifts, and improve the ability to confidently identify these pigments, a systematic study was carried out to evaluate the effects of different pigment recipes and laking substrates on reflectance spectra.

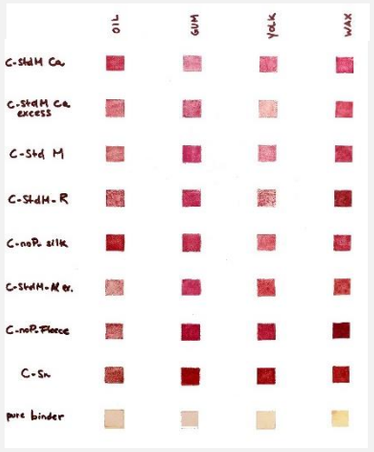
The anatomy of a red lake FORS spectrum



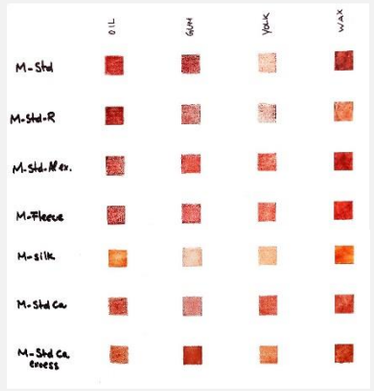
METHODS:

- Madder and cochineal pigments prepared using standardized versions of historical recipes
- ASD FieldSpec 4 Hi-Res Spectrometer
- White reference taken on a 99% Spectralon standard.
- Spectra collected at fixed geometry.
- Five spectra were collected for each sample, with each point spectrum being an average of 64 spectra.

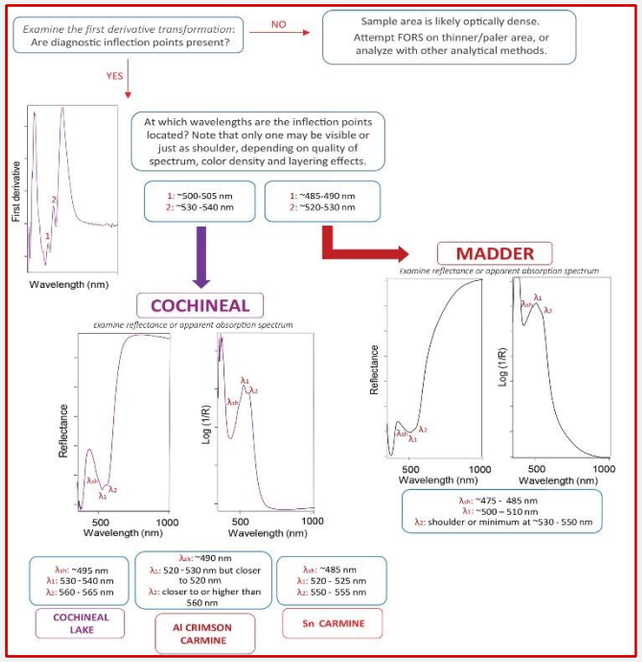
COCHINEAL



MADDER

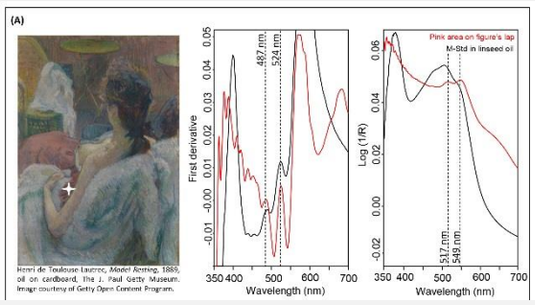


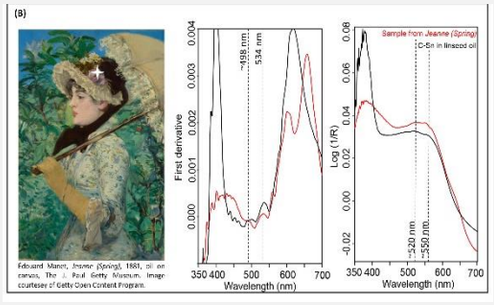
A DECISION TREE FOR THE IDENTIFICATION OF ORGANIC RED PIGMENTS



- In contrast to the absorption features typically used for identification, features in the first derivative transformation of the FORS spectra provided a more robust means of primary identification.

FEATURES	COCHINEAL-BASED PIGMENTS	MADDER-BASED PIGMENTS
$\lambda_{shoulder}$	~485-497 (Δ ~ 12 nm)	~469-481 (Δ ~ 12 nm)
$\lambda_{abs,1}$	520-538 nm (Δ = 18 nm)	500-509 nm (Δ = 9 nm)
$\lambda_{abs,2}$	555-574 nm (Δ = 19 nm)	~538-548 nm (Δ ~ 10 nm)
1st inflection point	496-503 nm (Δ = 7 nm)	~486-490 nm (Δ ~ 4 nm)
2nd inflection point	533-545 nm (Δ = 12 nm)	520-524 nm (Δ = 4 nm)





ACKNOWLEDGMENTS:

Jo Kirby, Herant Khanjian and Jing Han. Funding was provided by the Getty Graduate Internship provided by The J. Paul Getty Trust and hosted by the Department of Science at the Getty Conservation Institute.

Want to know more? Check our paper out! =)

Fonseca, B., Schmidt Patterson, C., Ganio, M. *et al.* Seeing red: towards an improved protocol for the identification of madder- and cochineal-based pigments by fiber optics reflectance spectroscopy (FORS). *Herit Sci* **7,** 92 (2019) or scan the QR code above.