Alterations of Yellow Ochres in Wall Paintings in the Vesuvian Area

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Ochres were widely employed in the paintings in the Vesuvian area. It is common knowledge that some regions of the wall paintings experienced colour changes of the ochres from bright yellow to dark red, due to the heat flow during the eruption of the Mount Vesuvius in the year AD 79. For a deeper comprehension of the processes involved in such modifications, some fragments of yellow ochre from a wall painting of a Pompeian house were artificially heated with different procedures. Changes have been explored as a function of peak temperature, heating and cooling rates, and permanence time at maximum temperature.

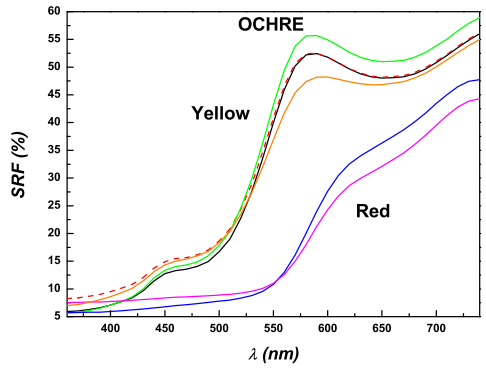

Figure 1. Spectral Reflectance Factor of ochres. Dashed line indicates the reference sample: yellow ochres refer to samples heated up to 250°C and red ochre to those heated up to 400°C.

The samples, taken from the same area of the wall painting, were heated up to 250°C or 400°C, at different heating rates and permanence times at maximum temperature. After cooling they were examined by means of XRD, SEM-EDX, μ-Raman, Spectrophotometric and Colorimetric analyses, in order to correlate chromatic alterations and chemical changes.

Results from the heated samples were compared with an unheated one taken as reference. Stable induced colour changes were observed only on samples heated up to 400°C, regardless of heating and cooling rates and permanence time at maximum temperature.

Typical Spectral Reflectance Factors are reported in Fig. 1, where dashed line indicates the reference sample: a significant difference exists among the samples heated up to 250°C (yellow ochre) and those heated up to 400°C (red ochre).

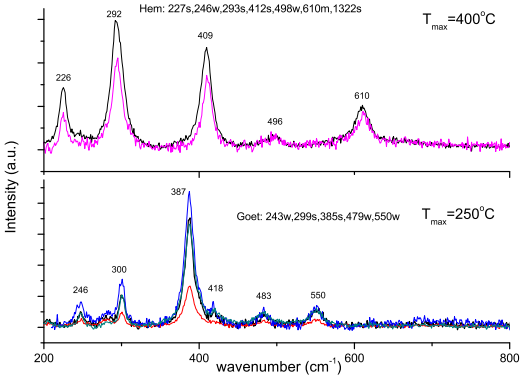

Figure 2. Raman spectra of samples heated up to 250 and 400 °C. Peaks indicate the typical structures of goethite and hematite [2].

From colorimetric investigations it came out that, due to the transformations induced by the higher maximum attained temperature, the red samples show the lightness coordinate, L*, well lower than that relative to yellow ones and the redness-greenness coordinate, a*, vary significantly, being the most discriminating colorimetric coordinate in differentiating the ochres, as reported also in literature [1].

SEM-EDX analyses confirmed the presence of iron, as main constituent, and of metallic impurities, typical of Italian ochres.

XRD and μ-Raman measurements (Fig. 2) revealed the chemical nature of samples and proved that chromatic changes are associated to the complete transformation of goethite into hematite, as a consequence of heating at higher temperature.

Anyway, a partial and initial transformation of goethite into hematite is observed in XRD and μ-Raman spectra even at lower temperature for samples that do not show any colour modifications.

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