

Diffuse Reflectance and Photothermal Radiometry Analysis of Thermally Treated Bones

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It is a common situation in archaeology and forensics to find burned bones. It is however, not easy to determine the conditions in which the materials were burned. Different methodologies have been devised providing interesting results using infrared thermography, X-ray diffraction and FTIR spectroscopy. In this work the effects of successive thermal treatments on pig diaphysis bones measured by photothermal radiometry and diffuse reflectance are reported. The samples were cut as squares of approximately 1 cm² of area and with thickness from 200 - 400 microns. They are thermally treated in the range from ambient temperature up to 350°C, on intervals of 50°C, during 2 hours for each treatment. After each treatment, the samples were analyzed by diffuse reflectance in the visible region of the optic spectra. When this analysis finished, the samples were studied by PTR in the heat transmission configuration as a function of the modulation frequency of the exciting laser, providing the thermal diffusivity of the sample. Diffuse reflectance permitted following the kinetic changes occurring in the sample due to the thermal treatment. Reflectance spectra changes strongly with thermal treatments, showing that for a given wavelength, the magnitude of the spectra grows systematically for the first thermal treatments, reaching a maximum around 150°C. After this temperature the reflectance decays to values much lower than the ambient temperature reflectance, showing a partial stabilization at 300°C. Similarly, thermal diffusivity shows an increase for low thermal treatment temperatures up to a maximum around 250°C, decaying for higher temperatures. These results show that the thermal treatments induce changes in the physical properties of the samples. Therefore these results could help understand the induced modifications on complex inorganic and organic bone structure.