H64 Heat Intensity Versus Exposure Duration Part I: Macroscopic Influence on Burned Bone

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The goal of this presentation is to provide attendees with information regarding the impact of duration of exposure compared to intensity of heating upon bone.

This presentation will impact the forensic community and/or humanity by providing an understanding of the contribution and interaction of intensity of heating and duration of exposure to the state of burned remains.

Throughout the last several decades burned bone has received copious attention in the anthropological literature, as the focal point of numerous forensic and archaeological examinations. Specifically, investigations, both laboratory and replicative, have focused upon developing criteria for identifying and assessing the degree of heat alteration through classification of color variation. Research has also focused upon change in surface morphology towards determination of pre-incineration condition. In addition, examinations have sought to recognize the micromorphological impact of heating.

At the most basic level, the condition and appearance of burned bone is due to exposure to heat, specifically the combined factors of duration and the intensity of heating. As noted in the literature, these two variables undoubtedly have a profound impact upon the condition of the remains, color changes, and fracture patterns. Nonetheless, the degree to which these variables influence the modification or destruction of the organic component of bone has not been systematically assessed. To potentially illuminate this situation, and understand the contribution and interaction of the intensity of heating and the duration of exposure to the state of burned remains, bone was heated using two exposure scenarios. One model represents a residential structure fire in which temperatures grow gradually and reach a maximum of approximately 1000 degrees Fahrenheit (F). The second model mimics an automobile fire in which temperatures build rapidly, exceeding 1400 F after less than two minutes. These models provide an opportunity to compare the varied effects of duration and intensity of heating on specimens and the resultant impact upon bone.

Our sample (15 specimens in total) was divided into two groups to represent each of the scenarios. Samples were heated in an electric kiln. Thermocouple devices positioned inside the kiln continuously monitor temperatures which are then relayed to a laptop computer running DaqView 5.0. For each model, seven samples of fresh bone, complete with soft tissue, were loaded into the kiln, prior to heating. One specimen was retained as a control. For model one, temperatures were raised in increments of 150 degrees every 3 minutes, resulting in a maximum temperature of 1050 degrees F over an interval of 21 minutes. For model two, the temperature was raised in increments of 250 degrees every 2 minutes resulting in a maximum temperature of 1750 degrees F over a period of 14 minutes. Prior to each temperature increase interval, one specimen was removed for analysis.

All extracted specimens were evaluated macroscopically. Surface color was assessed using a photospectrometer. Resultant analysis showed the differing effects of the two variables, specifically their impacts upon surface colors and fracture patterns. Specimens from scenario one, a lower temperature, longer duration fire displayed a range of color changes and fracture patterning. Specimens from burn scenario two, characterized by a high intensity shorter duration fire experienced a rapid loss of the organic component generating warping and characteristic fracture patterns. The differences seen in surface color changes, as well as fracture patterns between the two scenarios offer criteria to the forensic anthropologist tasked with interpreting and examining burned remains.

Burned Bone, Heat Fractures, Fire Models

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