

SPECIES IDENTIFICATION OF BONE FRAGMENTS: DEVELOPMENT OF A NEW COMBINED METHOD OF HEAT TREATMENT AND X-RAY DIFFRACTION ANALYSIS*

Sophie Beckett¹, Keith D. Rogers², John G. Clement³

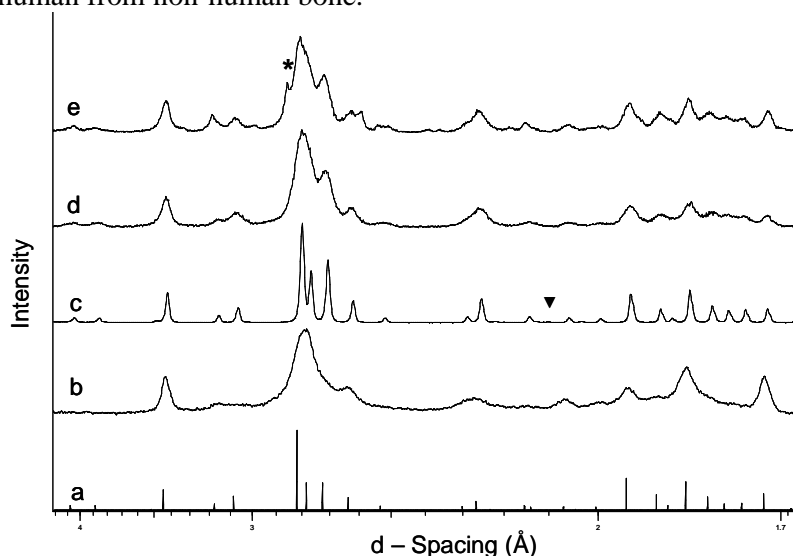
¹Cranfield Forensic Institute, Department of Applied Science, Security and Resilience,

²Cranfield Health, Translational Medicine, *Cranfield University, Shrivenham, SN6 8LA, UK*

³Melbourne Dental School, Faculty of Medicine, Dentistry and Health Science,
The University of Melbourne, 720 Swanston Street, Melbourne 3010, Australia

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Bone fragments are frequently recovered in forensic and archaeological contexts and there is often a need to identify whether the bone fragments are human. This is difficult for fragments that lack distinguishing morphological features. Currently available techniques have limitations with respect to their success, reliability and applicability. For example, it is often not possible to successfully carry out DNA analysis on bone that has been burnt to high temperatures. In addition, many current techniques are limited by their high cost, complexity of sample preparation and, long turn-around times. The characterisation of inter-species variation in bone mineral (b-HAP) for the purpose of species identification is therefore of relevance to forensic science and archaeology, but has not previously been widely explored. Results of an investigation of unheated bone mineral and behaviour of bone upon heating, for 12 animal species (including human) demonstrate that b-HAP characteristics, quantitatively measured using X-ray diffraction (XRD) and Rietveld analysis, exhibit significant inter-species variation. Human bone was found to be significantly different to all other species in terms of b-HAP lattice parameter values from unheated and heated bone and in terms of recrystallisation behaviour of b-HAP upon heating bone to 600 °C. The amounts of b-HAP thermal decomposition products were also significantly different for human bone heated to 1400 °C compared to those obtained for most other species. Therefore, there is potential for the development of an XRD based method of species identification, particularly one that distinguishes human from non-human bone.



Examples of X-ray diffractograms from unheated bone (b – human) and bone heated to 600 °C (c – human, d – cattle, e – rat). For clarity, diffractograms have been stacked and the expected peak positions for calcium hydroxylapatite (from PDF 9-432) are presented in (a). Most intense peaks for additional mineral phases are denoted by * (β -TCP) and ▼ (MgO).