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Investigating Heat Distribution in South African Archaeological sites with clumped isotope thermometry

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Controlled use of fire and cooking are among the most important discoveries in early human development. However, despite recent advances, additional methodological tools are required in order to refine our understanding of fire use in the past. The microscopic distribution of past heating events in archaeological contexts was modelled in the Middle Stone Age (MSA) deposits of Blombos Cave, South Africa (Haaland et al. 2017)[1] through colour classification and µFTIR analysis of deposited glauconite grains. While proving a very reliable method at Blombos, it is limited in its applicability to sites rich in glauconite grains. In this study, we apply carbonate clumped-isotope (Δ_{47}) thermometry (Müller et al. 2017)[2] for the detection of different temperature exposures of bivalve shell samples embedded in polyester resin within micromorphological sediment blocks. Δ_{47} reflects the temperature-dependent over-abundance of ^{13}C -^{18}O bonds within the skeletal aragonite of shells, and in heat exposed samples, will yield a combined signal of the original shell formation temperature and subsequent temperature-dependent reordering. Here we attempt to confirm the reliability of the method by cross-referencing the results from the marine shell samples with previously analysed glauconite samples (Haaland et al. 2017)[1] from the same sections from Blombos Cave. Additionally, we attempt to enhance our understanding of heat distribution in the archaeological context of Blombos Cave through analysis of sections where glauconite is absent. Finally, we produce novel information on a previously unanalysed shell midden context from Klipdrift Shelter, South Africa. Our results demonstrate the potential of the application of carbonate clumped-isotope thermometry on micromorphological blocks for furthering our understanding of marine shell fire exposure and showcasing its potential use for archaeological sites positioned at coastlines and riverbeds.

[1]Haaland, M.M. et al. (2017) ‘Heat-induced alteration of glauconitic minerals in the Middle Stone age levels of Blombos Cave, South Africa: Implications for evaluating site structure and burning events’, Journal of Archaeological Science, 86, pp. 81–100.

[1] Müller, P. et al. (2017) ‘Prehistoric cooking versus accurate palaeotemperature records in shell midden constituents’, Scientific Reports, 7(1).