

## **A new luminescence dating chronology for the Rhafas cave site (NE Morocco): Insights into Palaeolithic human cultural change under varying palaeoenvironmental conditions in the Maghreb**

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Archaeological sites in northern Africa provide a rich record that is of increasing importance for current debates relating to the origins of modern human behaviour and to Out of Africa human dispersal events. Particular interest is placed on the cultural transition between the North African Middle Stone Age (MSA) and Late Stone Age (LSA), and the need for accurately defined chronologies, however the timing and nature of Palaeolithic human behaviour and dispersal across north-western Africa (the Maghreb) and potential correlation with environmental conditions remain poorly understood.

The inland cave site of Rhafas (Morocco) preserves a long stratified sequence providing valuable chronological information about cultural changes in the Maghreb spanning the North African MSA through to the Neolithic. In this study, we apply optically stimulated luminescence (OSL) dating on sand-sized quartz grains to the cave deposits of Rhafas as well as to a section on the terrace in front of the cave entrance. Single grain OSL dating reliably constrains the timing of technocomplexes beyond the limits of radiocarbon by directly dating sediment associated with archaeological traces. We combine OSL dating with multi-proxy geological investigations (XRF, grain size analyses, stable isotopes, thin sections) to investigate site formation processes and reconstruct palaeoenvironmental conditions during human occupation phases at Rhafas.

Our results indicate that the occupation of the site started at least in MIS 6 during a phase of relatively arid environmental conditions. Climatic amelioration after c.140 ka is associated with a change in sediment geochemistry at the site, most likely linked to a change in sediment source due to shifting wind directions. Tanged pieces – typical for the classical Aterian technocomplex – start to occur in the archaeological sequence in MIS 5, consistent with previously published chronological data from the Maghreb. From 55 ka, climatic conditions were sufficiently humid for the pedogenic cementation of Rhafas sediments by carbonates, resulting in the formation of a duricrust several centimetres thick. Deposits from the last glacial period are associated with LSA technocomplexes and fall within previously established chronologies from the Maghreb.