



## **Age constraints for Palaeolithic cave art by U-Th dating of thin carbonate crusts**

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U-series dating is an important geochronological tool which is widely applied for instance in speleothem based palaeoclimate research. It has also great potential to provide age constraints for Archaeology, especially for sites or artefacts in cave environments. We present our methods to conduct precise U-Th dating of calcite crusts that formed on top of cave paintings. Recent developments in multi-collector (MC) inductively coupled plasma mass spectrometry (ICPMS) U-series dating greatly improved the precision of this method, and sample sizes needed to obtain reliable results were significantly reduced. Based on these developments the U-series technique can be applied for accurate dating of thin calcite crusts covering cave art at many sites, while taking care not to harm the art underneath. The method provides minimum ages for the covered art and, where possible, also maximum ages by dating the flowstone layer the art is painted on.

The U-Th method has been used in a number of recent projects to date calcite precipitates above and occasionally below cave paintings in Spain. Initial results from Cantabria have shown that the earliest dated paintings are older than  $41.4 \pm 0.6$  ka, dating at least to the Early Aurignacian period and present a far longer chronology than that based so far on radiocarbon dating. Here we outline our methodology and the steps we take to demonstrate the reliability of U-Th dates, and present some recent results of our ongoing U-Th dating programme.