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Uranium-series dating of bracketing mineral accretions associated with Kimberley rock art

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Uranium-series radiogenic dating methods have been successfully applied for the first time to layered mineral accretions that are commonly associated with rock art sites in the Kimberley region of Western Australia. Particularly promising results have been obtained from an important coastal site characterised by extensive rock engravings ('pecked' cupules) on cave walls. Considered one of the oldest art styles, 'rock markings' such as these cupules offer an insight into how the first Australians interacted with and transformed their environments and are found across the world with specific historical and social meanings. The cupules were not made for utilitarian purposes such as grinding foodstuffs and instead represent a visual residue of multi-sensorial interactions people have with places.

This study focuses on millimetre to centimetre thick mineral accretions into which the cupules have been ground as well as others accumulating within the cupule hollows, providing a rare and important opportunity to provide bracketing ages for the rock art. Extensive mineralogical and geochemical analyses have identified a recurring suite of dominantly sulphate, oxalate and phosphate minerals, with other minor phases, that comprise many of the accretions forming in rock shelters across the Kimberley. In particular, magnesium phosphate minerals such as newberyite are found to host sufficient uranium for the application of uranium series dating methods. The identification of micron-scale layering within the internal stratigraphy of these accretions using LA-ICP-MS and SEM-EDS analysis, enables targeted, high-resolution micro-sampling of the uranium rich layers. The application of uranium-series dating to these layers is particularly important as co-genetic samples from multiple sample sets within individual growth layers, and sequential layers across the accretion's internal stratigraphy, both allow testing for closed system behaviour with respect to uranium and thorium to be demonstrated, an issue which has hampered many previous radiogenic dating studies.

This study demonstrates the importance of detailed inorganic and organic geochemical characterisation of both the sample and its associated rock shelter in the production of reliable and reproducible ages via uranium-series dating of rock art associated materials. The method has the potential to provide significant numbers of dates bracketing rock art ages across a region that currently has very little high quality geochronological information.