



## Focus Article

# U-series dating at Nerja cave reveal open system. Questioning the Neanderthal origin of Spanish rock art

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## ABSTRACT

U/Th data obtained on CaCO<sub>3</sub> layers covering rock art at Nerja Cave (Spain) evidence erroneous ages and an inverse relation between uranium concentration and apparent ages. This open system behavior could be due to a mechanism causing uranium mobility, resulting in apparent ages being too old with respect to their real age. This article also questions recently published U/Th data on samples from Ardales, Maltravieso and La Pasiega caves (Spain) where a few U/Th ages older than 40 ka BP, suggested that cave art could be attributed to Middle Palaeolithic population (Hoffmann et al., 2018). For these caves, U/Th data also display an inverse relation between U content and ages, indicating possible uranium mobility and erroneous ages.

## 1. Introduction

Cave art dating is a key issue for the knowledge of human artistic development. Uranium series dating (or uranium-thorium or U/Th) of secondary CaCO<sub>3</sub> layers underlying or overlying rock art has been used when no direct radiocarbon (<sup>14</sup>C) dating is applicable in order to give a limit age to the artistic representations (e.g. Bischoff et al., 2003). U/Th data obtained on Spanish decorated caves proposed a significantly older chronology for rock art than the one previously established using archaeological and <sup>14</sup>C studies, and suggested that the Neanderthals may be the authors of the cave art (Pike et al., 2012; Hoffmann et al., 2016, 2018). These data have been intensely discussed from an archaeological and chronometric point of view (e.g. Bednarik, 2012; Clottes, 2012; Pons-Branchu et al., 2014; Aubert et al., 2018; Slimak et al., 2018; Pearce and Bonneau, 2018; White et al., 2019).

In order to test the reliability of U/Th ages obtained on CaCO<sub>3</sub> layers covering rock art, some authors suggested the use of two dating radiometric methods (U/Th and <sup>14</sup>C) on the same samples (e.g. Plagnes et al., 2003; Fontugne et al., 2013; Shao et al., 2017). This approach has been done on a few samples from the Lower galleries of Nerja Cave (Spain). In some cases, it revealed age concordance and in other cases age

disagreement, interpreted as the consequence of an open system behavior of the sample (unreliable ages, see Valladas et al., 2017) but without determination of mechanism causing it. In this article, we present U/Th data obtained on CaCO<sub>3</sub> samples from the Upper gallery of Nerja Cave, with evidence of open system behavior resulting in erroneous U/Th ages. The recently published old ages obtained for rock art from Spanish caves are also discussed, since the same phenomena could have occurred.

2. U/Th dating of CaCO<sub>3</sub> samples from the pisciform chamber at Nerja cave

Nerja cave (Malaga, Spain) is a large cave, developed in Triassic dolomitic marble. It contains important archaeological remains and graphic manifestations including animals and signs (Sanchidrián, 1994). <sup>14</sup>C analyses of charcoal fragments from inner rooms indicate human occupation from 40,695 to 5970 yr cal BP (Medina-Alcaide et al., 2015). In the Upper Galleries, the Pisciform Chamber displays a decorated panel with six red paintings, the "Focas", interpreted as seals (Sanchidrián, 1994). From this room, small fragments of CaCO<sub>3</sub> removed from the decorated panel (GN12-10, GN13-20 and GN13-21,

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