A rock engraving made by Neanderthals in Gibraltar

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The production of purposely made painted or engraved designs on cave walls—a means of recording and transmitting symbolic codes in a durable manner—is recognized as a major cognitive step in human evolution. Considered exclusive to modern humans, this behavior has been used to argue in favor of significant cognitive differences between our direct ancestors and contemporary archaic hominins, including the Neanderthals. Here we present the first known example of an abstract pattern engraved by Neanderthals, from Gorham's Cave in Gibraltar. It consists of a deeply impressed cross-hatching carved into the bedrock of the cave that has remained covered by an undisturbed archaeological level containing Mousterian artifacts made by Neanderthals and is older than 39 cal kyr BP. Geochemical analysis of the epigenetic coating over the engravings and experimental replication show that the engraving was made before accumulation of the archaeological layers, and that most of the lines composing the design were made by repeatedly and carefully passing a pointed lithic tool into the grooves, excluding the possibility of an unintentional or utilitarian origin (e.g., food or fur processing). This discovery demonstrates the capacity of the Neanderthals for abstract thought and expression through the use of geometric forms.

Middle Paleolithic | symbolism | art | Iberia | cognition

Considerable debate surrounds the Neanderthals' cognitive abilities (1–7), and the view that the Neanderthals did not have the same cognitive capacities as modern humans persists in the literature (8) despite evidence to the contrary (9–15). One of the arguments against Neanderthals' modern cognition is their apparent inability to generate cave art (16–19). The earliest evidence of rock art is typically associated with the arrival of modern humans (MH) in Western Europe ~40 kyr (20, 21). The dating of calcitic layers covering painted dots at El Castillo Cave, Spain has pushed back this starting point beyond 41 kyr, opening the possibility of a Neanderthal authorship (22). Possible hypotheses include (*i*) the earliest rock art was produced by MH before their arrival in Europe but remains unidentified; (*ii*) rock art was created by Neanderthals or other archaic hominins and predated the arrival of MH; (*iii*) MH developed rock art on arrival in Europe; and (*iv*) rock art was developed in Europe after the arrival of MH.

The lack of associated archaeological remains precludes assigning the El Castillo paintings to a specific population. Other factors contributing to the difficulty in testing the foregoing hypotheses include persistent uncertainties in the chronology of archaeological sites at the so called Middle-to-Upper Paleolithic transition in Europe (23–25) and in the taxonomic affiliation of their inhabitants during this period (26–28).

Recent excavations at Gorham's Cave led to the discovery in an area at the back of the cavity, below basal archaeological level IV, of an abstract pattern engraved into the bedrock. Level IV is an archaeological horizon containing exclusively Mousterian artifacts (29–31) deposited between 38.5 and 30.5 cal kyr BP (29, 32) (*SI Appendix*, Table S1). In this paper, we describe this engraving, provide additional contextual data demonstrating its attribution to Mousterian Neanderthals, reconstruct how it was created, and discuss implications of our findings for Neanderthal culture and cognition.

Gorham's Cave

Gorham's Cave is located in Gibraltar, a small promontory situated at the southern extreme of the Iberian Peninsula (Fig. 1). The eastern side of Gibraltar faces the Mediterranean Sea and is subjected to intense wave action, which has led to the formation of steep cliffs and large sea cavities (33). Gorham's Cave is one of these caverns. In the cave, the surface of fresh rock is a white, slightly crystallized lime-dolostone of Jurassic age. In its natural state, the same rock is light gray, fine-grained, and rough because of surface weathering caused by condensation of sea spray, mainly during the summer season, when the humid easterlies are dominant. Within the cave, the weathering of this rock has produced a network of 10–40 mm deep × 1–9 mm wide dissolution cracks (*SI Appendix*, Fig. S1).

Significance

The production of purposely made painted or engraved designs on cave walls is recognized as a major cognitive step in human evolution, considered exclusive to modern humans. Here we present the first known example of an abstract pattern engraved by Neanderthals, from Gorham's Cave in Gibraltar. It consists of a deeply impressed cross-hatching carved into the bedrock of the cave older than 39 cal kyr. The engraving was made before the accumulation of Mousterian layer IV. Most of the lines composing the design were made by repeatedly and carefully passing a pointed lithic tool into the grooves, excluding the possibility of an unintentional or utilitarian origin. This discovery demonstrates the Neanderthals' capacity for abstract thought and expression.

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engraving were produced by exporting depth maps obtained with the LAS Montage into the Leica Map DCM 3D software.

The Gorham's Cave engraved lines were extensively examined and photographed with macro lenses and a HIROX VCR-800 digital microscope at magnifications ranging from 20× to 160×. The microscope was moved over the engraving using an arm attached to a photo tripod, to avoid vibrations and contact with the rock. Particular attention was given to documenting (*i*) the occurrence of surface features, from the literature (48, 49) or produced experimentally in the framework of the present study, which could be used to reconstruct the craftsman's action, and (*ii*) the type of tool used and the order of the engraved lines. The location of the duricrust in relation to the engraving and the state of preservation of the engraving were examined as well. The width, depth, and sections of the archaeological engraving were calculated with TIVMI software (http://projets.pacea.u-bordeaux.fr/TIVMI/), using the 3D model for the engraving generated using Agisoft Photoscan Standard Edition. The widths obtained with this method were verified by comparing them with those measured on photos of the archaeological engraving.

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