FAQs

How did the GH site form, and what conditions allowed the fossils to be preserved?
The formation of the GH site is closely linked to Quaternary sea-level fluctuations driven by the expansion and melting of ice caps. The cavity was carved by marine erosion into consolidated marine sediments deposited during earlier high sea-level stands. During a subsequent marine transgression, several meters of sediment accumulated inside the cave. When sea level later regressed, wind-blown fine sands became the main depositional agent. It was during this phase that most of the fossil remains were introduced into the lower part of the cave. These remains were subsequently buried by fine sediments transported by wind and surface runoff. Finally, the cave entrance was sealed by a dune. Together, these natural processes account for the exceptional preservation of the fossil remains.

Were any remains other than human fossils identified at Grotte à Hominidés?
Yes. In addition to the human fossils, the cave has yielded thousands of faunal remains and approximately 300 stone artifacts made of quartzite and flint. The lithic assemblage documents a second phase of the Acheulean techno-complex in Atlantic Morocco, following an earlier Acheulean phase identified at Site L of Thomas Quarry I and dated to approximately 1.3 million years ago.

What period of human evolution does this study pertain to?
The Grotte à Hominidés fossils date to the transition between the Early and Middle Pleistocene. This period witnessed the dispersal of Homo erectus out of Africa, as well as the extinction of more ancient hominin groups such as *Australopithecus* and *Paranthropus*. Hominins from this time typically show postcranial proportions approaching those of modern humans, with relatively short arms and long legs, although brain size generally remains around 1,000 cubic centimeters.

Why is this discovery significant?
First, hominin fossils dating to this time period are extremely rare in Africa, Europe, and Asia, making the GH remains an important addition to the human fossil record. Second, they provide, for the first time, a fossil sample whose morphology makes it a strong candidate for representing a deep ancestral population related to Homo sapiens. Previously, only fossils from Atapuerca in Spain, particularly those from the Gran Dolina site, had been proposed to show derived features potentially linked to Homo sapiens. The Grotte à Hominidés fossils therefore open the possibility of an evolutionary connection with the oldest known Homo sapiens fossils from Jebel Irhoud, dated to approximately 315,000 years ago.

To which species do the Grotte à Hominidés fossils belong?
We argue that the most appropriate interpretation is that these fossils represent an evolved form of Homo erectus. They display more derived features in their mandibles and teeth than older Homo erectus fossils from Africa and Asia, but they lack the derived traits that characterize either Neanderthals or anatomically modern Homo sapiens.

Why were hominin remains found in this cave?
During the Pleistocene, early humans likely competed with large carnivores for space and resources, particularly caves. A human femur recovered from the site shows surface modifications, including tooth marks and fractures consistent with carnivore chewing. Similar damage is observed on other animal remains from the cave. This evidence indicates that carnivores were responsible for the accumulation of remains through predation and/or

scavenging. The size and morphology of the marks on the hominin femur suggest that they were most likely produced by hyenas shortly after death, although it is not possible to determine whether the individual was actively hunted or scavenged soon after death.

Were early hominins frequently eaten by carnivores?
Although encounters between early hominins and large predators in Northwest Africa during this period were probably common, direct evidence of carnivore consumption of hominins is rare. The gnawed femur from Grotte à Hominidés represents one of the few cases in which carnivore predation or scavenging of hominins can be reasonably inferred.

Were these hominins capable of hunting and accessing meat and animal fat?
Yes. Evidence from nearby sites, such as the Grotte des Rhinocéros, demonstrates that early hominins were capable of killing and processing large prey. They were also likely able, at times, to defend access to resources against large carnivores. As a result, their position in the Pleistocene food web probably alternated between predator and prey, depending more on circumstances than on cognitive or technological limitations.

What is a magnetic polarity reversal?
Earth's magnetic field is dipolar, with north and south magnetic poles. It can exist in two configurations: normal polarity, corresponding to the present-day situation in which the north magnetic pole lies near the geographic North Pole, and reversed polarity, in which it lies near the geographic South Pole. Magnetic polarity reversals occur when the Earth's magnetic field flips between these two states and happen simultaneously on a global scale.

What is the chronological significance of the Matuyama–Brunhes transition?
The Matuyama–Brunhes transition is a fundamental chronological marker dated to approximately 773,000 years ago. Its magnetic signature, recorded in rocks and sediments worldwide, provides a robust means of dating geological, archaeological, and paleoanthropological sequences. It marks the boundary between the Early and Middle Pleistocene.

Why do rocks become magnetized?
Many rocks contain magnetic minerals such as magnetite and hematite. When these minerals form or settle, their magnetic moments align with Earth's magnetic field at that time. As a result, rocks preserve a record of the polarity and orientation of Earth's magnetic field when they were deposited or crystallized.