New ages from Jebel Irhoud, Morocco

Update #1 to *Human Origins: How diet, climate and landscape shaped us*

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The date

New fossil finds and a better constrained age for the Jebel Irhoud fossil site in Morocco shed new light on our evolution. The new ages indicate that the site is approximately 315 thousand years old (315 ka), or nearly twice as old as the previous estimated age of 160 ka for the site. The new, older age was obtained by applying the thermoluminescence dating method, which estimates the amount of time elapsed since stone flint tools found from the same layer as the fossil bones had been heated by fires made by those living at the site. The thermoluminescence method measures the amount of light given off by the stones tools (the amount they luminesce) as they are heated to higher temperatures. The idea is that the fires at the site were hot enough to completely erase any luminescence trapped in the stones. Once cooled, and so long as they were never exposed to the heat of a fire again, the stones gradually accumulated stored luminescence through time from natural radiation received from the surrounding sediment. The present-day background radiation dose of the deposit was measured from where the stone tools were recovered and was assumed to have remained more or less constant back through time. Heating of the stone flints in the lab causes the stored luminescence to be released, and the amount released could be measured. Dividing the total released luminescence by the radiation dose rate measured at the site allows an age to be calculated.

Luminescence dating, both thermoluminescence and optically stimulated luminescence (or OSL), has revolutionized our ability to date archaeological sites beyond what was previously limited to the last 50 thousand years by the radiocarbon method. The drawback to luminescence dating is that it too has limits in how far back it can reach because the amount of luminescence that can accumulate is limited. Once the stones have acquired maximum luminescence they can acquire no more, making it difficult to apply the method to samples older than 200 ka. So, the new age determined at Jebel Irhoud by thermoluminescence in excess of 300 ka is remarkable.

The other drawback with the thermoluminescence method is that the dates are not nearly as precise as those obtained by the radiocarbon dating method. The weighted average age of 14 samples from the fossil-bearing layer at Jebel Irhoud is 315 ka, but this age is associated with a fairly large uncertainty, with a 68% probability that the age of the site is between 349 ka and 281 ka, and a 95% probability that the age of the site is between 383 ka and 247 ka. The age range of 383 ka to 247 ka is consistent with both the range in age of a human tooth recovered from the site determined by a different method known as electron spin resonance (a far more complicated method than thermoluminescence that I will not try to explain here), and the known age ranges of fossil animals found at the site. Therefore, although not terribly precise, the new age is a huge improvement on previous ones for the site and, as we shall see, the new age provides valuable insights into the interpretation of the Jebel Irhoud fossils and their possible connection to other fossil sites in Africa.

The fossils

The Jebel Irhoud site has yielded a rich human fossil assemblage comprising skulls, jaws, teeth, leg and arm bones from at least five individuals, including a child and adolescent. Although the original location of all the fossils is not known, they are all assumed to have come from the same layer at the site associated with the new date of circa 315 ka. The face, jaw and teeth are considered to be

similar to our own, although the jaw and teeth are unusually large, and the size of the browridge is variable. The most significant difference appears to be in the shape of the skull, being lower in height and more elongate (less bulbous) than ours (see figure below). The features of the skull resemble those of other skulls of similar age, such as the 260 ka skull from the Florisbad site in South Africa. These differences in the shape of the skull suggest that those living at Jebel Irhoud, and more broadly throughout Africa from around 330 to 230 ka, were not yet fully us (*Homo sapiens*).

The line of descent in our *Homo* lineage is thought to be from early *Homo* species (*Homo habilis*, for example) to *Homo erectus* to *Homo heidelbergensis* to our predecessor species, and finally, to us *Homo sapiens*. As I discuss in my book, the range of variations within a species and the complexity of speciation in a large continent such as Africa, makes it difficult from the limited number of fossils available to delineate species clearly. Some experts, the 'lumpers', view the changes in our lineage as gradational and refer to the Jebel Irhoud fossils as 'archaic' *Homo sapiens*. Other experts are 'splitters' and argue for stepwise evolution of distinct species. I believe there are enough physical differences and culture differences (see below) to support an intermediary species in the evolution of *H. heidelbergensis* to *H. sapiens*, an intermediary species that would take the place of the lumpers' archaic *Homo sapiens*. However, this intermediary species lacks a generally accepted species name, and so I refer to it as our 'predecessor' species.

To my view, the new age indicates that the fossils at Jebel Irhoud represent some of the earliest members of our predecessor species and not, as implied by many of the news stories, that our species *Homo sapiens* now has an age range that extends back to around 300 thousand years. The oldest yet recovered fossils of our species *Homo sapiens*, ones that represent anatomically modern humans (AMHs) remain those found in East Africa that date to between 200 ka and 150 ka. The earliest members of our species most probably descended from our predecessor species, who were widespread throughout Africa by around 280 ka as represented by the fossil skulls found at Jebel Irhoud in Morocco, Florisbad in South Africa and Laetoli and Ileret in East Africa.

Fossil skulls dated between 315 and 260 thousand years old that are possibly representative of our predecessor species intermediate between *H. heidelbergensis* and *H. sapiens* (from left to right: Florisbad, Laetoli (Smithsonian Institution) and Jebel Irhoud (Natural History Museum, London)).

Fossil skulls of our species Homo sapiens from 160 thousand years ago (Herto, two images on left; photos by David Brill (humanoriginsphotos.com)) and modern (two images on the right). Our species is largely defined by its bulbous shaped skull.

Cultural differences

The arrival of our predecessor species is associated with the major transition from the Earlier Stone Age to the Middle Stone Age (MSA), a transition marked by smaller, more regionally-diverse stone tools. Jebel Irhoud is now the oldest site known having a direct association of fossils with MSA tools. MSA tools are widespread throughout Africa from around 300 ka to 230 ka, but most often not associated with human fossil remains. Some of the MSA stone points recovered from Ethiopia have been interpreted from their edge damage to have been used as thrown spears by at least 279 ka. The stone points from Jebel Irhoud have not yet been interpreted as having been thrown as spears (javelins). Those living at Jebel Irhoud were competent hunters based on the animal bones found. It may be that they made effective use of sharpened wooden spears without stone armatures, something their predecessor *Homo heidelbergensis* was doing.

Obsidian projectile spear tips from Ethiopia dating to at least 279 ka (Sahle et al., 2013) and a photo of a !Kung San throwing a spear (photo courtesy of Neil Roach).

The presence of burnt bones and charcoal suggests they had control of fire. However, they do not appear to have used fire to intentionally heat the stones (pyrotechnology). The earliest evidence for intentional heating of stones to improve their work-ability dates from 164 ka at the Pinnacle Point site in South Africa, presumably made by *H. sapiens*. Heating was probably not necessary in the case of the raw stone material available at Jebel Irhoud and the heating of about a third of the stone tools there was likely because they inadvertently ended up beneath where later fires were made.

The other cultural artefact to appear for the first time in the MSA is ochre, an iron-rich rock used for, among other things, symbolic body painting based on the specific collection of the reddest coloured stones. The earliest use of ochre is in East Africa, but no ochre has been reported from the Jebel Irhoud site. The absence of thrown stone-tipped spears and ochre at Jebel Irhoud may indicate that these cultural innovations were only developed later among groups of our predecessor species. Alternatively, these cultural items may have been present among groups in sub-Saharan Africa but were lost by groups too small to sustain these cultures after they had expanded into North Africa where soon became isolated from other groups.

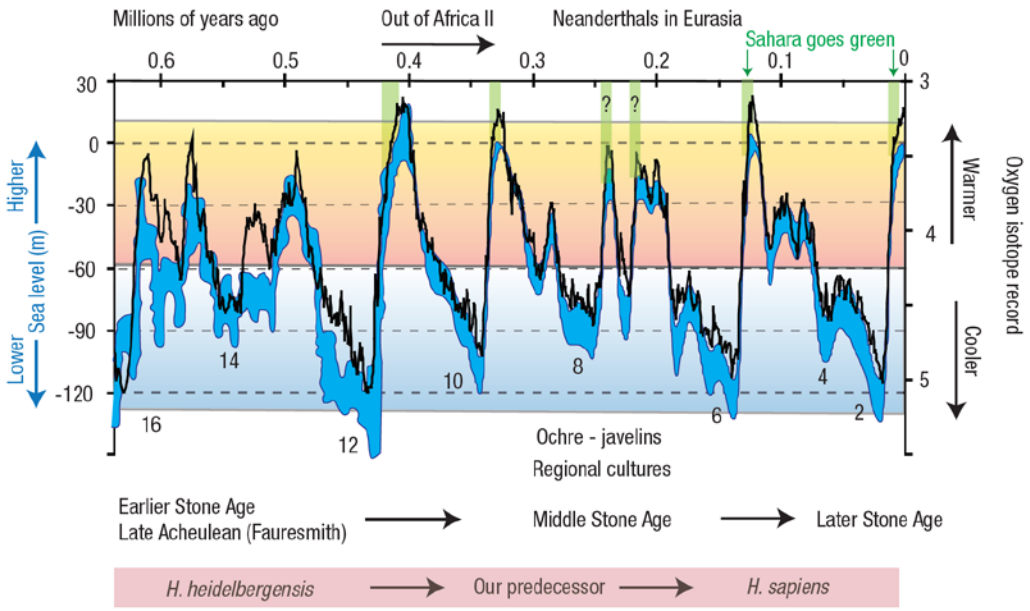
Ochre stones and grinding ochre into a red powder.

Speciation events

Do the fossils at Jebel Irhoud suggest that the geographical region of origin of our predecessor species was North Africa? I argue in my book that the Maghreb, located at the northernmost tip of Africa was a potential geographical region of origin for species within our human lineage. This was based primarily on the periodic isolation of the Maghreb, separated from the rest of Africa and Eurasia by the Sahara-Arabian Desert and the Mediterranean Sea. Relatively small groups living in isolation in the Maghreb over long periods of time may have evolved away from other groups. These substantial physical barriers would have made exchange highly unlikely, except during relative brief periods when the Sahara-Arabian Desert 'greened' by receiving enough rainfall for the transformation of the desert into grassland and lakes.

These greening events may have made it possible for the periodic mixing of previously isolated groups living in the Maghreb, sub-Saharan Africa and Eurasia. We know the Sahara-Arabian Desert greened most recently 9 to 6 ka, with large impacts on the movement and interaction of people throughout the region. There is also good evidence of widespread greening 130 to 120 ka go associated with the movement of our species out of Africa into the Levant, and possibly into North Africa as indicated by the first appearance there of distinctive Aterian stone tools. What the groups represented by Jebel Irhoud fossils had evolved into by the time of the 130 ka greening event and to what extent they may have intermingled with *Homo sapiens* coming from sub-Saharan Africa is unknown. There were other greening events, such as the one associated with when modern people left Africa as part of the Great Expansion 60 thousand years ago, but the timing and extent of past greening events remains poorly known.

The interglacial period that occurs within the dated range of the Jebel Irhoud fossil site of 383-247 ka that is most likely to have had a significant greening event is Marine Isotope Stage (MIS) 9 – roughly 330 ka. The fossils at Jebel Irhoud may represent early members of our predecessor species who evolved there among small, isolated populations of *H. heidelbergensis* and then spread out into the African continent with the greening of the Sahara associated with the MIS 9 interglacial period. Alternatively, our predecessor species may have evolved from *H. heidelbergensis* somewhere in sub-Saharan Africa and moved into the Maghreb during the MIS 9 or another greening event. Unfortunately, the age resolution of archaeological sites and number of sites are not sufficient to determine at this stage where in Africa our predecessor species evolved.



Ochre, javelins and diverse Middle Stone Age regional cultures are associated with the evolution of our predecessor species from *H. heidelbergensis* in Africa. The age range of 383-247 ka of the Jebel Irhoud site places it around the time of the MIS 9 Interglacial period when a greening of the Sahara may have allowed movement of groups living in North Africa and sub-Saharan Africa.

What we know from the dated MSA stone tool assemblages in North Africa, East Africa Rift Valley and South Africa is that our predecessor species was widespread throughout Africa by around 280 ka, but from which of these areas they evolved into us *Homo sapiens* remains unresolved. In my book I suggest that the currently available information favours South Africa as our species' geographical region of origin – check it out and see if you agree.

Further Reading

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