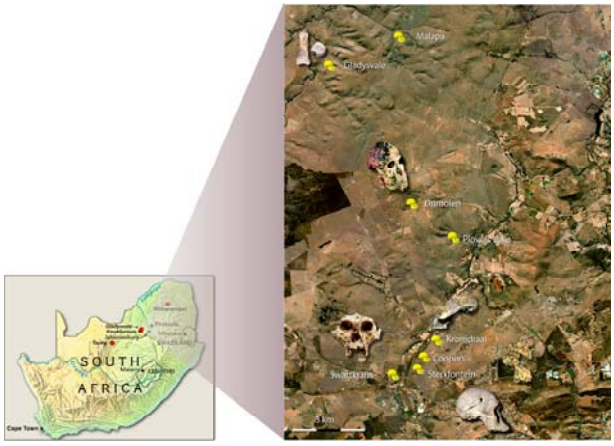
***Australopithecus sediba* - a new milestone in the history of Humankind, research led by Prof. Lee Berger from the University of the Witwatersrand, Johannesburg and Prof. Paul Dirks from the James Cook University, Australia (former head of the Wits School of Geosciences).**

The new fossil site

Malapa (meaning “homestead” in seSotho) is situated roughly 15 km NNE of the well-known sites of Sterkfontein, Swartkrans and Kromdraai in Gauteng Province, South Africa. It is part of the “Cradle of Humankind”, a UNESCO World Heritage Site.



The first hominid specimen from this site, a right clavicle (UW88-1), was discovered by nine year old Matthew Berger on 15 August 15 2008. To date more than 130 fossil elements of a previously unknown human ancestor were found making this one of the richest fossil hominid sites ever discovered.

The site in October 2008

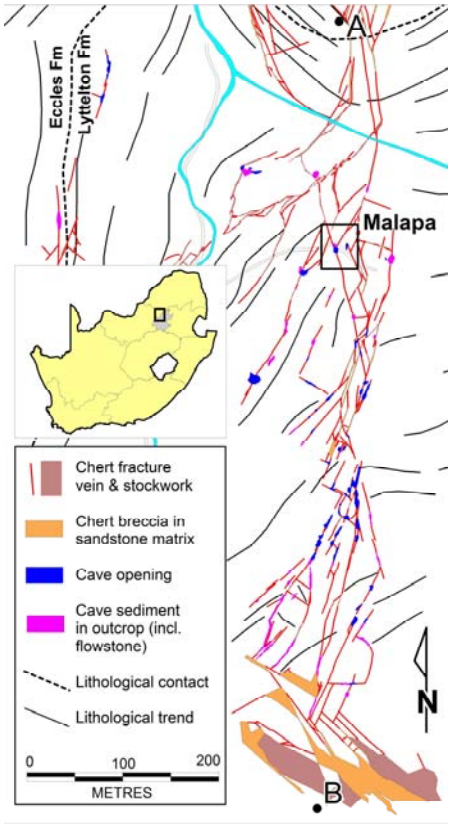
The site in January 2009

… After removing the vegetation

The site in February 2009

Formation of the fossil assemblage

As a part of a complex cave system the Malapa cave formed in a dolomitic limestone.



Cave system in the Nash nature reserve

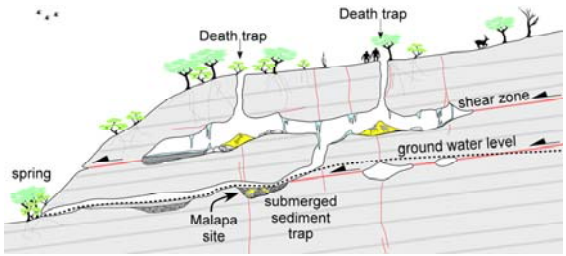
Originally the vertical entrance to the cave was more than 30 metres deep. Eroded by valley incision and exposed through mining activity probably in the early 20th Century, the clastic sediments are now exposed on the surface.

A cave entrance near the site

The fossil layers accumulated at the base of these shafts which may have operated as death traps. The sediments were cemented by lime-saturated water and were sealed with flowstones.

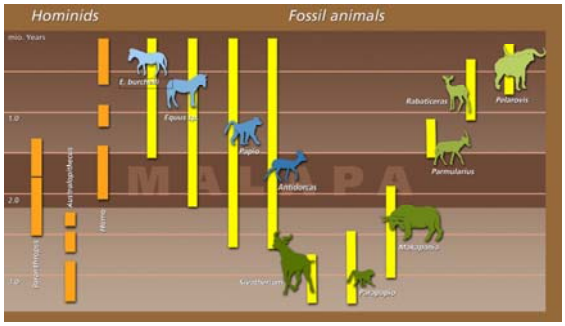
The excellent preservation of the fossils implies a fast deposition and only minor transportation of the bodies of the animals.

One hypothesis is that in the search for water, animals might have fallen into the cave. The predators could have been attracted to the smell of decomposing bodies and suffered the same fate. Subsequent rainfalls washed the intact bodies more deeply into the cave where they were submerged in an underground lake.



A hypothesized reconstruction of the site 1.9 mya

Age determination



Dating based on fauna

For determining the age of the hominid fossils, three different methods were applied: faunal dating, paleomagnetic dating, and a radiometric dating.

More than 200 animal remains of 25 different species were collected. Representatives of the extant species *Felis silvestris* (wild cat) and *Parahyaena brunnea* (brown hyena), as well as *Lycaon* sp. (wild dog), *Tragelaphus cf. strepsiceros* (Kudu), and *Equus* sp. (zebra). Zebra have their earliest recorded appearance in Africa at approximately 2.36 Ma.

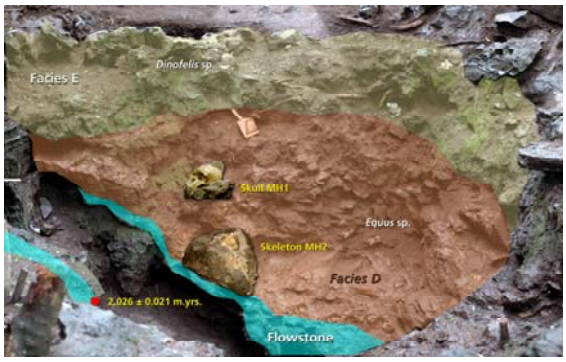
The extinct felid *Megantereon whitei* as well as *Dinofelis* collected from facies E has a last recorded appearance in Africa of approximately 1.5 Ma.

Canine of a hyena

The Sediba hominids were embedded in facies D, only 40 cm apart.

Right below this layer a flowstone containing uranium-bearing sediments was dated using Uranium – Lead dating. Two independent radiometric dates were obtained from the Institute of Geological Sciences, University of Berne (2.024± 0,062 MA) and from the Archaeomagnetism Laboratory, University of New South Wales (2.026±0.021 MA).

In addition the flowstone shows a reversed magnetic polarity. At the base, however, normal polarity was found, which is considered to be the Huckleberry Ridge Subchron (2.06±0.04 MA). The hominid fossils were surrounded by sediments of normal polarity thought to be the Olduvai Subchron (1.95-1.75 MA).



Species *Australopithecus sediba* sp. nov.

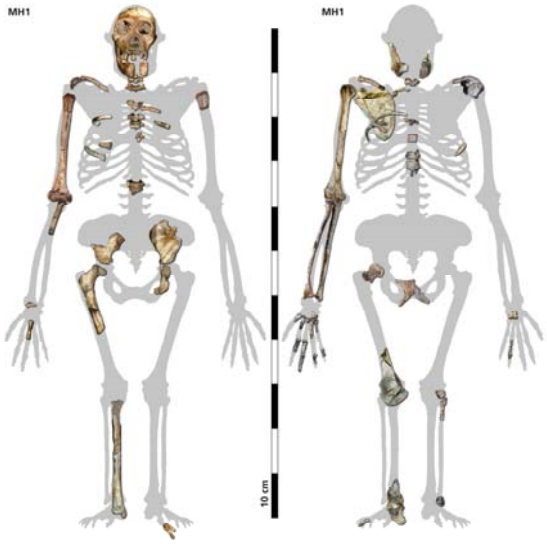
Order Primates Linnaeus 1758

Suborder Anthropoidea Mivart 1864

Superfamily Hominoidea Gray 1825

Family Hominidae Gray 1825

Genus *Australopithecus* Dart 1925



The word *sediba* means “fountain” or “natural spring” in the seSotho language.

Hominid 1 (MH1) is a juvenile individual represented by a partial cranium, fragmented mandible and partial postcranial skeleton that is designated as the species holotype (the “first” or “type” of the species).

Although the individual was not yet fully grown, its tooth eruption status shows that no serious morphologic changes of diagnostic relevance would have taken place. Compared to the growth rates of both humans and chimpanzees, the individual already attained at least 95% of its adult brain size.

The adult individual MH2 (paratype) is represented by isolated maxillary teeth, a partial mandible, and partial postcranial skeleton.

The skull

The juvenile skull with a reconstruction based on CT-Scans and the associated lower jaw, put back into position.

The cranium is relatively small but is substantially different in form from *Australopithecus africanus*:

The vault is relatively transversely expanded with vertically oriented walls. The front part of the brain is large.

The marks for the origin of the temporal muscles are widely spaced.

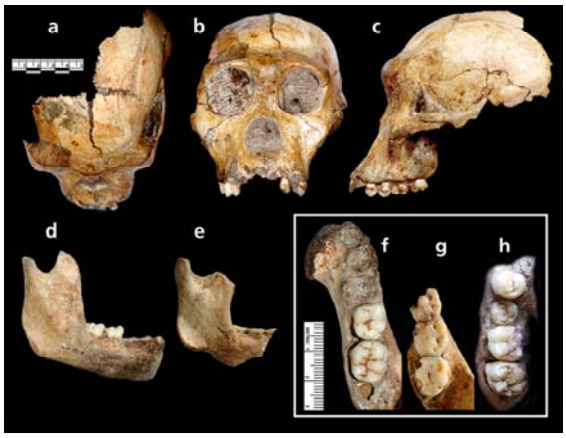
The brain volume (420 cm^3 is smaller than that of the average for *Au. africanus* (480 cm^3).

The face differs from *Au. africanus* in having pronounced, flaring zygomatics and the outline of the infraorbital region.

The frontal part of the lower jaw is vertically oriented with a slight bony chin. The teeth are relatively small.

These differences also align *Au. sediba* with the genus *Homo.*

Au. sediba mirrors the *Au. africanus* pattern of maxillary molars that increase slightly in size posteriorly, whereas the molars of early specimens of *Homo erectus* increase from M^1 to M^2, but then decrease in size in M^3.



a-c The skull of MH1 (UW88-50); d, f lower jaw of MH1 (UW88-8); e, g lower jaw of MH2 (UW88-54), h upper dentition of MH1 UW88-50.

A mosaic of locomotor patterns

The shoulder girdle of *Au. sediba* retains an australopith pattern:

The articulation of the shoulder blade faces upward and the marks for the muscles, which strengthen this articulation, are pronounced.

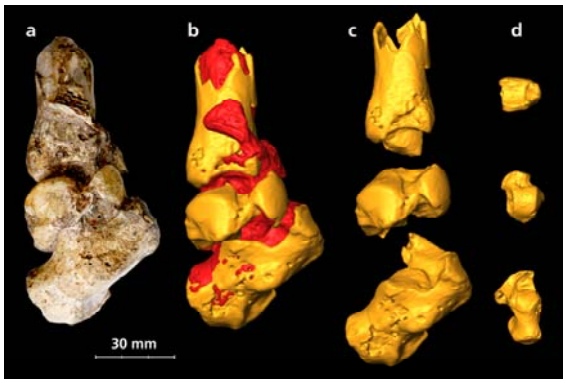
Both upper and lower articulations of the upper arm are massive. The bones of the lower arm are long and resemble those of *Au. africanus* and even great apes like orang-utans!

The finger bones are robust, curved and possess strong markings for the flexor sheets. This reflects a pronounced climbing adaptation.

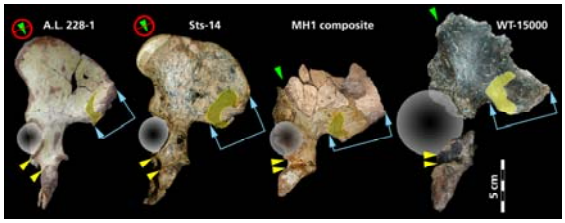
Numerous features of the thigh, the knee joint and the ankle however shows that *Au. sediba* clearly shows an australopith-like locomotor pattern.

The leg bones and hip are markedly different from the australopithecines and are more like the genus *Homo*.

The ankle joint and the heel bone are formed in such a manner that the foot could have been inflexed, an advantage for climbing.



The foot root represents a mosaic of climbing and bipedal adaptations.



Comparison of the pelvis, which points to the close relationship of *Au. sediba* with the genus *Homo* (see text).

Several functionally important aspects of the pelvis connect *Au. sediba* to later representatives of the genus *Homo*.

A column-like buttress of the ilium demonstrates the similarity with *Homo* (green arrow), which points to an improvement of hip stabilisation. This buttress prevents swaying of the pelvis during bipedal movements like running.

The rear part of the ilium is strongly expanded (blue arrows), which means an improvement of the extensor muscles of the back. The shortened distance between the joint of the spinal column (facies auricularis, projected from the inside as a yellow area) and the hip joint optimizes the lever arm during weight transmission.

The ischium changes the lever arm for the hamstrings by its different orientation and position (yellow arrows).

Conclusions

The Sediba skeletons cannot be accommodated within any existing fossil taxon. On the basis of a combination of primitive and derived characters of the cranium and postcranium, *Australopithecus sediba* could represent an evolutionary transitional form.

The age and overall morphology of *Australopithecus sediba* implies that it is most likely descended from *Au. africanus*.

The overall body plan is that of a hominid at an australopithecine adaptive grade but on the way to the genus *Homo*.

The small brain (420 cm^3) and craniodental characteristics support the argument that this species is most parsimoniously attributed to the genus *Australopithecus.*

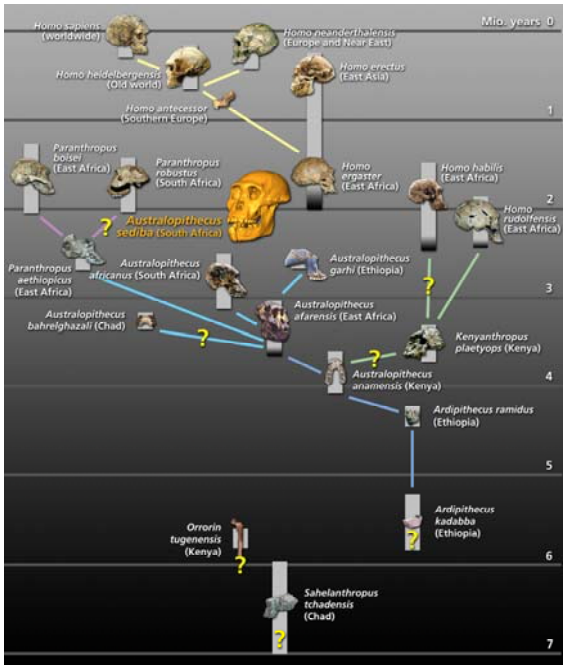
However some peculiarities of the locomotor apparatus lead to the conclusion that this new species exhibits more derived characteristics of early representatives of the genus *Homo* than all other australopithecines. In addition the skull points to some similarities with *Homo erectus* (SK 847 from Swartkrans; WT-15000 “Turkana boy” from Kenya and other fossils attributed to this species).

The origin of the genus *Homo* is widely debated, with several candidate ancestors proposed in the genus *Australopithecus* or perhaps *Kenyanthropus*.

The earliest occurrence of a fossil attributed to *Homo* (*H.* aff. *habilis*) is a jaw fragment at 2.33 Ma in Ethiopia. However, within early *Homo*, the hypodigms and phylogenetic relationships between such forms as *H. habilis* or *H. rudolfensis* remain unresolved, and the placement of these species within *Homo* has been challenged. Therefore, the identity of the direct ancestor of the genus *Homo*, and thus its link to earlier *Australopithecus*, remains controversial.

Australopithecus sediba represents a good morphological candidate ancestor for the genus *Homo*, or a sister group to a close ancestor that persisted for some time after the first appearance of it.

The Sediba specimens demonstrate that the evolutionary transition from a small-bodied and perhaps more arboreal-adapted hominid (such as *Au. africanus*) to a larger-bodied, possibly full-striding terrestrial biped (such as *H. erectus*) occurred in a mosaic fashion.



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