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The *Homo sapiens* Cave hominin site of Mulan Mountain, Jiangzhou District, Chongzuo, Guangxi with emphasis on its age

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One of the most hotly debated and frontal issues in paleoanthropology focuses on the origins of modern humans. Recently, an incomplete hominin mandible with a distinctly weaker mental protuberance than modern human and a great variety of coexisting fossil mammals were unearthed from the *Homo sapiens* Cave of Mulan Mountain, Chongzuo, Guangxi. The mammalian fauna from the *Homo sapiens* Cave characterized by the combination of *Elephas kiangnanensis*, first occurring *Elephas maixmus*, and *Megatapirus augustus*, and strikingly different from the Early Pleistocene *Gigantopithecus* fauna and the Middle Pleistocene *Ailuropoda-Stogodon* fauna of South China could be regarded as an early representive of the typical Asian elephant fauna. Faunal analysis, biostratigraphic correlation, and, most importantly, U-series dating all consistently support an estimate of ca. 110 ka for the age of the fossil *Homo sapiens* and coexisting mammalian fauna, that is, the early Late Pleistocene. The fauna is mainly made up of tropical-subtropical elements, but grassland elements have a much greater variety than forest elements, which probably indicates a drier climate at that time. This discovery of early *Homo sapiens* at the Mulan Mountain will play a significant role in the study of the origin and its environmental background of modern humans.

Homo sapiens Cave, Chongzuo, Guangxi, *Homo sapiens*, Asian elephant fauna, early Late Pleistocene, origin of modern humans

The origin of modern humans is currently one of the hottest scientific subjects. Since the introduction of Molecular Anthropology into the field of human origin in 1987, the study of human evolution has been focused on a brand new issue: the origin of modern humans. Based on mitochondrial DNA analysis, Cann (1987) argued that all modern humans were descendants of a human population living in Africa about 200—100 ka ago[1]. Some Chinese researchers also inferred from the study of genome variation that the direct ancestor of Chinese were immigrants that came to China ca. 60 ka ago. However, these arguments (representatives of the replacement theory) contrast markedly with the evidence from the hominin fossils and Paleolithic remains discovered in China, and also that from the paleoenvironmental study. In recent years, paleoanthropologists such as Xinzhi Wu and others have proposed a "Continuity with hybridization" model for the origin of modern humans in China, which is also the Asian context of the

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Multiregional Continuity Model, because the evidence of physical anthropology from the chronologically continuous hominin fossil records of China supports the argument that the modern humans of China are descendants of the early hominins, like Peking Man, who had colonized the area, but already carried some foreign genes[2]. Presently, the vigorous debate between the Out of Africa Model and the Multiregional Continuity Model is still ongoing and unsettled[3–5].

Currently, much more attention is paid to the fossil hominin records of ca. 100 ka ago, because it is a critical time for the radiations of modern humans. In recent years, quite a few *Homo sapiens* sites of ca. 100 ka old have been successively discovered in East Asia, such as Huanglong Cave of Yunxi, Hubei, Xinglong Cave of Fengjie, Chongqing, Leiping Cave of Wushan, Chongqing, Migong Cave, Lingjing of Xuchang, Henan, and Hang Hum Cave, Lang Trang Cave, and Duoi U'Oi Cave of northern Vietnam[6–9], and so on, which have provided fundamental information for the study of human evolution during Late Pleistocene in East Asia, and especially for the origin of modern humans. Nevertheless, no decisive material with undoubtedly convincing morphological features that can settle the ongoing debate on the origin of modern humans has been found from these sites, which has been a bottleneck when discussing the East Asian origin of modern humans.

Recently, researchers of the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences and Chongzuo Biodiversity Research Center, Peking University found a hominin site at Mulan Mountain, Chongzuo, Guangxi. Two hominin teeth, one hominin mandible and a large variety of coexisting mammalian fossils were unearthed. During the extensive investigation around the Mulan Mountain, a total of five fossil bearing caves with different elevations were also discovered. Two of them yield *Gigantopithecus*, and one yield *Homo sapiens*, which is named as the *Homo sapiens* Cave. Faunal analysis and U-series dating show that the age of the hominin site is early Late Pleistocene. The site is significant not only for the study of human evolution in China and East Asia, but also for the origin of modern humans in China.

1 Geographic and geological backgrounds

The *Homo sapiens* Cave of Mulan Mountain is about 2 km northwest to the Chongzuo Eco-Park (the main habitat of the critically endangered species white-headed langur), and is located on the southwest slope of the Mulan Mountain, east of Mulan Village, Luobai, Chongzuo (22°17′13.6″N, 107°30′45.1″E) (Figure 1). This area lies in the southern edge of the southern subtropical zone, where the solar radiation is very strong. The temperature of the coldest month averages above 13℃, and the annual highest temperature is about 40℃. The average accumulated temperature of days when daily average temperature is above 10℃ is around 7433—7930℃. The Annual rainfall averages between 1150 mm and 1550 mm. The general climate of this area shows some transitional features between tropics and subtropics. But viewed from the local flora and fauna and other natural conditions, it is more tropical, so this area is usually put into the Northern Tropics. However, the tropical landscape of this area is not as typical as Malaysia and India due to the lower temperature and the influence of monsoon. Therefore, the climate of this area should be paid more attention when concerning zoogeography.

Chongzuo area was a part of the Tethys during late Paleozoic, within which carbonatite from the upper Devonian series to the lower Trias series are mainly developed with a total thickness of about 2400 m. The region has a complicated tectonic framework due to the complex effects of the latitudinal, Neocathaysian, and northwest oriented tectonic systems.

The humid northern tropical bare karst of this area has two types of karst landforms, peak-cluster valley and peak-cluster depression (cockpit karst). And the deeply undercutted tropical peak-cluster depressions are dominant, which reflects a better cycling condition and strong vertical infiltration of karst water leading to the formation of high density cone karst and plenty of rounded or polygonal depressions.

The karst cones of the Mulan Mountain area are formed by the limestone of the Majiaoling Formation of the Lower Trias series, the elevations above sea level of which are around 250—320 m. The elevation above sea level of the Mulan Mountain is 323 m, and that of the bottom of the valley is 145 m. The Hejiang River, embracing the Mulan Mountain, flows from the west to the east. Many karst caves of various dimensions are very developed on the steep karst cone slopes. As a consequence of the continuous uplift of the Chongzuo area

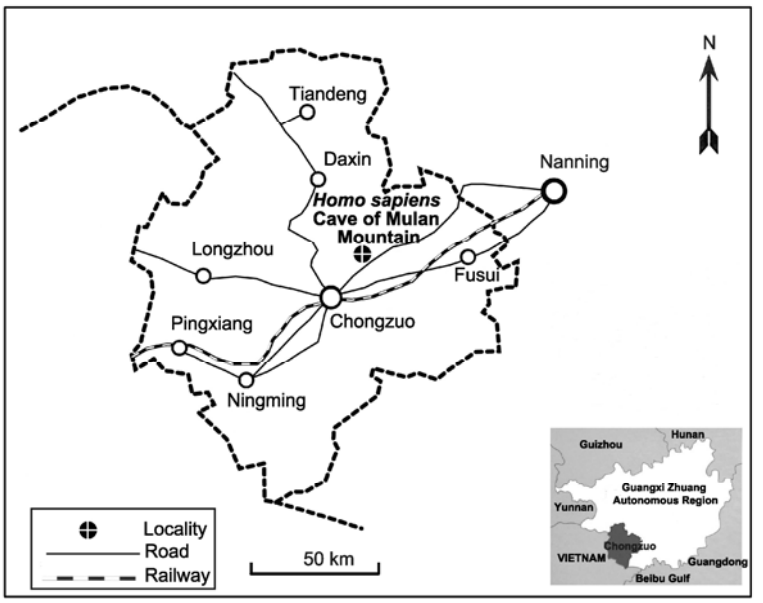

Figure 1 Geographic location of the *Homo sapiens* Cave of the Mulan Mountain, Chongzuo, Guangxi.

since Quaternary, multiple horizons of planation surfaces, terraces, and karst caves with different elevations have been formed. Generally speaking, the higher the elevation of the cave is, the older the age is. On the slope of the Mulan Mountain, a total of six horizons of karst caves are developed (Figure 2). The elevation of the highest horizon, the sixth horizon, is about 270 m above seal level, and that of the lowest horizon, the first horizon, is about 150 m, slightly higher than the riverbed. The sediments of the karst caves of the fifth horizon with an elevation of about 200 m above sea level yield the common fossil members of the Early Pleistocene of South China, such as *Gigantopithecus*, *Sinomastodon*, *Stegodon preorientalis*, *Cervavitus fenqii*, *Dicoryphochoerus*[10]. The age of this horizon, e.g. the *Gigantopithecus* Cave of the Mulan Mountain, can be estimated as early Early Pleistocene. The fourth horizon, the most important one in this area, with an elevation of about 180 m above seal level yields hominin remains, e.g. the *Homo sapiens* Cave of the Mulan Mountain (Figure 2).

2 Geomorphology and geological setting of the *Homo sapiens* Cave

The natural entrance of the *Homo sapiens* Cave of the Mulan Mountain is south-oriented. The elevation of the ceiling of the main entrance is 179 m above sea level, 34 m higher than the local riverbed. The main axis of the cave is approximately east-west oriented. The cave is about 33 m long, and 14 m wide. The maximum eleva-

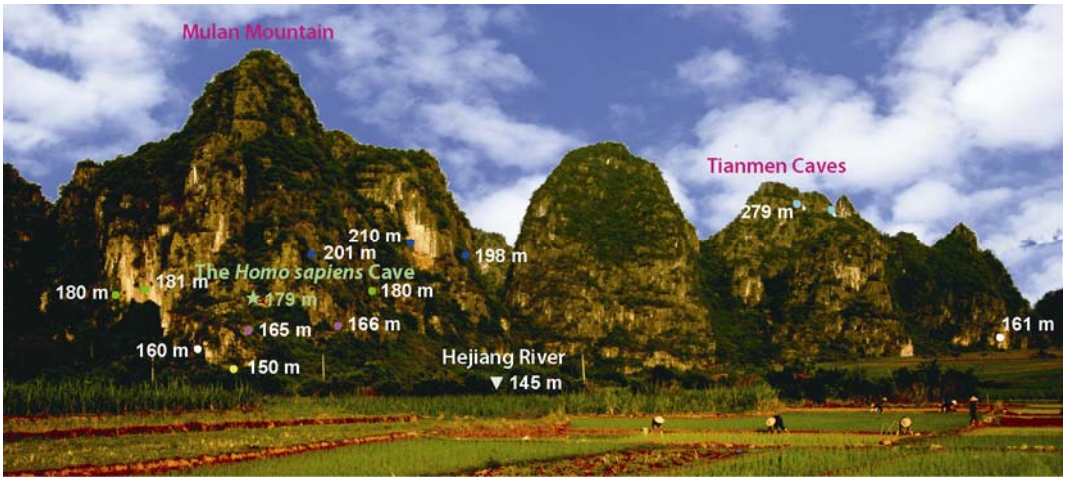

Figure 2 Vertical distribution of the *Homo sapiens* Cave and other caves (elevations above sea level).

tion difference between the ceiling and the floor of the cave is about 5 m. The drainage corridor of the cave is a sinkhole located east most of the cave. The excavation area is a pipe-shaped branch cave 22 m from the main entrance. The northwest-oriented branch cave was originally filled up with sediments.

The sediments of the *Homo sapiens* Cave consist of two units stratified at different time. They are Unit A (probably Middle Pleistocene) and Unit B (Late Pleistocene), respectively.

Unit A:

1. Greyish brown sandy clay cemented by calcite with numerous limestone breccias of 0.2—3 cm. 20 cm
2. Calcitic floor with crystallized carbonate from place to place. 5 cm
3. Solid greyish brown sandy clay with a few limestone breccias interbedded with calcitic beds, yielding few fossils. 35 cm
4. Calcitic floor with crystallized carbonate from place to place. 5—10 cm
5. Solid brownish yellow sandy clay cemented by calcite contacting with the lower unit by an obvious erosive surface. 45—65 cm

Unit B:

1. Calcitic floor with interrupted banded cavity filled with small stalagmites and stalactites between itself and the upper unit. 5—15 cm
2. Solid yellowish brown sandy clay cemented by calcite with a few limestone breccias interbedded with interrupted calcitic beds, yielding *Homo sapiens*, *Elephas kiangnanensis*, *Elephas maximus* and plentiful other mammalian fossils. 100—130 cm
3. Interrupted greyish white calcitic floor with unstable thickness. 3—10 cm
4. Greyish brown silty clay with many iron-manganese nodules, yielding plentiful mammalian fossils. 70 cm
5. Blocky yellowish white silty clay with yellowish brown iron mottling, yielding few fossils. 50 cm
6. Greyish white clay with few yellowish brown iron mottling. 50 cm
7. Loosely cemented yellowish brown silt (30 cm, bottom unsighted).

The upper Unit A is composed of the original sediments, while the lower Unit B was deposited after the erosion of the original sediments, which is also the *Homo sapiens* yielding unit. Between the two units, there is an easily recognizable erosive contact surface.

3 The features and age of the *Homo sapiens* Cave fauna

3.1 The features of the *Homo sapiens* Cave fauna

A large variety and amount of mammalian fossils were collected from the *Homo sapiens* Cave after two times of trial excavation. Preliminary identification shows that there are 55 species belonging to 44 genera, 25 families, and 8 orders (Table 1). The fauna is characterized by the coexistence of *Elephas kiangnanensis* and *Elephas maximus*, and the occurrence of early *Homo sapiens*.

The hominin mandible unearthed from the *Homo sapiens* Cave is an edentulous fragment with the symphysis, left corpus from the alveolus of i1 through p3, and right corpus from the alveolus of i1 through p4 preserved. The mandible is relatively delicate. The mental protuberance is weakly defined, much weaker than

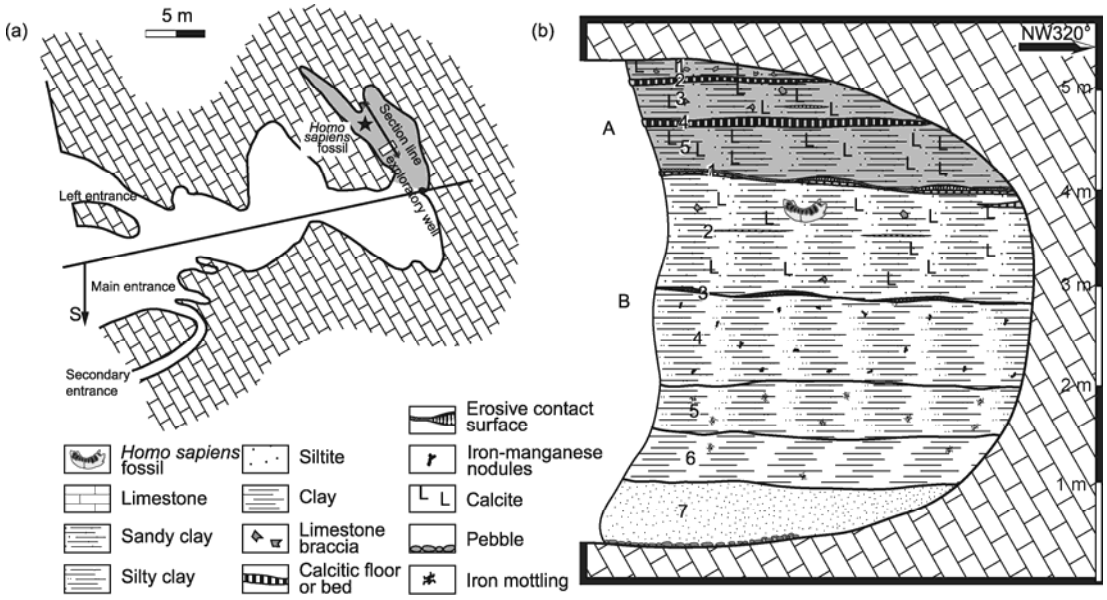

Figure 3 The plan (a) and geological section (b) of the *Homo sapiens* Cave of the Mulan Mountain.

Table 1 List of the *Homo sapiens* Cave fauna and comparison to related faunas

The *Homo sapiens* Cave Chongzuo, Guangxi	Sanhe Cave Chongzuo, Guangxi[10]	Nongmo Mountain Cave Bama, Guangxi[13]	Wuyun Cave Tiandong, Guangxi[17]	Huanglong Cave Yunxi, Hubei[6]	Tham Khuyen Cave Langson, Vietnam[16]
Large mammals					
Homo sapiens	□			◎ ★	*H. erectus*
Pongo pygmaeus	◎	◎	◎ ★		◎ ★
Hylobates sp.	◎	◎			◎
Macaca sp.	◎	◎	◎	◎	◎
Trachypithecus sp.	◎		◎	◎	
Ursus thibetanus	◎ ★	◎	◎ ★	◎ ★	◎ ★
Arctonyx collris	◎ ★		◎ ★	◎ ★	◎ ★
Panthera pardus	◎ ★		◎ ★	◎	◎ ★
Felis sp.	◎	◎	◎	◎	◎
Paguma sp.	◎		◎	◎	◎
Viverra sp.	◎				◎
Elephas kiangnanensis					*E.namadicus* ?
Elephas maximus			◎ ★		◎
Megatapirus augustus	*T. sinensis*	◎	◎ ★	◎ ★	◎ ★
Rhinoceros sinensis	◎ ★	◎ ★	◎ ★	◎ ★	◎ ★
Sus scrofa	◎	◎ ★	◎ ★	◎ ★	◎ ★
Sus cf. *S. xiaozhu*	◎ ★				◎
Muntiacus sp.	◎		◎	◎	◎
Cervus unicolor	◎		◎	◎	◎ ★
Buballus bubalus				◎ ★	◎ ★
Megalovis guangxiensis	◎ ★				
Small mammals					
Neotetracus sinensis			◎ ★		
Blarinella sp.	◎		◎		
Soriculus sp.	◎		◎		
Crocidura hosfildi	◎ ★				
Crocidura sp.	◎		◎		
Chimarrogale sp.					
Mogera insularis	◎ ★				
Rhinolophus paneni	◎ ★			◎	
Rhinolophus pearsoni	◎ ★			◎ ★	
Rhinolophus sp.	◎			◎	
Hipposideros pratti	◎ ★		◎	◎ ★	
Pipistrellus sp.					
Sciurotamias sp.	◎		◎	◎	
Dremomys sp.	◎				
Belomys sp.	◎		◎	◎	
Petaurista alborufus	◎			◎ ★	
Petaurista elegans	◎			◎	
Petaurista sp.	◎				
Typhlomys cinereus	◎ ★		◎		
Atherurus sp.	◎		◎		◎ ★
Hystrix subcristata	◎ ★		◎ ★	◎ ★	◎ ★
Hystrix magna	◎ ★				
Eothenomys sp.	◎				
Mus pahari	◎ ★		◎ ★		◎
Apodemus cf. *A. draco*	◎ ★				
Apodemus cf. *A. peninsulae*	◎ ★		◎ ★		
Hapalomys delacouri	◎ ★		◎ ★		
Chiropodomys cf. *C. gliroides*	◎		◎ ★		
Niviventer confucianus	◎		◎		
Niviventer fulvescens	◎ ★		◎		
Leopoldamys edwardsi	◎		◎		
Bandicota cf. *B. indica*					
Rattus norvegicus	◎ ★		◎		◎
Rattus rattus	◎				

◎ Same genus; ★ same spcies; □ Hominoidea.

modern humans. As a consequence, the incurvation between the alveolar margin and the base of the symphysis is also weaker than modern humans. The pronounced mental protuberance and incurvation in the anterior region of the symphysis are typical features of modern humans, while *Homo erectus* and early *Homo sapiens* lack these features. So this mandible from the *Homo sapiens* Cave clearly shows the primitive features of early *Homo sapiens* (Study on this mandible will be published elsewhere).

The *Homo sapiens* Cave fauna bears great similarities to the Early Pleistocene Sahe Cave fauna[10] except the appearances of *Neotetracus sinensis*, *Pipistrellus* sp., *Bandicota* cf. *B. indica*, *Homo sapiens*, *Elephas kiangnanensis*, *Elephas maximus*, etc. The fact that there are 38 common genera in the two faunas seemingly reveals a succession of their zoogeographic features.

The *Homo sapiens* Cave fauna is distinctly different from the Early Pleistocene *Gigantopithecus* fauna due to the absence of primitive species such as *Gigantopithecus blacki*, *Stegodon preorientalis*, *Ailuropoda microta*, *Tapirus sanyuanensis*, and so on.

The *Homo sapiens* Cave fauna doesn't have *Ailuropoda* and *Stegodon*, and is characterized by the coexistence of primitive *Elephas kiangnanensis* and *Elephas maximus*, so it is also distinctly different from the Middle Pleistocene *Ailuropoda-Stegodon* fauna.

Recent discoveries and studies reveal that three turnovers occurred in the elephant radiations during Quaternary in South China. In early Pleistocene, *Sinomastodon* was once prevalent, and became one of the typical members of the *Gigantopithecus* fauna. It became extinct in Middle Pleistocene, and was replaced by *Stegodon*, a main member of the *Ailuropoda-Stegodon* fauna. The appearance of *Elaphas kiangnanensis* until Late Pleistocene (or late Middle Pleistocene) changed the features of the *Ailuropoda-Stegodon* fauna, and *Elaphas maximus* became dominant in the fauna.

Elephas originated in Africa, and dispersed throughout Eurasia in Late Pliocene. About 3.5 Ma ago, it completely disappeared from Africa, e.g. *Elephas iolensis*[11], but it survives in Asia until present. There are 12 species in the genus *Elephas*, and *Elephas maximus*, the best known one, is the type species. Female Asian elephant usually does not have tusks, and the morphology of molars and skull of Asian elephant is different from all extinct species of the genus except *Elephas kiangnanensis*. *Elephas kiangnanensis* is probably more closely related to Asian elephant based on molar morphology, but both of them have stronger adaptive capacity than *Stegodon*, and can adapt themselves to various ecological types. The occurrence of *Elephas kiangnanensis* in Chongzuo area in Late Pleistocene probably caused the decline of the *Ailuropoda-Stegodon* fauna and the rise of the Asian elephant (*Elephas maximus*) fauna. Here, we suggest naming the Late Pleistocene fauna form South China that contains *Elephas maximus* from South China as Asian elephant (*Elephas maximus*) fauna to distinguish it from the typical Middle Pleistocene *Ailuropoda-Stegodon* fauna (s. s.) and Early Pleistocene *Gigantopithecus* fauna. The *Homo sapiens* Cave fauna should be taken as an early representative of the fauna.

Compared to the Early Pleistocene Sanhe Cave fauna from the same area, the species richness of the *Homo*

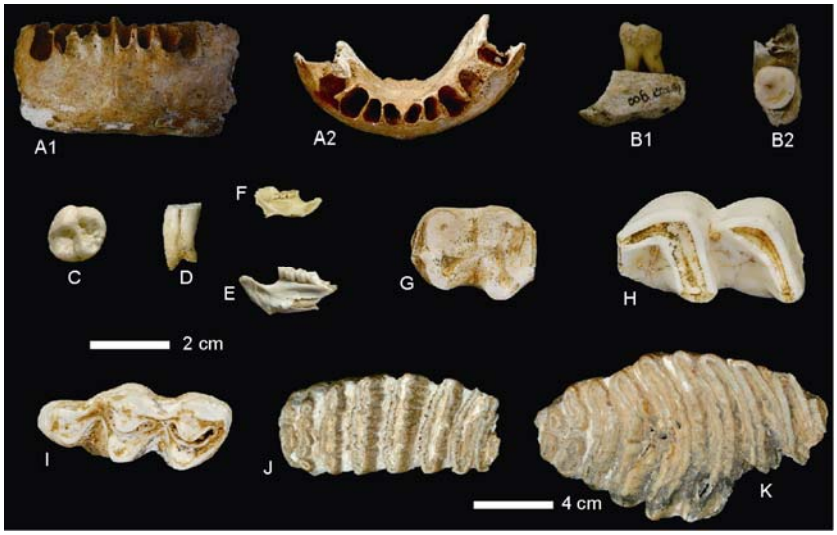

Figure 4 *Homo sapiens* and some of other mammalian species from the *Homo sapiens* Cave. A, *Homo sapiens* (V16750.01), an incomplete mandible, anterior and occlusal view; B, *Homo sapiens* (V16750.02), left m3, buccal and occlusal view; C, *Pongo pygmaeus* (V16751.01), right dM2, occlusal view; D *Histrix magna* (V16759.02), dp4, lingual view; E, *Bandicota* cf. *B. indica* (V16768), right mandible, lingual view; F, *Rattus rattus* (V15770.01), left mandible, lingual view; G, *Megatapirus augustus* (V16752.01), right m1, occlusal view; H, *Rhinoceros sinensis* (V16753.01), right m3, occlusal view; I, *Megalovis guangxiensis* (V16754.01), left m3, occlusal view; J, *Elephas maximus* (V16755), left dp4, occlusal view; K, *Elephas kiangnanensis* (V16756), right M2, occlusal view. Scale bar: 4 cm for J and K, while 2 cm for others.

sapiens Cave fauna is relatively poor, lacking the common members of South China such as *Ailuropoda*, *Stegodon*, *Rhizomys*, and so on. The species of tropical-subtropical forest bats, *Rhinolophus* and *Hipposideros*, are relatively rare. Whereas, muroid rodents abundantly occurred. All these features indicate that this fauna was experiencing an ecological transition.

3.2 The age of the *Homo sapiens* Cave fauna

The *Homo sapiens* Cave fauna is composed of 21 large mammals and 34 small mammals. There is no primitive Neogene relicts in the fauna, such as *Sinomastodon*, *Dicoryphochoerus*, *Hesperotherium*, *Cervavitus*, and so on. And the fauna also lacks common members of the Early Pleistocene *Gigantopithecus* fauna, such as *Stegodon orientalis*, *Ailuropoda wulingshanensis*, *Sinicuon dubius*, *Tapirus sanyuanensis*, and so on. So it is undoubtedly later than the Longgupo fauna from Wushan, Chongqing, *Gigantopithecus* Cave fauna from Liucheng, Guangxi, Mohui Cave fauna from Tiandong, Guangxi, Longgu Cave fauna from Jianshi, Hubei, Sanhe Cave fauna from Chongzuo, Guangxi, and Hei Cave fauna from Niushui Mountain, Daxin, Guangxi[12−15].

Compared with the Middle Pleistocene Nongmo Mountain fauna from Bama, Guangxi, Bulali Mountain fauna from Wuming, Guangxi, and Tham Khuyen Cave fauna from Langson Mountain, Vietnam[13,16], the *Homo sapiens* Cave fauna essentially differs from them by lacking *Gigantopithecus*. In addition, there is also no common members of Middle Pleistocene like *Cuon antiquus* and *Tapirus sinensis* in the fauna. Until present, the latest record of *Gigantopithecus* is from the hominin site of Tham Khuyen Cave, Langson Mountain, Vietnam, the age of which is 0.48 Ma. Therefore, the age of the *Homo sapiens* Cave fauna should be later than Middle Pleistocene.

The Wuyun Cave fauna of Tiandong, Guangxi contains more than 40 mammals[17]. Based on the faunal features and the morphology of *Elephas maximus*, its age should probably be early Late Pleistocene, but not Middle Pleistocene. The *Homo sapiens* Cave fauna of the Mulan Mountain shares 13 members with it, like *Elephas maximus*, *Megatapirus augustus*, etc. Nevertheless, the *Homo sapiens* Cave fauna also has relatively primitive members, such as *Elephas kiangnanensis*, *Hystrix magna*, *Megalovis guangxiensis*, and so on. Furthermore, the percentage of the extant species in the *Homo sapiens* Cave fauna is lower (78% for the Wuyun Cave fauna, while 76% for the *Homo sapiens* Cave fauna). So the age of the *Homo sapiens* Cave fauna should be a little earlier or equivalent to the Wuyun Cave fauna.

There are 11 common members in The *Homo sapiens* Cave fauna and the Huanglong Cave fauna from Yunxi, Hubei, e.g. *Homo sapiens*, *Megatapirus augustus*, and so on, which showes the ages of the two faunas are similar even though there is 10° latitude difference between them. The ESR and U-series dating of the latter supports a 103−44 ka estimate of its age, and more probably ca 100 ka[6]. However, there are also some primitive members, such as *Hystrix magna*, *Megalovis guangxiensis*, and so on. Furthermore, the percentage of extinct large mammals of the *Homo sapiens* Cave fauna is higher (24% for the *Homo sapiens* Cave fauna, while 21% for the Huanglong Cave fauna). So the age of the former should be a little earlier.

The *Homo sapiens* Cave fauna shares 7 members with the 66 ka old hominin site of Duoi U'Oi Cave, northern Vietnam[9], such as *Pongo pygmaeus*, *Ursus thibetanus*, *Cervus unicolor*, and so on. However, all the members of the latter are extant species. So the age of the former should be undoubtedly earlier.

The faunal comparisons above show that the age of the *Homo sapiens* Cave of the Mulan Mountain is later than the Middle Pleistocene Nongmo Mountain fauna of Bama, Guangxi and Tham Khuyen Cave fauna of Langson Mountain, Vietnam, but earlier than the Wuyun Cave fauna of Tiandong, Guangxi and Huanglong Cave fauna of Yunxi, Hubei. It is a transitional fauna from Middle to Late Pleistocene. In addition, for the consideration that advanced forms such as *Elephas maximus*, *Sus scrofa*, *Bandicota* cf. *B. indica*, and so on, occurred in the fauna, and that the fauna has a higher percentage of extant species, the age of the *Homo sapiens* Cave fauna should be early Late Pleistocene (or late Middle Pleistocene).

^{230}Th-^{234}U Unequilibrium U-series dating method was adopted here to confirm the result of the faunal correlation. Two samples were taken from the Layer 1 and Layer 2 of Unit B, respectively. The sample from Layer 1 is ML-6A, and the one from Layer 2, which is also the fossil *Homo sapiens* yielding layer, is ML-6B. Both samples were analyzed at the Minnesota Isotope Laboratory, Department of Geology and Geophysics, University of Minnesota, and the result is shown in Table 2. The ages from the two samples are 100 ka and 111 ka, respectively. This result is consistent with the faunal

Table 2 U-series dating results of calcitic floor in the *Homo sapiens* Cave of the Mulan Mountain

Sample number	^{238}U (ppb)	^{232}Th (ppt)	$\delta^{234}U^{*}$ (measured)	^{230}Th/^{238}U (activity)	^{230}Th/^{232}Th (atomic×10^{-6})	^{230}Th age (a) (uncorrected)	^{230}Th age (a) (4.4±2.2×10^{-6} corrected)	^{230}Th age (a) (1.0±1.0×10^{-6} corrected)
ML-6A	223.3±0.8	230091±5156	52.7±4.3	0.6611±0.0481	11±1	106558±13091	74098±21556	100000±14080
ML-6B	121.6±0.2	24872±425	66.9±2.6	0.6904±0.0228	56±2	111791±6369	106193±6705	110545±6422

^{230}Th dating results. The error is 2σ error.

correlation. ML-6B came from the same layer as the *Homo sapiens* fossils, so the age of them should probably be 111 ka.

4 The environmental background of the *Homo sapiens* Cave fauna

The *Homo sapiens* Cave of the Mulan Mountain lies south of the Tropic of Cancer (22°17′N, 107°30′E). Zoogeographically, it belongs to the South Yunnan mountainous area subdistrict, South China district, China-India subrealm, Oriental realm. There are 39 same species in the fauna as the present fauna in the subdistrict such as *Neotetracus sinensis*, *Crocidura hosfildi*, *Chimarrogale*, *Mogera insularis*, *Rhinolophus pearsoni*, *Hipposideros pratti*, *Dremomys*, *Petaurista petaurista*, *Typhlomys cinereus*, *Atherurus*, *Hystrix subcristata*, *Eothenomys*, *Apodemus draco*, *Hapalomys delacouri*, *Chiropodomys gliorides*, *Niviventer fulvescens*, *Leopoldamys edwardsioides*, *Bandicota* cf. *B. indica*, *Macaca*, *Trachypithecus*, *Arctonyx collris*, *Paguma*, *Muntiacus muntjak*, and so on, which account for 89% of all the genera of the fauna. So the fauna reflects some successive similarities with the local extant fauna.

The *Homo sapiens* Cave fauna is characterized by the tropical and subtropical mammal components. At the family level, 52 percent of the families are mainly distributed in the Oriental Realm, such as Rhinolophidae, Hipposideridae, Platacanthomyidae, Hystricidae, Hominidae, Hylobatidae, Cercopithecidae, Pongidae, Viverridae, Elephantidae, Rhinocerotidae, Tapiridae, and so on. At the genus level, more than 81 percent of the genera are Oriental elements, such as *Hipposideros*, *Belomys*, *Atherurus*, *Typhlomys*, *Eothenomys*, *Leopoldamys*, *Viverra*, *Arctonyx*, *Tapirus*, *Rhinoceros*, *Muntiacus*, *Pongo*, *Hylobates*, *Macaca*, *Trachypithecus*, and so on. At the species level, except widespread species, there is no Palearctic elements in the fauna. So the fauna is featured as an Oriental tropical-subtropical fauna.

Compared with the *Homo sapiens* Cave fauna, the Early Pleistocene Sanhe Cave fauna has more forest inhabitants, such as various horseshoe bats (*Rhinolophus*), special arboreal *Tylonycteris fulvidus*, *Kerivoula hardwickei*, completely arboreal flying squirrel, penciled-tailed tree mice with high population density, treeshrew, Sumatran rabbit, civet, muntjac, and so on, which reveals the environment at that time was tropical forest or forest-shrub. The *Homo sapiens* Cave fauna lacks forest or bamboo forest inhabitants, such as giant panda, stegodont, bamboo rat, treeshrew, and so on. Moreover, the species richness of horseshoe bat and roundleaf bat, which usually inhabit tropical-subtropical forest, is very poor, and there is no *Tylonycteris fulvidus*, *Kerivoula hardwickei* in the fauna. Muroid rodents occurred in the fauna with high diversity and population density. All these differences could probably reveal the forest was shrinking, while the grassland was expanding at that time. This was probably a result of the wetting and drying fluctuation of the climate.

5 Conclusions

After the discoveries of orangutan and Asian elephant fossil from the *Homo sapiens* Cave in 2007, trial excavations were carried out in this cave. Two hominin teeth and a number of mammalian fossils were unearthed in November 2007. In May 2008, the first author of this paper found another edentulous incomplete mandible of *Homo sapiens* and lots of coexisting mammalian fossils. The famous paleoanthropologist Xinzhi Wu thought this mandible possessed the morphological feature of early *Homo sapiens*, and was a critical hominin specimen.

The *Homo sapiens* Cave fauna of the Mulan Mountain lacks *Gigantopithecus blacki*, *Ailuropoda*, and *Stegodon*. Its features are distinctly different from the *Gigantopithecus* fauna and the *Ailuropoda-Stegodon* fauna. The fauna is a transitional one between the typical *Ailuropoda-Stegodon* fauna (s.s.) and the Asian elephant fauna, the age of which is early Late Pleistocene. This fauna provided important information for the subdivision of the Quaternary fauna of South China.

The *Homo sapiens* Cave fauna lacks the main mem-

bers of the typical *Ailuropoda-Stegodon* fauna, such as *Ailuropoda*, *Stegodon*, *Rhizomys*, and so on, but it has advanced forms such as *Elephas maximus*, *Bandicota indica*, and so on, which probably indicates a biological event caused by climate transition. A biological event usually represents a complete sequence from extinction to radiation[18]. Repenning thought there happened 11 biological events in late Cenozoic. He called the former 10 events Event 1 (6.7 Ma ago) to Event 10 (130 ka ago), respectively, and used the widely accepted name, Late Pleistocene Extinctions (11000 years ago), for the last event[19]. Liu et al. (2000) ordered the Quaternary mammalian faunas. There were totally 6 biological events in their sequencing, which are Event 6 (2.6 Ma, Renzidong Cave, Anhui), Event 7 (1.87 Ma, Nihewan, Hebei), Event 8 (1 Ma, Gongwangling, Shanxi), Event 9 (0.5 Ma, Zhoukoudian, Beijing), Event 10 (0.13 Ma, Dingcun, Shanxi), and Late Pleistocene Extinctions (11 ka, Qingshantou, Jiling)[20]. There are 55 species, both the relic forms of Early, Middle Pleistocene and newly occurred species in Late Pleistocene, in the *Homo sapiens* Cave fauna of the Mulan Mountain. It is usually accepted that the occurrences of new species can be used as reliable indicators for a new geological age. The Event 10 defines the boundary between Middle and Late Pleistocene. In Chongzuo area, the Event 10 is equivalent to the datum of the lowest stratigraphical occurrences of *Elephas maximus* and *Bandicota* cf. *B. indica*. So the *Homo sapiens* Cave fauna should be Later than Event 10, whose age should be early Late Pleistocene (ca. 110 ka).

The *Homo sapiens* Cave fauna shows some features indicating a climate transition. The drying and wetting fluctuation at that time was violent, which led to the change of the combination of the forest inhabitants. The causes and backgrounds of the climate change and the features of human evolution at that time still needs further study.

Until present, 6 *Homo erectus* and *Homo sapiens* sites have been found in the Mulan Mountain area of Chongzuo, Guangxi, China and neighbouring areas of Vietnam and Laos[9]. All of them lie in the humid tropical bare karst area. Karst cave are very developed on the slopes of peak-cluster mountains, which makes this area one of the most potential areas for the study of the origins of modern humans.

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