Chapter 7
The Hominid Fossils from China Contemporaneous with the Neanderthals and Some Related Studies

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Abstract Among the more than 70 hominid fossil sites so far found in China, those of the Middle and Late Pleistocene are the most frequent. These Chinese hominids are contemporaneous to the Neanderthals. For the past decade, more attention has been paid to the field of Middle and Late Pleistocene human evolution in Chinese paleoanthropological studies, which resulted in a series of new hominid fossil finds and further understanding of human evolution in China. In this chapter, we briefly review the main hominid fossils found in China which are contemporaneous to the Neanderthals, and we report the research advances achieved in recent years including new hominid fossil sites and related studies.

Keywords Middle Pleistocene • Late Pleistocene • Human evolution • New sites

The Main Hominid Fossils Contemporaneous to the Neanderthals

Since the initial discovery of hominid fossils at the beginning of the twentieth century, more than 70 hominid fossil sites have been found in China. These fossils have been attributed to either *Homo erectus* or *Homo sapiens*. Most of these hominid fossils were found in Middle to Late Pleistocene deposits, and their chronological ages are approximately contemporaneous to those of the Neanderthals and their lineage. Figure 7.1 and Table 7.1 list some important Middle and Late Pleistocene hominid fossils found in China, respectively.

In this chapter, some of the hominid fossils listed in Table 7.1 are briefly described, either because of their well-preserved condition or because there have been very few studies on them since their discovery.

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Hexian

The hominid fossils found in Hexian, Anhui Province, include one skull cap, two cranial fragments, one mandible, and some isolated teeth (Fig. 7.2). These fossils were found in 1980 and 1981. Since then, a few papers were published giving simple descriptions of the fossils (Wu and Dong 1982; Wu 1983; Huang et al. 1982). These studies put the Hexian fossils into *Homo erectus*. But both the morphology and chronological age of the Hexian fossils pointed to a difference between Hexian and other *Homo erectus* fossils found in China. Recently, some new studies have been carried on Hexian fossils by Chinese colleagues, which address the morphological variation of *Homo erectus* in China and the endocast features of Hexian (Liu and Zhang 2004; Wu et al. 2006b).

Xujiayao

The Xujiayao site is located in Shanxi Province. The three excavations of Xujiayao in 1976, 1977, and 1979 respectively unearthed 20 hominid fossils including 12 pieces of parietal bones, 1 temporal bone, 2 pieces of occipital bone, 1 mandibular fragment, 1 child's maxilla, and 3 isolated teeth. Figure 7.3 displays some cranial fragments of the Xujiayao hominids. The chronological age of 125–104 ka makes these hominid fossils of great value to research on the origin of modern Chinese. Till now, only a few site reports with very simple descriptions of the hominid fossils have been made (Wu 1980, 1986).

Chaoxian

The hominid fossils found in Chaoxian, Anhui Province, include an occipital fragment, a maxillary fragment with both lateral incisors and right P^3-M^1, and three isolated teeth

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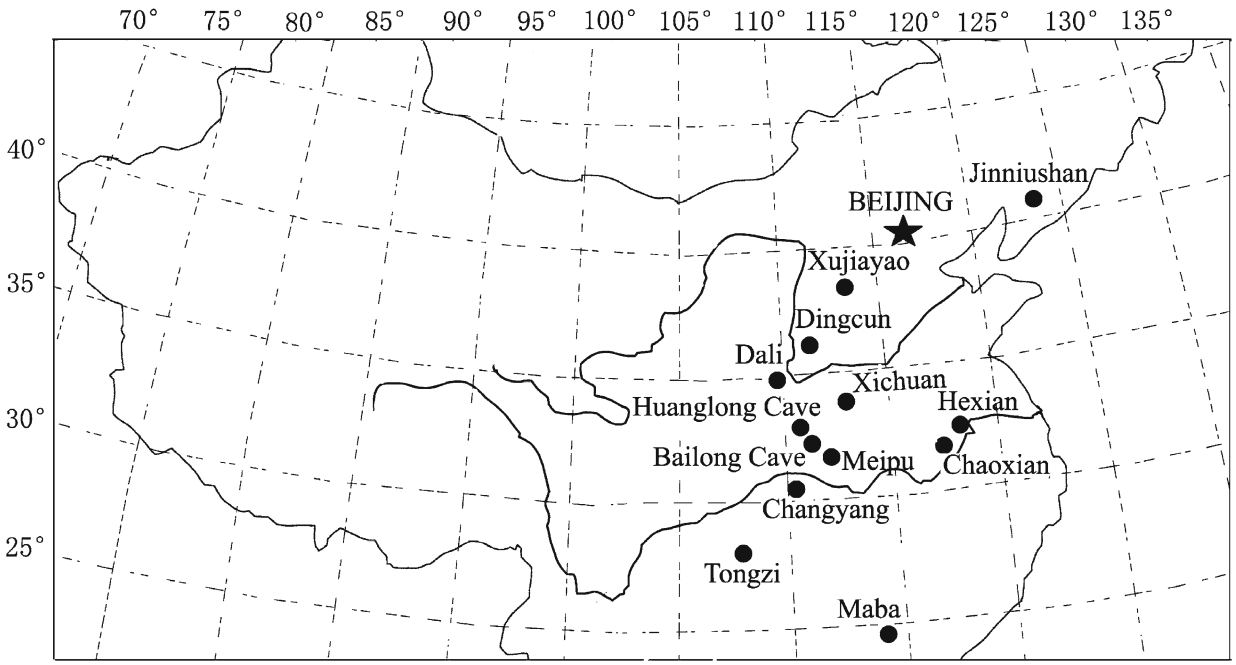

Fig. 7.1 The main hominid fossil sites in China contemporaneous to the Neanderthals

Table 7.1 The main human fossils of China contemporaneous with the Neanderthals

Sites	Main specimens	Geological epoch	Chronological dates
Hexian	1 skull cap, 2 cranial fragments, 1 mandible, and 9 isolated teeth	Middle Pleistocene	270–150 ka
Dali	1 cranium	Middle Pleistocene	209 ka
Jinniushan	1 cranium, 6 vertebrae, os coxae, 1 ulna	Middle Pleistocene	280 ka
Maba	1 skull-cap	Middle Pleistocene	135–129 ka
Xujiayao	15 cranial fragments, 2 jaw bones, and 3 isolated teeth	Late Pleistocene	125–104 ka
Dingcun	3 teeth; 1 parietal	Middle or Late Pleistocene	210–160 ka
Tongzi	6 teeth	Middle or Late Pleistocene	181–113 ka
Chaoxian	1 occipital; 1 maxilla with left I^2, P^2-M^2 and right I^2, P^1-M^1	Middle Pleistocene	200–160 ka
Changyang	Left maxilla with P^1 and M^1; isolated P_2	Middle Pleistocene	–
Meipu, Yunxian	4 isolated teeth	Middle Pleistocene	–
Xichuan	13 isolated teeth	Middle Pleistocene	–
Huanglong Cave	7 teeth	Late Pleistocene	103–94 ka
Loc 4, ZKD	1 premolar	Middle Pleistocene	250–110 ka
Bailong Cave	4 isolated teeth	Middle Pleistocene	–
Dadong, Panxian	3 isolated teeth	Middle Pleistocene	260-130 ka

(left P^4-M^2) (Fig. 7.4c). The Chaoxian site is only 50 km from Hexian, and the chronological age for the deposit yielding the hominid fossils is 200–160 ka, which have led some colleagues to propose that the overlapping of the time ranges between Hexian and Chaoxian suggest *Homo erectus* and archaic *Homo sapiens* may have coexisted in China (Chen and Zhang 1991). There was also a study on the tooth wear and tooth use of Chaoxian hominids (Zhang 1989).

Maba

The hominid fossil found at Maba in Guandong Province, south China, is only a skull cap composed of several fragments (Fig. 7.4a). After reconstruction, the Maba specimen contains the right orbital region and most of the skull cap including frontal, temporal, and occipital bones. Since Wu Rukang (Woo and Peng 1959) described the morphology of

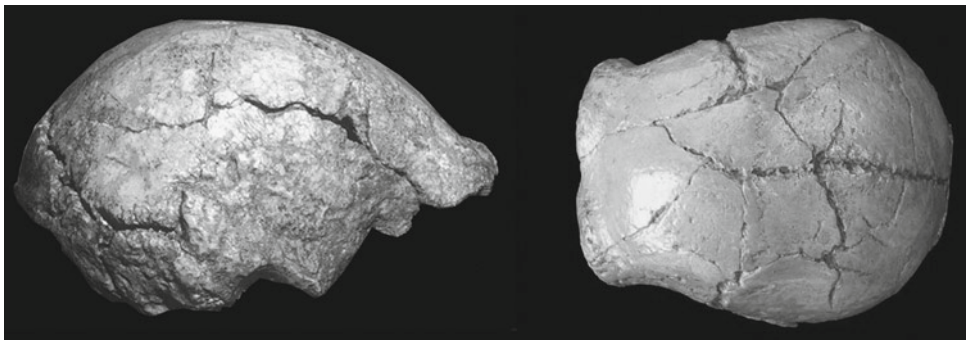

Fig. 7.2 Hominid cranium found in Hexian, Anhui Province of China

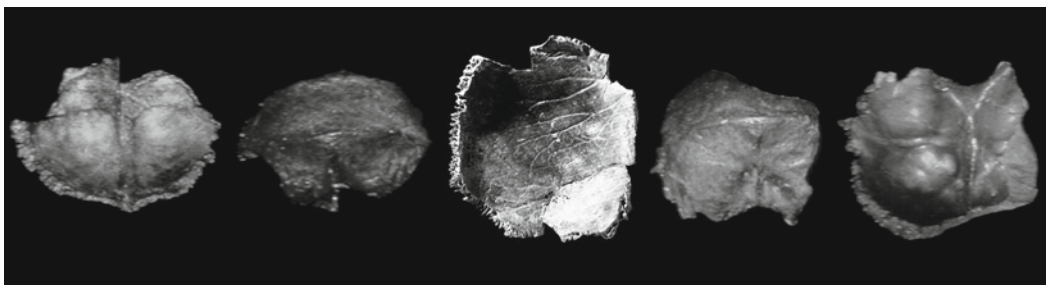

Fig. 7.3 Hominid fossils found in Xujiayao, Shanxi Province of China

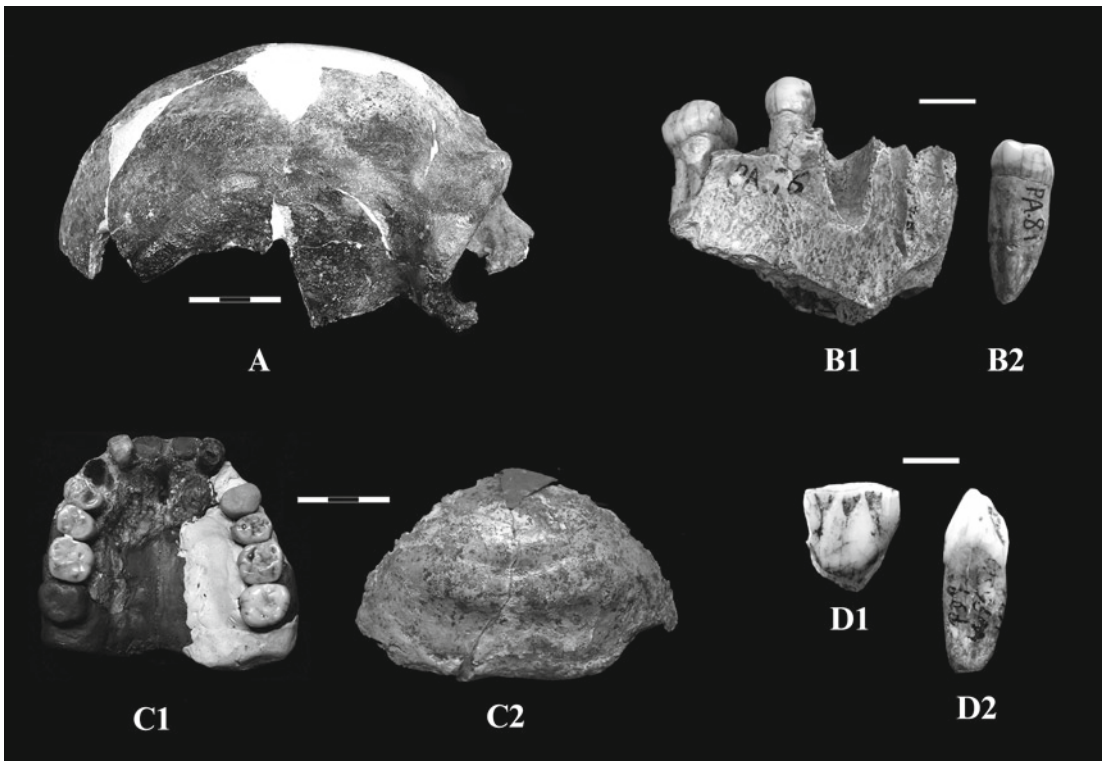

Fig. 7.4 Hominid fossils found in Maba (**a**), Changyang (**b**), Chaoxian (**c**), and Panxian (**d**)

Maba, no further specific study has been done on it. For the past decade, the main interest in Maba has been focused on its orbital shape. Wu Xinzhi (2004a, b) believes that the round-shaped orbit of Maba resembles that of European Neanderthals and differs from other Chinese hominids, suggesting gene flow between the two lineages (see the following section).

Xichuan

The 13 isolated hominid teeth (Fig. 7.5) collected from traditional Chinese medicine drug stores in Nanyang County and Xixia County, Henan Province, in 1973 supposedly came from Xichuan County, Henan Province. Because the teeth were not from excavations, there is no chronological age for them. According to Wu Rukang and Wu Xinzhi (1982), most of the teeth resemble those of *Homo erectus* morphologically. Because that was the only morphological description of these teeth, further studies are needed to clarify the morphological features of the Xichuan fossils and their relationship with other Middle and Late Pleistocene hominids in China.

Hominid Fossil Sites Recently Found in China

The research on Late Pleistocene human evolution in China has been playing an important role in the field of modern human origins not only for East Asia but around the world. Although many Late Pleistocene hominid fossils have been found in China, there are few dating between 100 and 50 ka, causing a big "fossil gap". For this reason, in recent years we have organized a series of field surveys and excavations in

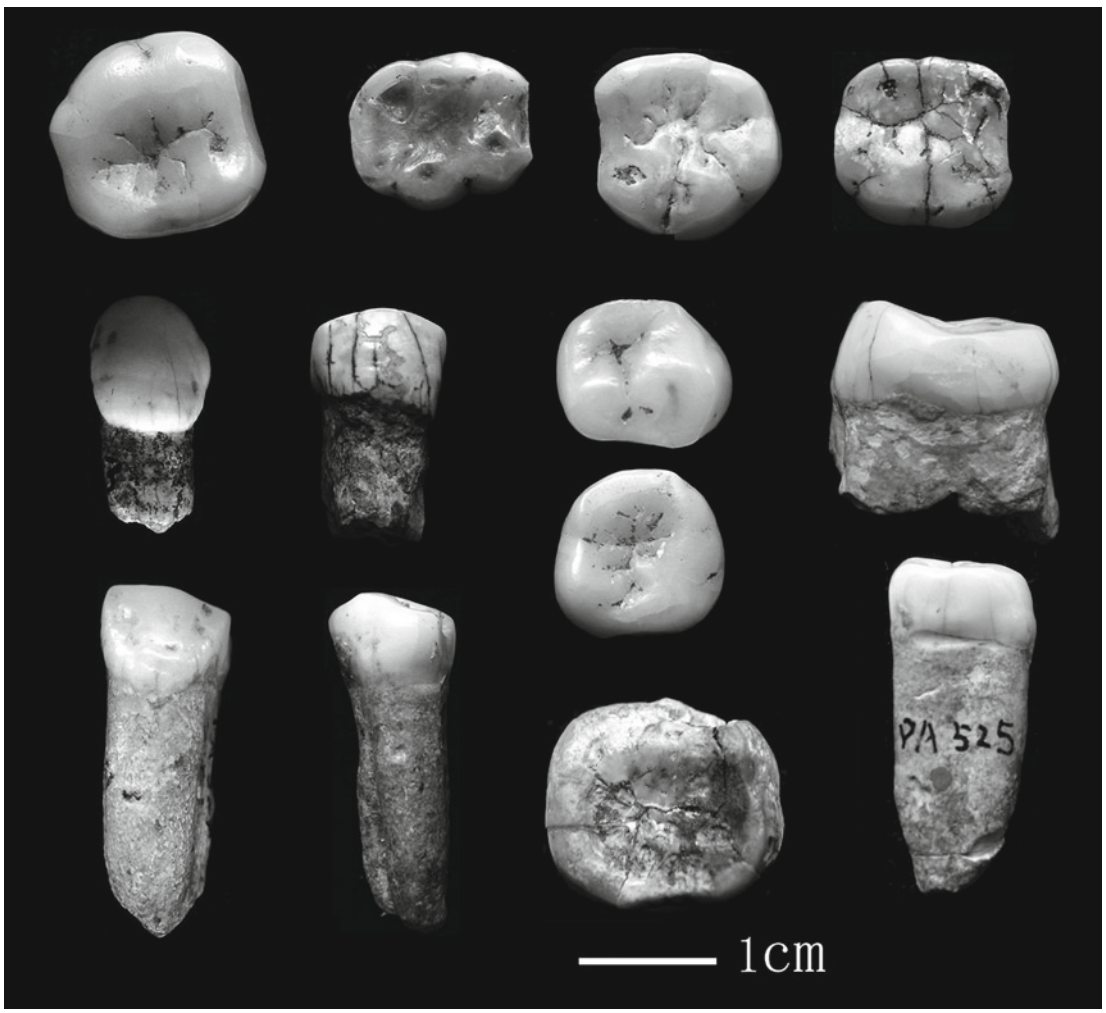

Fig. 7.5 Hominid teeth found in Xichuan, Henan Province

China trying to find more hominid fossils in this time period. In the past 5 years, several new Late Pleistocene human fossil sites have been found in China. Among them, one site near Zhoukoudian (ZKD) and four others in the West Hubei and Three Gorge region are the most important.

Tianyuan Cave

The Tianyuan Cave is located about 6 km southwest of the Zhoukoudian "Peking Man" site near Beijing. The cave was discovered in 2001, and excavations were carried out in 2003 and 2004, yielding both hominid and mammal fossils. The hominid fossils comprise 34 specimens including a mandible, teeth, and postcranial bones. The mammal fossils represent 29 species. No definite stone artifacts or other cultural remains have been found,but a great number of heavily fragmented bone flakes unearthed here suggest possible human activities. Preliminary analyses indicate that the fauna of the Tianyuan Cave is most similar to that of the ZKD Upper Cave and somewhat less close to the living fauna. The geological age should be Late Pleistocene. The results of absolute dating by several methods yielded an age of 42–39 ka, approximately the same age as that of Upper Cave (Tong et al. 2004; Shang et al. 2007). Detailed studies of the hominid fossils are underway.

West Hubei and Three Gorge Regions

The west Hubei and Three Gorge regions is a narrow area across the western part of Hubei Province with the Three Gorge area intermediate (Fig. 7.6). Since the first discovery of hominid fossils (a maxilla fragment and an isolated tooth) in Changyang County of this area in the 1950s (Chia 1957), 10 hominid fossil sites have been found (Liu et al. 2006d), including the Yunxian *Homo erectus* and Longgupo sites (Li and Etler 1992; Huang et al. 1995). In addition to these hominid fossil sites, more than 30 sites with stone artifacts and other evidence showing human activities have also been located. Since 2000, our field surveys have found four new Late Pleistocene human fossil sites, and some preliminary excavations have been carried out. All four sites have yielded hominid fossils, stone artifacts and other mammalian fossils.

Among the four new hominid fossil sites in the West Hubei and Three Gorge region, the Huanglong Cave is most important. The Huanglong Cave is located in Yunxi County, which is in the northwest of Hubei Province. From 2004 to 2006, three excavations were conducted at the Huanglong Cave. From these excavations, we found 7 hominid teeth (Fig. 7.7), some stone and bone tools, as well as nearly 3,000 mammal fossils. Preliminary dating analysis (U-series and ESR) indicates that the age of the human teeth is around 100 ka (Wu et al. 2006a).

Three other hominid sites, named Xinglong Cave, Leiping Cave, and Migong Cave, were found in the Three Gorge region within the Chongqing Municipality area (Liu et al. 2006d). Xinglong Cave is located in Fengjie County. In 2001, some mammal fossils were found in Xinglong Cave. The subsequent excavation found four human teeth, stone artifacts, ivory engravings, and other cultural remains. Based on biostratigraphic analysis and uranium series dating, the cave was dated about 100 ka (Gao et al. 2004). The second site recently found in the Three Gorge region is Leiping Cave, which is located in Wushan County. In 2004, while digging sand in the Leiping Cave, local farmers found a piece of human cranium and some mammal fossils. Then, our colleagues made a short excavation there unearthing more hominid fossils, stone tools, and mammal fossils. The hominid fossils found in the Leiping Cave include several cranial fragments (frontal, parietal, left and right temporal, and occipital bones), one upper incisor, and several limb bone fragments. According to the analysis of stratigraphy and faunal composition, we assume that the hominid probably lived in the early Late Pleistocene. The third new hominid fossil site, Migong Cave, is also located in Wushan County. Two hominid parietal fragments were found in 1999 and 2000, respectively. No formal excavation has been carried out in this site.

The field works in both past decades and recent years indicate that the West Hubei and Three Gorge regions are rich in hominid fossil and related materials. Some new sites from recent years' field works further make clear that hominids lived in these regions in the Late Pleistocene. For many years, it has been generally believed that the ages of most of the Late Pleistocene hominid fossils found in China are not earlier than 50 kyr BP. Although some of the them have been thought as early as more than 50 kyr BP, nearly all the dating is in debates because of either the unclear stratigraphic layer yielding the human fossils or methodology. Some colleagues even questioned the existence of the hominids around 100 ka in China. So, the hominid fossils and other related materials from Huanglong Cave and other sites will provide important information for research on the origin of modern Chinese.

Recent Studies on Middle and Late Pleistocene Human Evolution in China

For the past decade, with the advances in the research on modern human origins in East Asia, more attention has been paid to studies of Middle and Late Pleistocene human

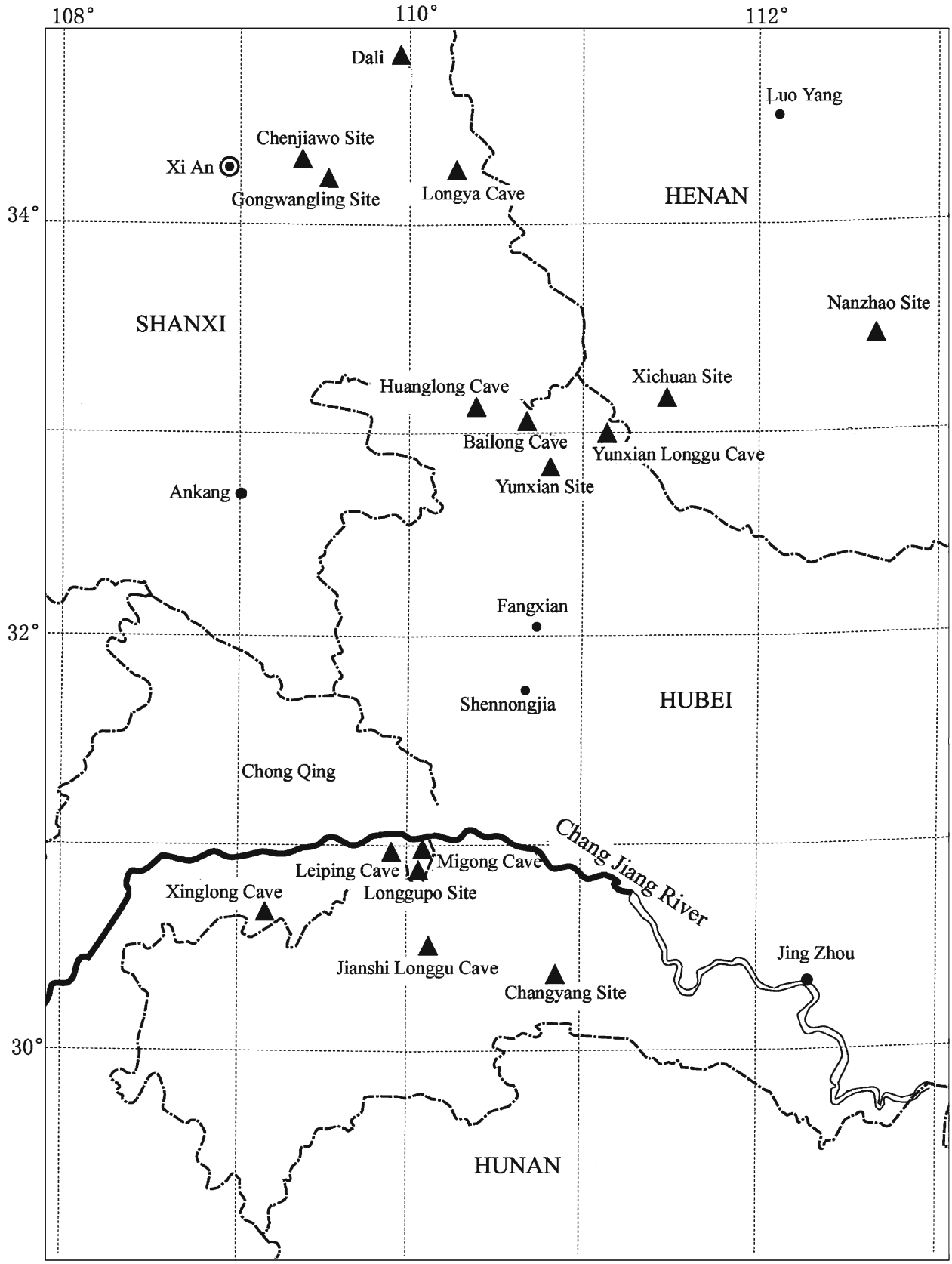

Fig. 7.6 The hominid fossil sites in the West Hubei and Three Gorge regions

Fig. 7.7 The hominid teeth found in the Huanglong Cave in Hubei Province

evolution in China. A series of studies carried out by Chinese colleagues have examined different aspects of Middle and Late Pleistocene hominid fossils found in China, including their morphology, geographical variation, temporal change, and relationship with hominids from other parts of the world. Some of their results are described below.

Morphological Features on the Chinese Hominid Fossils Suggesting Gene Flow Between Middle-Late Pleistocene Hominids in China and Neanderthals

The origin of modern Chinese has been the key research question for the past two decades in China. As part of this topic, there have been some comparative studies on the cranial morphology between China and European Neanderthals. According to these studies, Wu Xinzhi (1998, 2004a, b) proposed the continuity of human evolution in China as evidenced by a group of common morphological features like shovel-shaped incisors and flatness of the face. There is also a morphological mosaic between *Homo erectus* and archaic *Homo sapiens* in China, adding further support for the regional continuity hypothesis. Besides, Wu Xinzhi's studies show that a few features commonly seen in the Neanderthal lineage can be identified on some Chinese hominid fossil skulls, probably suggesting gene flow between the Middle-Late Pleistocene hominids in China and the Neanderthals in Europe. Based on them, a so-called "continuity with hybridization" model for human evolution in China was proposed (Wu 1998).

The morphological features selected as evidence of gene flow between Chinese hominids and Neanderthals include: (1) protruding nasal saddle of cranium No. 2 from Yunxian and cranium No. 1 from Nanjing; (2) circular orbit and sharp inferolateral orbital margin of the Maba cranium; (3) the surface bulge between the piriform aperture and orbit in the Dali cranium and cranium No. 1 of Nanjing; (4) the chignonlike structure of the occipital region (bunning) on the crania of Ziyang, Liujiang, and Lijiang; and (5) more lateral orientation of the anterolateral surface of the frontosphenoidal process of the zygomatic bone in Upper Cave cranium No. 102 (see Fig. 7.8). Wu Xinzhi argues that in the Pleistocene these features are rare in China, but they are more frequent in Africa and Europe, especially in the Neanderthal lineage. The most reasonable explanation for their occurrence in Pleistocene China is that they are due to small amounts of intermittent gene flow from Europe.

However, these opinions and related studies are not widely accepted and even questioned by Chinese colleagues. Recently, some Chinese colleagues including the present authors conducted some comparative studies trying to investigate the morphological basis for gene flow between Chinese hominids and Neanderthals. Our preliminary results do not give support for a Neanderthal influence on Chinese hominids at least for some proposed morphological features (Liu et al. 2003; Zhang et al. 2004). Our studies indicate that the morphological features listed above are not strong enough to serve as evidence to support gene flow between Chinese Middle and Late Pleistocene hominids and European Neanderthals. The main problems for these five features is they are either atypical (like occipital bunning), or not exactly the same as Neanderthal features (Trinkaus 2006). Also, until now, there is no archaeological evidence to support human migration between east Asia and Europe in the Middle Pleistocene.

Studies on Nanjing No. 1 and No. 2 Hominid Fossils

In 1993 two fragmentary hominid crania were found in a cave site near Nanjing (Jiangsu Province) in east China and named Nanjing No. 1 and No. 2. The initial study (Wu and Li 2002) indicated morphological resemblance between the Nanjing and Zhoukoudian specimens, and both Nanjing No. 1 and No. 2 were put into *Homo erectus*. More recently, some further studies have been carried out on Nanjing hominid fossils. These studies involve different aspects of the Nanjing No. 1 hominid fossil including the nasal and facial

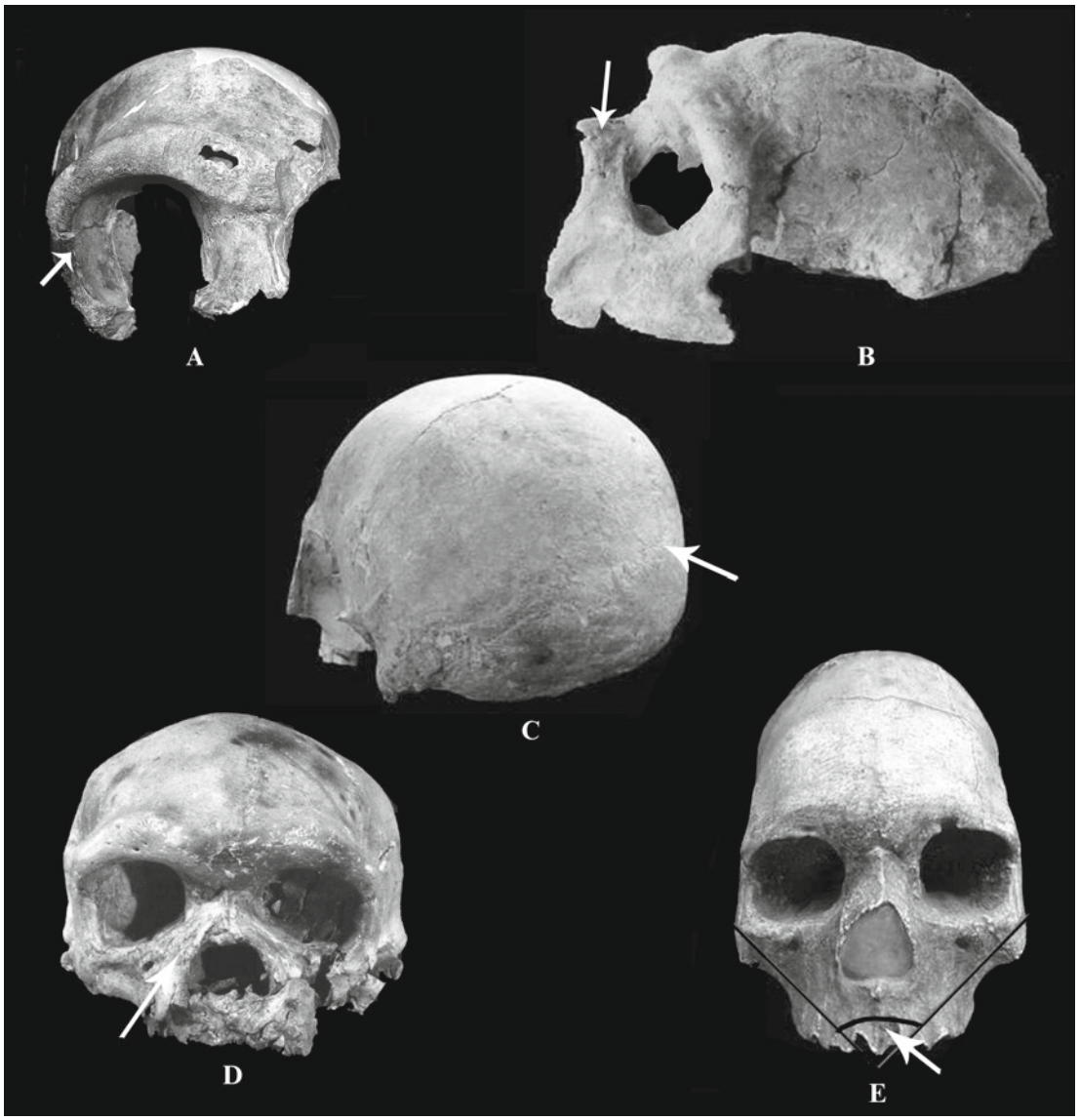

Fig. 7.8 Some Neanderthal features on the Chinese hominid fossils: (**a**) circular orbit and sharp inferolateral orbital margin of Maba; (**b**) protruding nasal saddle of Nanjing No. 1; (**c**) occipital bunning of Liujiang; (**d**) surface bulge between the piriform aperture and orbit of Dali; (**e**) more lateral orientation of anterolateral surface of the frontosphenoidal process of the zygomatic bone in UC 102

morphology (Zhang et al. 2004; Zhang and Liu 2005) and comparison of cranial morphology with *Homo erectus* from Eurasia and Africa (Liu et al. 2005). We also made a new reconstruction of the Nanjing No. 2 cranium, and its morphological features were studied (Zhang and Liu 2006).

As mentioned in the previous section, the highly projecting nasal bones of Nanjing No.1 have been believed to be evidence of gene flow from Europe. To further clarify this question, we studied the nasal morphology of Nanjing No. 1 and discussed the possibility of gene flow from European fossil hominids. Our observations show that highly projecting nasal bones have not been found in the crania from Africa, Europe, and West Asia during the time period of Nanjing *Homo erectus* or before. This feature appeared much later in Africa and Europe than in Asia. The available fossil evidence cannot support the western affinities of *Homo erectus* from Nanjing.

Nanjing No. 2 cranium has been believed to represent *Homo erectus*. However, its parietal and occipital bones were cracked into several fragments which were displaced from their normal positions. Recently, we made a new restoration and reconstruction of the Nanjing No. 2 cranium, which provides more anatomical details. Our study indicates that compared with *Homo erectus*, Nanjing No. 2 has larger parietal bones, relatively narrow upper squamous region of the occipital bone, and a probably larger cranial capacity. All these

features suggest affinities with archaic *Homo sapiens*. Our statistical analyses of metric data further show the closer affinity of Nanjing No. 2 to archaic *Homo sapiens* than to *Homo erectus* from both China and Indonesia. The results of the study indicate that there must be some uncertainty in referring Nanjing No. 2 to *Homo erectus*; it is more likely that it belongs to *Homo sapiens* (*sensu lato*).

In addition to these studies of specific morphological features of Nanjing No. 1 and No. 2, further comparative analyses with hominids from both Africa and Eurasia were also carried out (Liu et al. 2005). Our morphological comparisons and metric analyses show that Nanjing No. 1 cranium shares typical *Homo erectus* features with African and European counterparts, demonstrating that *Homo erectus* is a widely distributed lineage that evolved during the million years after its Late Pliocene origins. The differences between Nanjing No.1 and Zhoukoudian suggest a certain level of regional variation in East Asian *Homo erectus*. Our detailed cranial morphological comparative study between Nanjing No. 1 and KNM-ER 3733 (Zhang and Liu 2006) indicate that even though Nanjing No. 1 is about 1 Myr later than KNM-ER 3733 in age, most of the cranial features of Nanjing No. 1 resemble those of KNM-ER 3733. The morphological resemblances between Nanjing No. 1 and KNM-ER 3733 are mainly in the calvaria region, whereas most features in the facial region differ between the two crania. We believe that the morphological similarity in the calvariae is diagnostic and supports the claim to refer KNM-ER 3733 to *Homo erectus.* In addition, the similarity suggests stability of some members of *Homo erectus* in the morphology of calvaria over a span of at least a million years. Unfortunately, the significance of the differences in facial skeleton of these crania is still uncertain.

Brain Evolution: Studies of Hominid Endocasts

For the past 5 years, we have conducted a series of studies on the brain evolution of Chinese hominids (Wu et al. 2004; Wu et al. 2006b). Our current studies mainly focus on endocasts of fossil hominids from Zhoukoudian and Hexian (Fig. 7.9). For the Zhoukoudian endocasts, we investigated the detailed history of the reconstruction and studies of the endocasts for this important site. Their gross morphology and metrics were also described (Wu et al. 2004). Based on these analyses, we further discussed future studies on Zhoukoudian endocasts. In addition. we reconstructed the endocasts of Hexian and Maba from their original fossil crania. The morphological features and metric data for the Hexian endocast have been studied (Wu et al. 2006b). We found that Hexian has many morphological features in common with ZKD. Metrical analyses show that the brain height, frontal breadth, cerebral height, frontal height, and parietal chord increased from *Homo erectus* to modern humans, while the length, breadth, frontal chord, and occipital breadth did not change substantially. We have made an endocast of Maba and plan to study it soon.

Some Recent Studies on Late Pleistocene Human Evolution in China

Among the Late Pleistocene hominid fossils so far found in China, the hominid crania and postcranial remains found from Upper Cave and Liujiang are the most complete and well preserved. The original studies (Weidenreich 1939;

Fig. 7.9 Endocasts of hominids from Hexian (**a**), ZKD (**b**), and Maba (**c**)

Woo 1959; Wu 1960, 1961) indicated that both Upper Cave and Liujiang fossils preserve some primitive features of Late Pleistocene humans, but a group of modern Mongoloid features can also be identified. They have been regarded as an early type of ancestral Mongoloids.

Recently, great advances have been achieved in the study of Late Pleistocene human evolution which led to some new opinions on morphology and related evolutionary problems for Upper Cave and Liujiang. With such a background, we conducted new studies on these specimens (Liu et al. 2006a, b, c; Shang et al. 2006). Our studies cover several aspects related to the Upper Cave, Liujiang, and other problems of Late Pleistocene human evolution in China. Our comparative analyses of cranial morphology include the Upper Cave and Liujiang fossils, as well as modern Chinese specimens, including 1,180 skulls from different parts of China. Our results show: (1) The expression of most cranial features on the Liujiang cranium are within the variation ranges of modern Chinese, and only a few features of Liujiang have different expressions from modern Chinese; (2) A few primitive features such as a lower orbit can be observed on Liujiang cranium, indicating that it still preserves some Late Pleistocene human features, but compared with other Late Pleistocene humans, especially Upper Cave, the Liujiang cranium is more modern; (3) The differences between Liujiang and Upper Cave are mainly due to more primitive and robust features occurring on the Upper Cave crania. A few of these differences, such as the deeply depressed nasion of Upper Cave and broad nose of Liujiang, may be related to the climate or environmental adaptations. Based on these findings, we believe that the cranial morphology of Liujiang is very close to that of modern Chinese, and very few differences exist between them. Our studies do not support the opinion that the Liujiang cranium is more primitive than those of Upper Cave and Ziyang, and even put Liujiang as the earliest Late Pleistocene modern human in East Asia. The cranial differences between Liujiang and Upper Cave mainly reflect their evolution, and to a less extent the influences from their environments. Considering the similarity of cranial morphology between Liujiang and modern Chinese, and the uncertainty of the age of the fossiliferous layer of Liujiang, we believe that the current morphological evidence does not support the proposed earlier age for Liujiang.

The hominid fossils found in Liujiang include a complete cranium, the right os coxae, sacrum, two femur fragments and several vertebrae. Judged from the lack of duplication of elements, the comfortable articulation of the joint surfaces of adjacent bones and the similar texture of the bones, we are sure only a single individual is represented. This unusual discovery allows us to calculate body size, body proportions, and relative cranial capacity (encephalization quotient) for that individual rather reliably. Based on the measurements of the Liujiang cranium and reconstructed pelvis, we calculated the stature, body breadth, body weight, EQ index, and body proportion for the individual. Our result indicates that the Liujiang individual has body proportions (body height relative to body breadth) typical of warm adapted populations. Its encephalization quotient of 5.553 is greater than those of other Middle and Late Pleistocene humans such as Upper Cave and Jinniushan, and is closer to those of Minatogawa 2 and modern human populations. The body weight of 52.6 kg for Liujiang is also smaller than those of fossil humans living in higher latitude like Jinniushan, Upper Cave, and Neanderthals, and closer to those of Minatogawa, KNM-ER 3883, and KNM-ER 3733, which all lived in warmer climate region. We believe that the body size, body proportions, and relative cranial capacity (EQ) of the Liujiang individual suggest its resemblance to terminal Pleistocene and living humans.

Conclusion

The hominid fossils so far found in China indicate that Middle and Late Pleistocene was the time period when hominins were widespread living and evolving. More and wide morphological and behavioral variations occurred in these ancient humans. A series of newly found fossils and related studies provide evidence to support the existence of the early modern humans around 100 ka in China, which include the mandible and teeth found in Zhiren Cave of South China (Liu et al. 2010).

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