

RAPID COMMUNICATION

Jiangxichelys, a new nanhsiungchelyid turtle from the Late Cretaceous of Ganzhou, Jiangxi Province, China

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Abstract

A new taxon of nanhsiungchelyid turtle, *Jiangxichelys ganzhouensis* n. g. n. sp., is described on the basis of a complete shell from the latest Cretaceous of Ganzhou, Jiangxi Province, China. It is close to *Hanbodgemys*, but different from the latter in having a boot-shaped second marginal scute reaching the first vertebral scute, a larger first suprapygal, a large fifth vertebral extending onto the tenth peripheral, narrower lateral marginal scutes and a narrower posterior plastral lobe. This discovery adds a new element to the scanty record of nanhsiungchelyids from southern China and illustrates the diversity of the family in that area.

Keywords: Testudines, Nanhsiungchelyidae, Late Cretaceous, Jiangxi Province, China.

1. Introduction

The nanhsiungchelyids were a group of land turtles during the Late Cretaceous in Asia and North America, including a dozen taxa. Although well diversified in central Asia and northern China (Mlynarski, 1972; Sukhanov & Narmandakh, 1977; Brinkman & Peng, 1996; Sukhanov, 2000; Joyce & Norell, 2005; Danilov & Syromyatnikova, 2008; Sukhanov, Danilov & Syromyatnikova, 2008), only two forms have hitherto been reported from the southern part of China (Ye, 1966; Hirayama *et al.* 2009). Here we report on a complete turtle shell from the Late Cretaceous of southern China which belongs to a new genus and new species of Nanhsiungchelyidae.

The specimen was collected from the latest Cretaceous Nanxiong Formation in Ganxian County, northeast of Ganzhou City, Jiangxi Province (Fig. 1), during the construction of a development zone. The Nanxiong Formation or its equivalents are found across several provinces in southeastern China and represented by an extensive sequence of red mudstones, sandstones and conglomerates. In the Ganzhou area, these red beds have yielded lizard bones, dinosaur bones and eggs, and possible turtle eggs (Young, 1965, 1973; Sato *et al.* 2005; Mo, Xu & Evans, 2009). The specimen described herein is housed in the Natural History Museum of Guangxi Zhuang Autonomous Region (NHMG), Nanning, China.

2. Systematic palaeontology

TESTUDINES Linnaeus, 1758
CRYPTODIRA Cope, 1868
NANHSIUNGCHELYIDAE Ye, 1966
Jiangxichelys n. g.

Etymology. From Jiangxi Province.

Type species. *Jiangxichelys ganzhouensis* n. sp.

Diagnosis. A genus of Nanhsiungchelyidae of moderate size; carapace length up to 450 mm, without midline keel; cervical notch well developed and wide, and first vertebral vase-shaped as in *Hanbodgemys*. Different from all other nanhsiungchelyids in having the first marginal scute short and wide, with a long free edge and long contact with the second marginal; the second marginal boot-shaped, with a medial process reaching the first vertebral, preventing the contact between the first marginal and the first costal scute. In addition, it is different from *Hanbodgemys* in having a larger and triangular first suprapygal, a large and triangular fifth vertebral extending onto the tenth peripheral, narrower lateral marginal scutes and a narrower posterior lobe of the plastron; different from *Zangerlia* in the narrower and longer posterior lobe of the plastron; different from *Nanhsiungchelys* and *Anomalochelys* in the smaller cervical notch and narrower vertebrals; different from *Kharakhutulia* in the narrower plastron and longer anterior plastral lobe, which extends beyond the anterior edge of the carapace; different from *Basilemys* in the larger cervical notch, narrower peripherals and smaller posterior lobe of the plastron.

Distribution. Late Cretaceous of Jiangxi Province, China.

Jiangxichelys ganzhouensis n. sp.
Figures 2, 3

Etymology. From Ganzhou, the area where the specimen has been collected.

Holotype. A complete shell with articulated carapace and plastron (NHMG 010415, collection of the Natural History Museum of Guangxi Zhuang Autonomous Region, Nanning, Guangxi Province, China).

Type locality and horizon. Ganxian, northeast of Ganzhou City, Jiangxi Province, China; Nanxiong Formation, latest Cretaceous.

Diagnosis. Same as for genus.

Measurements. See Table 1.

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Figure 1. Map showing the location of Ganxian, Jiangxi Province, China.

Table 1. Measurements of *Jiangxichelys ganzhouensis* n. g. n. sp. (NHMG 010415) from the Late Cretaceous of Ganzhou, Jiangxi Province, China (in mm)

Character	Length	Width	Height
Carapace	450	360	120
Plastron	363	342	
Anterior lobe	105	166	
Bridge	164		
Posterior lobe	100	139	

2.a. Description

Preservation. The shell is complete, with articulated carapace and plastron. Part of the right side of the carapace, from the second to the sixth neural, is crushed and slightly pushed towards the left.

Shell surface ornamentation. The surface of the shell is worn. However, a clear sculpture composed of large cells separated by ridges, similar to that of *Nanhsiungchelys wuchingensis* (Ye, 1966) and *Zangerlia neimongolensis* (Brinkman & Peng, 1996), is visible on the carapace.

The carapace is oval in shape and broad; it is relatively high in comparison with *Nanhsiungchelys*. The cervical notch is wide and deep as in *Hanbodgemys orientalis* and *H. jaganchoboli* (Sukhanov, 2000; Sukhanov & Narmandakh, 2006). As in *H. jaganchoboli*, the peripherals have an obtuse cross-section in the bridge region. The posterior peripherals are subvertical and their ventral edge is turned inward, as in *Zangerlia neimongolensis*.

The nuchal is trapezoidal, and wider than that of *H. jaganchoboli*. The first neural is nearly complete, with the posterior end damaged. It appears to be rectangular in shape. The second neural is long and hexagonal, with short posterolateral sides. The third neural is rectangular and shorter than the second one. The fourth neural is hexagonal

with short anterolateral sides. The fifth neural seems to be similar to the fourth in shape. The outlines of the sixth and the seventh neurals are not discernible. The eighth neural is slightly longer than wide and reaches the first suprapygal. The neural formula is thus $4 < 6 < 4 > 6 > 6 - ? - ? - 4$. This neural formula is unusual among nanhsiungchelyids. There are two suprapygals. The first is triangular and relatively large, contacting the eighth neural and eighth costals anteriorly and the second suprapygal posteriorly. The second suprapygal is much larger and wider than the first one, contacting the first suprapygal and the eighth costals anteriorly, the pygal and the eleventh peripherals posteriorly and the tenth peripherals laterally. The pygal is wider than long; and convex posteriorly. Eleven peripherals are present. The peripherals are all wide, being twice or more the width of the marginal scute. The first peripheral has a strongly angled free margin as in *Hanbodgemys* and *Nanhsiungchelys*.

The cervical scute is single and more than twice wider than long, with forwards convergent lateral margins. The first vertebral scute is vase-shaped, with rounded lateral margins as in *Hanbodgemys*; it is slightly wider than long. The second vertebral is narrow and longer than wide. The third and fourth vertebrae are incomplete; they appear to be similar to the second vertebral in shape. The fifth vertebral is roughly triangular in shape and extends onto the tenth peripheral plate. The pleural scutes are wide, with the width of the second and third pleurals being more than twice of that of the corresponding vertebrae. The first pleural contacts the second to fifth marginals; the second pleural contacts the fifth to seventh marginals; the third pleural contacts the seventh to ninth marginals and the fourth pleural contacts the ninth to eleventh marginals. The marginal scutes are all narrow and included in the peripherals except the first, the second, the eleventh and the twelfth. The first marginal is very short and wide, with a long free margin. The second marginal is boot-shaped, with a long medial process extending onto the nuchal plate and contacting the first vertebral scute. As a result, there is no contact between the first marginal scute and the first pleural scute. The eleventh and the twelfth marginals are mesiolaterally expanded, extending well onto the second suprapygal (Fig. 2e, f).

The plastron is complete, but the surface is worn, so some sutures and most sulci are not discernible. The plastron is sutured to the carapace. The anterior lobe is long and triangular in shape, extending slightly beyond the anterior margin of the carapace. It is longer than the posterior lobe. The bridge is long, being clearly longer than the anterior lobe. The posterior lobe is short and narrow; and its end is far anterior to the posterior end of the carapace. The base of the posterior lobe is slightly narrower than the base of the anterior lobe. The epiplastron has a long midline suture. The hyoplastron is slightly longer than the hypoplastron in the bridge region. The contact suture of the hyoplastron with the fifth and sixth peripherals; and that of the hypoplastron with the seventh and eighth peripherals are visible on the left side. The xiphoplastron is long, with a straight xiphoplastron/hypoplastron suture which is close to the inguinal notch. The only preserved sulcus, the abdomino-femoral sulcus, is mostly straight with the lateral end turning posteriorly, lying anterior to the inguinal notch as in other nanhsiungchelyids.

2.b. Comparisons and discussion

NHMG 010415 is assigned to the family Nanhsiungchelyidae on the basis of the following combination of characters: the large-celled sculpture on the shell surface, a complete series of neurals, the plastron sutured to the carapace, the long bridge and the well-developed anterior lobe of the

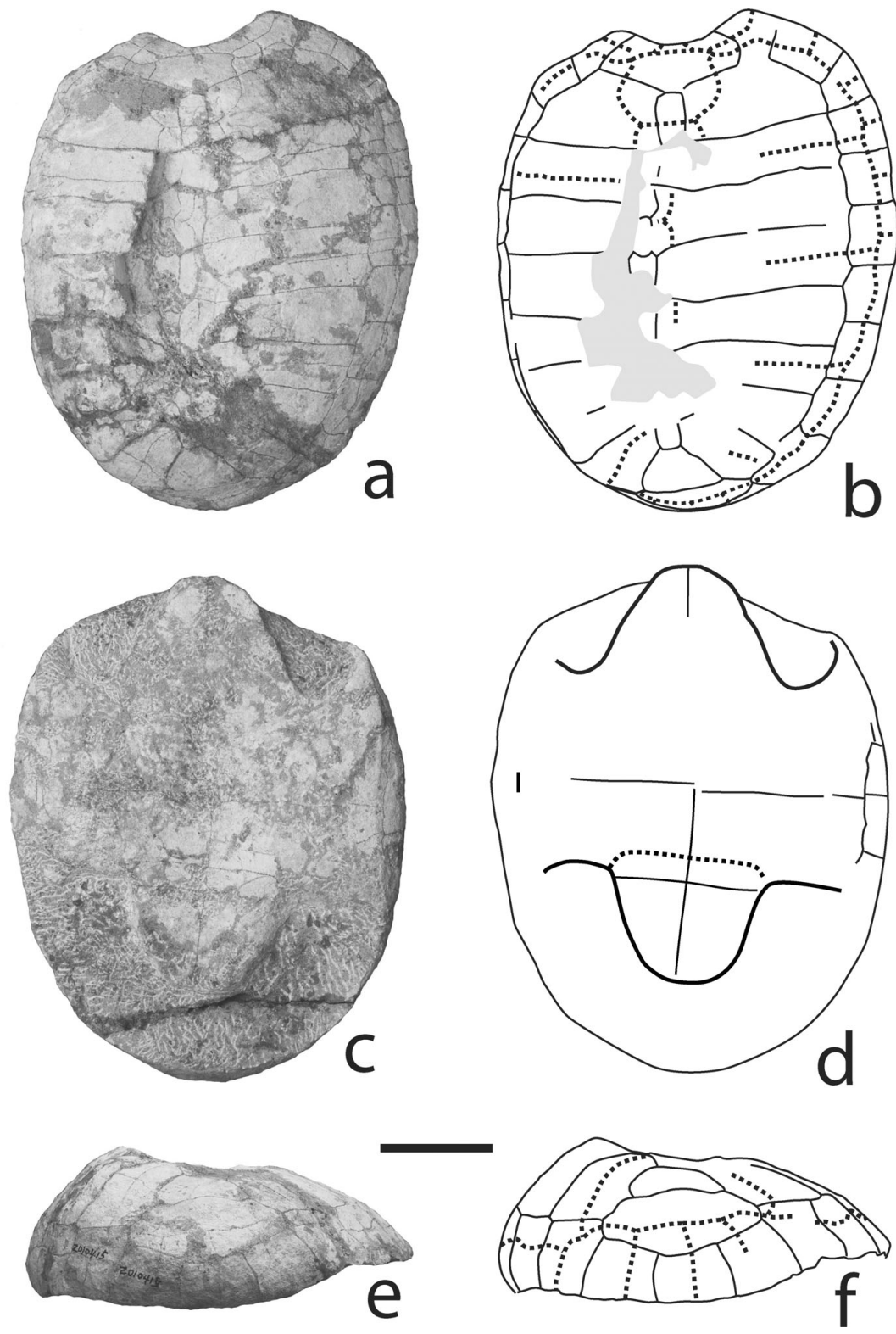


Figure 2. *Jiangxichelys ganzhouensis* n. g. n. sp. (Holotype, NHMG 010415) from the Late Cretaceous of Ganzhou, Jiangxi Province, China. (a, b) carapace in dorsal view; (c, d) plastron in ventral view; (e, f) carapace in posterior view. Scale bar: 10 cm.

plastron. The complete neural series reaching the suprapygal in our specimen is different from Adocidae. The family Nanhsiungchelyidae consists of five genera in Asia and one genus in North America. The Asian taxa include *Nanhsiungchelys wuchingensis* from the latest Cretaceous of Guangdong, China (Ye, 1966), *Zangerlia* from the

Late Cretaceous of Mongolia and Inner Mongolia, China (Mlynarski, 1972; Brinkman & Peng, 1996; Sukhanov, 2000; Joyce & Norell, 2005; Sukhanov & Narmandakh, 2006), *Hanbodgechelys orientalis* from the late Turonian–early Santonian of Eastern Gobi, Mongolia (Sukhanov & Narmandakh, 1977; Sukhanov, 2000; Sukhanov & Narmandakh, 2006),

Anomalochelys angulata from the Cenomanian of North Japan (Hirayama *et al.* 2001), and *Kharakhutulia kalandadzei* from the Cenomanian–early Turonian of eastern Mongolia (Sukhanov, Danilov & Syromyatnikova, 2008). An additional taxon, *Bulganemys jaganchoboli* Sukhanov & Narmandakh, 2006, is considered as a species of *Hanbodgemys* in a recent review (Danilov & Syromyatnikova, 2008), an opinion we follow here.

Anomalochelys and *Nanhsiungchelys* differ from NHMG 010415 in their larger size, in the very deep cervical notch and triangular first vertebral scute which is very narrow anteriorly. In addition, the cervical notch of *Anomalochelys* is formed only by the nuchal.

Both *Kharakhutulia* and *Basilemys* have a very shallow cervical notch which is different from the large and well-marked notch in NHMG 010415. *Kharakhutulia* differs from NHMG 010415 in its smaller size, and in the trapezoidal first vertebral scute that is wider anteriorly and extends onto the first peripheral plate. The plastron is wide and short, with a short anterior lobe which does not extend up to the anterior margin of the carapace and a very wide posterior lobe. *Basilemys* differs from NHMG 010415 in its small cervical scute, smaller first suprapygal plate, and the mesiolaterally expanded peripherals. The plastron is larger, with a longer bridge and wider posterior lobe in comparison with NHMG 010415 (Riggs, 1906; Hay, 1908; Langston, 1956; Mlynarski, 1976).

Zangerlia contains four species (*Z. testudinomorpha* Mlynarski, 1972; *Z. neimongolensis* Brinkman & Peng, 1996; *Z. ukhaachelys* Joyce & Norell, 2005 and *Z. dzamynchondi* Sukhanov & Narmandakh, 2006). In this genus, the posterior lobe of the plastron is wide and short (*Z. ukhaachelys*) to very short (*Z. testudinomorpha* and *Z. neimongolensis*), different from the relatively long and narrow plastron of NHMG 010415. In addition, in *Z. testudinomorpha* and *Z. dzamynchondi*, the hypoplastron is shortened and does not contribute to the posterior lobe. The anterior end of the carapace is known only in *Z. dzamynchondi*. It has a deep and narrow cervical notch, which is different from that of NHMG 010415. *Zangerlia* is likely a paraphyletic group, since the deep cervical notch on the carapace, as seen in *Z. dzamynchondi*, does not seem consistent with the relatively small skull which has a deep temporal emargination, as known in *Z. neimongolensis*. Hirayama *et al.* (2001) recognized two distinct types in the family Nanhsiungchelyidae: the first has a relatively large skull with a weak temporal emargination (*Nanhsiungchelys* (Ye, 1966)), and the second shows a much smaller skull with a distinct temporal emargination (*Zangerlia neimongolensis* (Brinkman & Peng, 1996), *Basilemys* (Langston, 1956; Brinkman, 1998)). It is worth noting also that the first type (large skull with weak temporal emargination) is associated with a carapace which has a deep cervical notch, while the second type (a much smaller skull with a distinct temporal emargination) is usually associated with a carapace which has a weak cervical notch. Thus the four species of *Zangerlia* probably belong to two distinct groups.

Among nanhsiungchelyids, NHMG 010415 most resembles *Hanbodgemys orientalis* in having a wide and well-marked cervical notch, a vase-shaped first vertebral, very narrow second to fourth vertebrae and a long triangular anterior lobe of the plastron. *H. jaganchoboli* is based on an incomplete carapace and bridge region of the plastron. Its general morphology is similar to that of *H. orientalis*, but the size is smaller (Sukhanov, 2000; Danilov & Syromyatnikova, 2008). In addition, NHMG 010415 shares with the two species of *Hanbodgemys* the very wide and short first marginal scute, with a long free margin. However, the

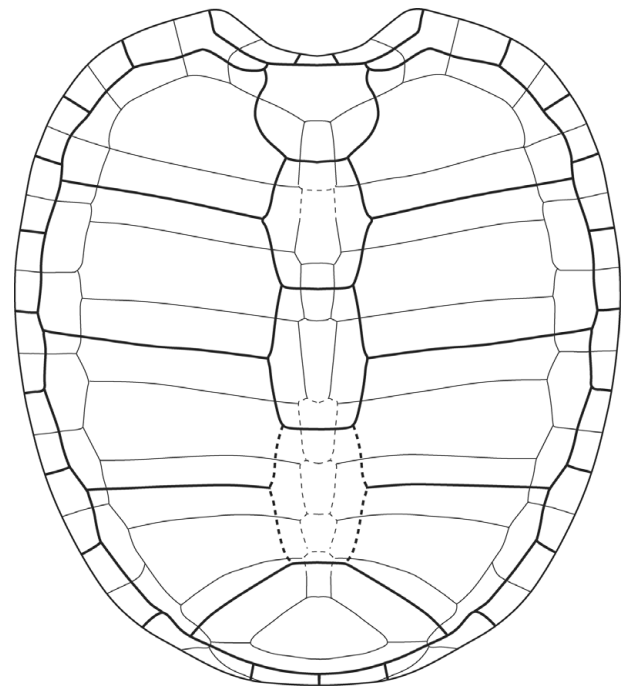


Figure 3. Reconstruction of the carapace of *Jiangxichelys ganzhouensis* n. g. n. sp.

second marginal scute of NHMG 010415 is boot-shaped, with a long medial process reaching the first vertebral scute and preventing the contact between the first marginal and the first pleural scute. This morphology is unique among nanhsiungchelyids and considered here as an autapomorphic feature. In *Hanbodgemys jaganchoboli*, the boot-shaped second marginal is present only on the right side, while the left second marginal has a normal rectangular shape (Sukhanov, 2000, fig. 17.24); it is thus considered here as an anomaly. The similar first and second marginal scute pattern is also known in *Basilocheilus macrobios*, a basal trionychoid from the latest Jurassic–earliest Cretaceous Phu Kradung Formation of NE Thailand (Tong *et al.* 2009). However, *Basilocheilus* is much larger, with a carapace length up to 90 cm, and the general shape of its carapace, and particularly the plastron is very different. In addition, NHMG 010415 differs from *Hanbodgemys* in the larger first suprapygal relative to the second suprapygal. This is considered here as a primitive feature among nanhsiungchelyids, found also in *Zangerlia testudinomorpha* (Mlynarski, 1972). In both species of *Hanbodgemys*, *Zangerlia neimongolensis* (Brinkman & Peng, 1996) and *Basilemys variolosa* (Langston, 1956), the first suprapygal is much smaller than the second. NHMG 010415 also differs from *Hanbodgemys* in the narrower lateral marginals, which cover less than half the width of the peripheral plates. In *Hanbodgemys orientalis*, ‘the pleura-marginal sulcus probably coincides with the costo-peripheral suture’ (Sukhanov, 2000, p. 343). In *H. jaganchoboli*, the marginals cover more than two thirds of the width of the peripheral. NHMG 010415 has a large triangular fifth vertebral scute which extends onto the tenth peripheral. This is different from the small and rounded fifth vertebral of *Hanbodgemys orientalis* and *H. jaganchoboli* which is included in the second suprapygal posteriorly. The large and triangular fifth vertebral is present also in *Zangerlia testudinomorpha*, *Basilemys variolosa* and *B. sinusosa*; but only in *Basilemys* this scute extends onto the tenth peripheral like in NHMG 010415. Although the plastron of NHMG 010415 did not deliver much detail

Table 2. Comparison between *Jiangxichelys ganzhouensis* n. g. n. sp. and other nanhsiungchelyids

Characters/taxon	NHMG 010415	<i>Hanbodgemys</i>	<i>Zangerlia</i> ¹	<i>Nanhsiungchelys</i>	<i>Anomalocheilus</i>	<i>Kharakhutulia</i>	<i>Basilemys</i>
Cervical notch	Wide and large, formed by nuchal and peripheral 1	Wide and large, formed by nuchal and peripheral 1	?	Deep, formed by nuchal and peripheral 1	Very deep, Formed by nuchal only	Very shallow, formed by nuchal and peripheral 1	Very shallow, formed by nuchal and peripheral 1
Anterior margin of peripheral 1 angled	Yes	Yes	?	Yes	No	No	No
Suprapygal 1	Large	Small	Large	?	?	?	Small
Vertebral 1	Vase-shaped	Vase-shaped	Trapezoidal, wide anteriorly	Trapezoidal, narrow anteriorly	Triangular, narrow anteriorly	Trapezoidal, wide anteriorly	Oval or sub-rectangular
Vertebral 5	Large, triangular, extending onto peripheral 10	Rounded, included in suprapygal 2 posteriorly	Large, triangular, reaching peripheral 10	?	Large, reaching peripheral 10	?	Large, triangular, extending onto peripheral 10
Marginal 1/ pleural 1 contact	Absent	Present	?	Present	Present	Present	Present
Marginal 2	Boot-shaped, reaching vertebral 1	Rectangular	?	Rectangular	Rectangular	Rectangular	Rectangular
Lateral marginals	Less than half peripheral width	As wide as peripherals	As wide as peripherals	As wide as peripherals?	?	Slightly narrower than peripherals	About one third peripheral width
Anterior lobe	Triangular and long, extending beyond the carapace front margin	Triangular and long, extending up to the carapace front margin	Trapezoidal, extending beyond the carapace front margin	Triangular, not extending beyond the carapace front margin	?	Wide and short, not extending to the carapace front margin	Triangular, extending beyond the carapace front margin
Posterior lobe	Narrow with rounded posterior end	Wide and sub-rectangular in shaped	Short and trapezoidal in shape	?	?	Wide and short	Trapezoidal in shape

¹*Zangerlia dzamynchondi* is not included.

on morphology of the scutes and some plates, its whole shape is quite different from that of *Hanbodgemys orientalis*, except for the shape of the anterior lobe. The base of the anterior lobe in NHMG 010415 is slightly wider than the base of the posterior lobe, in contrast to *H. orientalis*. In addition, the posterior lobe of NHMG 010415 is narrower and longer than that of *H. orientalis*. The comparison between NHMG 010415 and other nanhsiungchelyids is summarized in Table 2. The reconstruction of the carapace is shown in Figure 3.

3. Conclusions

In conclusion, a new genus and new species of Nanhsiungchelyidae is erected: *Jiangxichelys ganzhouensis* n. g. n. sp. It is characterized by a combination of primitive and apomorphic features and close to *Hanbodgemys*, thus nested in the clade composed of *Hanbodgemys*, *Nanhsiungchelys* and *Anomalocheilus* (Hirayama *et al.* 2001). The relatively high domed carapace and the long anterior lobe of the plastron extending beyond the anterior margin of the carapace which are reminiscent of some land tortoises, indicate that *Jiangxichelys* probably had a terrestrial lifestyle like other nanhsiungchelyids. The family Nanhsiungchelyidae was a successful group of land turtles during the Late Cretaceous in Asia; most of them are concentrated in Mongolia (Danilov & Syromyatnikova, 2008; Sukhanov, Danilov & Syromyatnikova, 2008). In southern China, in addition to *Nanhsiungchelys wuchingensis*, a nanhsiungchelyid turtle close to *Anomalocheilus* was reported recently from the Latest Cretaceous of Nanxiong Basin (Hirayama *et al.* 2009). The discovery of *Jiangxichelys ganzhouensis* adds a new element to the poor record of nanhsiungchelyids from southern China, and demonstrates the diversity of the family in that area.

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