

# The turtle *Xinjiangchelys radiplicatoides* BRINKMAN et al., 2013 (Reptilia: Testudines) from the Lower Qigu Formation (Upper Jurassic) of Liuhuanguo, Xinjiang, People's Republic of China

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## Abstract

A small turtle specimen consisting of a partial plastron and fragments of the carapace is described from the Lower Qigu Formation of Liuhuanguo, Xinjiang Uygur Autonomous region, People's Republic of China. It is the stratigraphically oldest vertebrate find from this important locality which has yielded a highly diverse vertebrate fauna, a short review of which is provided. The specimen shows great similarity to *Xinjiangchelys radiplicatus* (YOUNG & CHOW, 1953) from the Middle/Upper Jurassic of Sichuan. It is even more similar to *Xinjiangchelys radiplicatoides* (BRINKMAN et al. 2013) recently described from the Upper Shishugou Formation of Pingfengshan in the Central Junggar Basin, and is accordingly referred to that species. The xinjiangchelyid turtle fauna of the Qigu Formation at Liuhuanguo contains at least 4 different taxa, *X. radiplicatoides* BRINKMAN et al. 2013, *X. chowi* MATZKE et al., 2005, *X. qiguensis* MATZKE et al., 2004 and an as yet unnamed species from the turtle-amphibian-archosaur assemblage. Although this appears to be a comparatively high diversity, all these taxa have so far only been found in different stratigraphic levels spanning almost 200 m of sediment thickness. As xinjiangchelyid turtles are the most common macrofossils of the Qigu Formation in the southern Junggar Basin they may have some biochronological value. Both *X. radiplicatoides* and *X. chowi* are now known from Upper Jurassic strata of both the southern and central Junggar Basin, indicating that faunistic similarities between these areas were present.

**Key words:** Testudines, Jurassic, Xinjiang, Junggar Basin, *Xinjiangchelys*.

## 1. Introduction

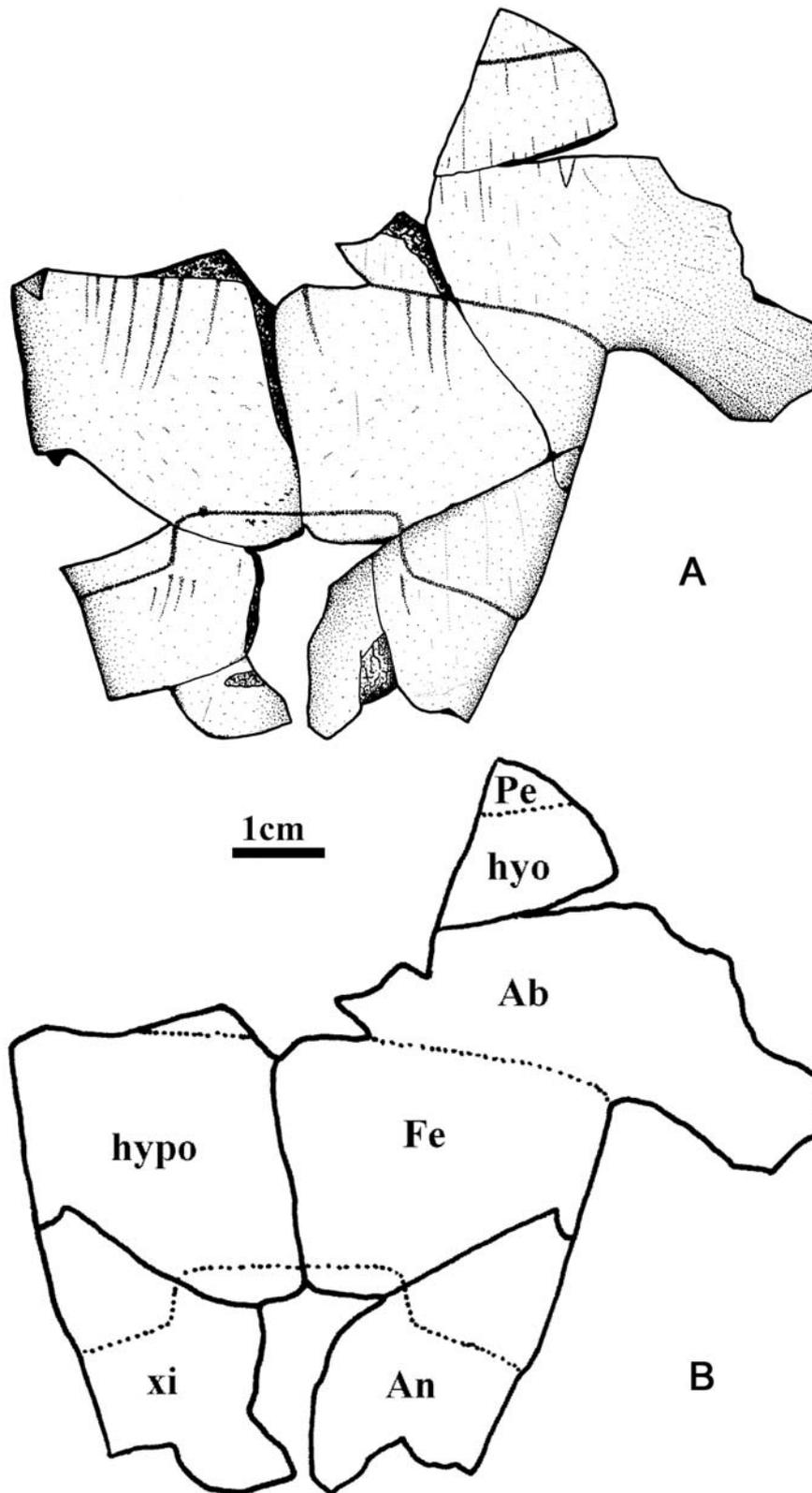
Central Asia has most probably played a very crucial role in the early evolution of eucryptodiran turtles during the later half of the Mesozoic. A large number of taxa, some of them represented by exceptionally well-preserved material, has been described from many localities including the Junggar and Turpan basins of the Xinjiang Uygur Autonomous Region in north-western China (see BRINKMAN et al. 2013; RABI et al. 2010, 2013, 2014 for recent reviews).

Among the most common turtles of the later half of the Jurassic are the speciose but little understood xinjiangchelyids, which may in fact represent a paraphyletic “grade” of early eucryptodires rather than a monophyletic taxon (BRINKMAN et al. 2013; RABI et al. 2013).

The diversity of xinjiangchelyids is high in the Junggar Basin. Single localities are very often dominated by single species, whereas separate localities tend to have different species (BRINKMAN et al. 2013). The specimen described here, represented by a very incomplete shell, was partially figured and briefly mentioned in previous publications (MAISCH et al. 2001, 2003, 2004b), where it was attributed to *Xinjiangchelys* cf. *radiplicatus* (YOUNG & CHOW, 1953). It is from the middle part of the Qigu Formation (Upper Jurassic) sensu PFRETZSCHNER et al. (2005) of Liuhuanguo, SW of Urumqi in the southern Junggar

Basin, a locality most famous for its diverse assemblage of fossil mammals (MARTIN et al. 2010). It currently represents the stratigraphically oldest determinable vertebrate specimen from that locality, the fossil vertebrate record of which encompasses more than 500 meters of continental redbed sediments in total, which likely represents a rather long time period (MAISCH et al. 2001, 2003).

In light of the new discoveries of well-preserved Upper Jurassic xinjiangchelyid material in both the Junggar and Turpan basins (BRINKMAN et al. 2013; RABI et al. 2013) it appears worthwhile to re-investigate the specimen and to provide a more detailed description of it. As will be demonstrated below, the specimen described here is of particular interest as it represents a species only recently recorded from the Upper Shishugou Formation (Upper Jurassic) of Pingfengshan in the Wucuiwan field area of the central Junggar Basin, *Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013). As BRINKMAN et al. (2013) have already demonstrated the presence of another Liuhuanguo taxon, *Xinjiangchelys chowi* MATZKE et al., 2005, at Pingfengshan, this, in combination with the new determination reported here, strengthens the faunistic links between the Upper Jurassic tetrapod faunas of the southern and central Junggar basin, which so far have been commonly interpreted as rather different (e. g., MAISCH et al. 2004b)



**Fig. 1.** *Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013), SGP 2001/34, from the Middle Qigu Formation (Upper Jurassic) of Liuhuanggou, SW of Urumqi, Xinjiang Uygur Autonomous region, People's Republic of China. Incomplete plastron in ventral view. Scale bar of all figures is 10 mm.

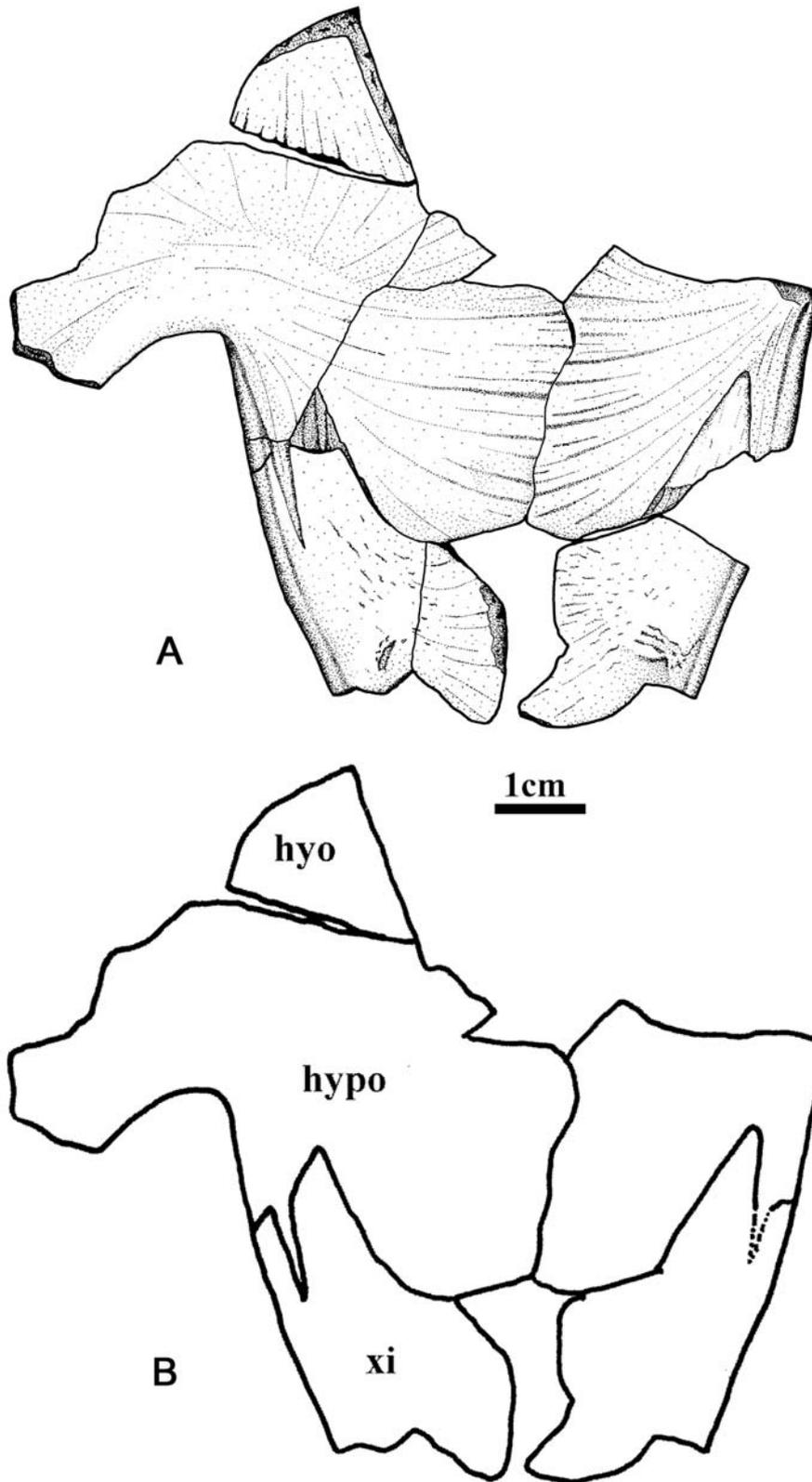


Fig. 2. *Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013), SGP 2001/34, incomplete plastron in dorsal view.

### Abbreviations

SGP: Sino-German Project. Material property of the People's Republic of China, currently housed for study at the Geosciences Department of Tübingen University. ab – abdominal; an – anal, fe – femoral; hyo – hyoplastron; hypo – hypoplastron; pe – pectoral; p.s. – pleural sulcus; xi – xiphoplastron.

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## 2. Systematic palaeontology

Testudines BATSCH, 1788

Pancryptodira JOYCE, PARHAM & GAUTHIER, 2004  
(following PÉREZ-GARCÍA et al. in press)

Xinjiangchelyidae NESSOV in KAZNYSHKIN et al., 1990

Genus *Xinjiangchelys* YE, 1986a

Type species: *X. junggarensis* YE, 1986a

Included species: *X. junggarensis* YE, 1986a, *X. radiplicatus* (YOUNG & CHOW, 1953), *X. latimarginalis* (YOUNG & CHOW, 1953), *X. tianshanensis* (NESSOV, 1995), *X. qiguensis*

MATZKE et al., 2004, *X. chowi* MATZKE et al., 2005, *X. radiplicatoides* BRINKMAN et al. 2013, *X. wusu* RABI et al. 2013. The species *X. levensis* and *X. latiens* have recently been re-referred to a separate genus, *Annemys* (RABI et al. 2014) on a firm osteological and phylogenetic basis.

*Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013)

Figs 1–5, Pls. 1–2

Material: SGP 2001/34 (Figs. 1–5, 6C, Pl. 1, Figs. 1–4), incomplete posterior half of a plastron, five fragmentary costals and three articulated peripherals, found about 350 meters above the Toutunhe-Qigu boundary (sensu PFRETZSCHNER et al. 2005); questionably also SGP 2001/35, an isolated costal fragment, found about 470 m above the Toutunhe-Qigu boundary in the turtle-amphibian-archosaur assemblage (see MAISCH et al. 2003, referred to as TAAA below), Liuhuanggou, Southern Junggar Basin, Xinjiang Uygur Autonomous Region, People's Republic of China (see Fig. 6A, B).

## 3. Description

Plastron: Much of the posterior portion of the plastron is preserved (Figs. 1–2, Pl. 1, Fig. 1). The xiphoplastra are incomplete, but enough of the anal sulcus is preserved to demonstrate that it extended onto the hypoplastra, as is typical for most xinjiangchelyids (RABI et al. 2013, 2014). It has a characteristic omega-shape, just as in *X. radiplicatus*, *X. radiplicatoides*, *X. latimarginalis*, *X. wusu* as well as in *Annemys latiens* and *A. levensis*

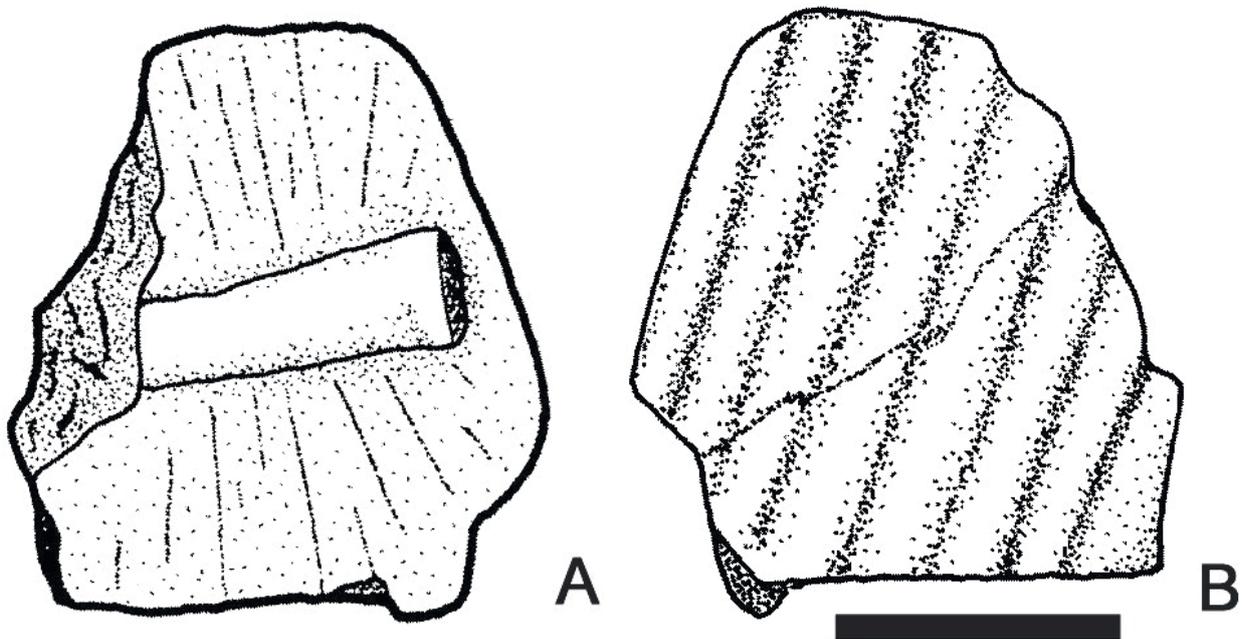
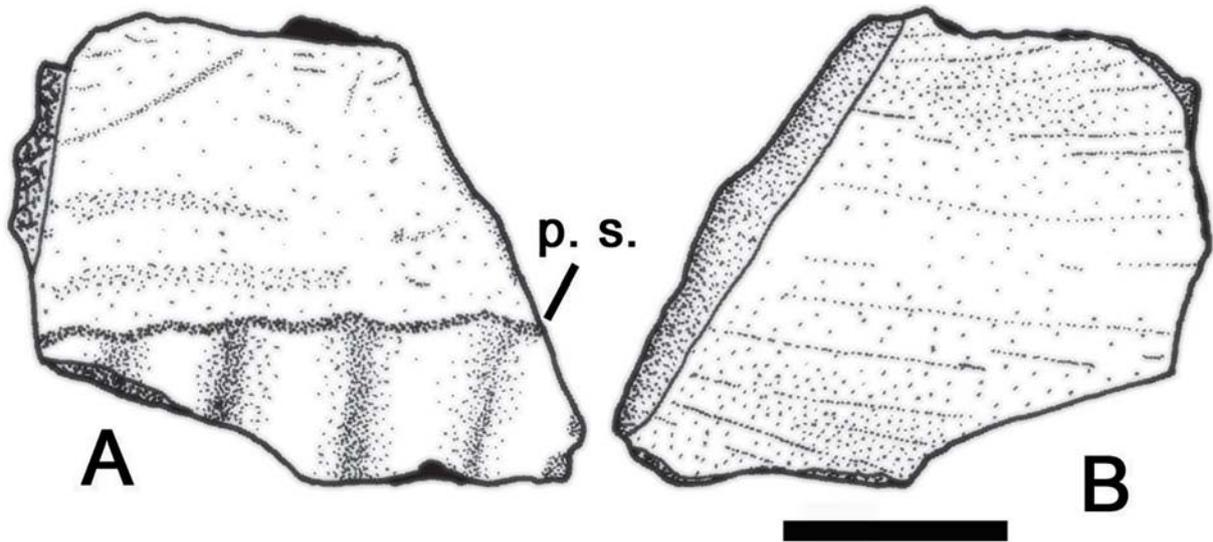


Fig. 3. *Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013), SGP 2001/34, incomplete costal, probably median portion of right second costal, in A: ventral, B: dorsal view.

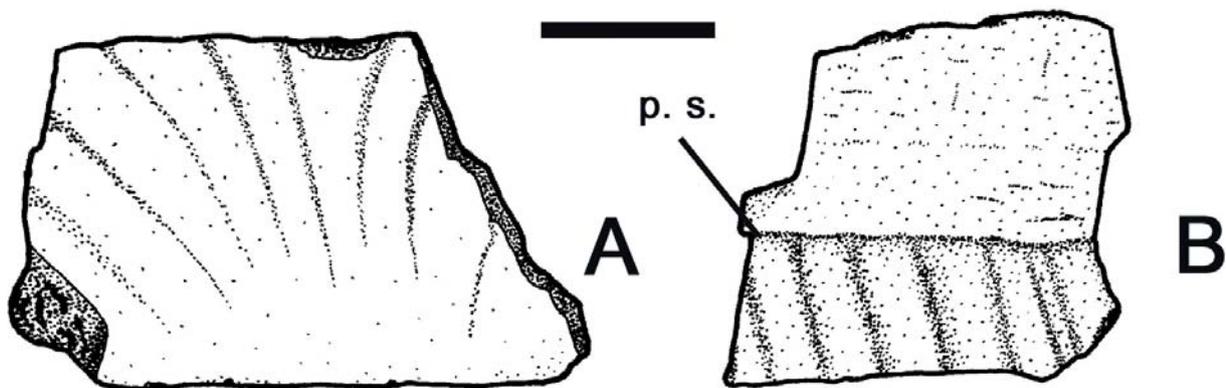


**Fig. 4.** *Xinjiangchelys radiplicatooides* (BRINKMAN et al., 2013), SGP 2001/34, incomplete costal, possibly lateral portion of right fourth costal, in A: dorsal and B: ventral view.

(RABI et al. 2014). The anterior process of the xiphiplastron noted to be a characteristic feature of most xinjiangchelyids by MATZKE et al. (2004) is well developed. In dorsal view (Fig. 2) it can be seen that there are actually two xiphiplastral processes that enclose a posterior projection of the hypoplastron. There is no indication that mesoplastral elements were present in the specimen, however, the bridge is incomplete on both sides. The femoral sulcus is rather straight but slightly obliquely oriented, similar to most *Xinjiangchelys* species, including *X. radiplicatooides*, but very different from the almost transversely running sulcus of *X. qiguensis*. The inguinal process, although slightly incomplete around the edges, seems to have been rather short and stout, just as in *X. radiplicatus*, *X. radiplicatooides* or *X. wusu*, but very different from *X. qiguensis*

(compare MATZKE et al. 2004; BRINKMAN et al. 2013; RABI et al. 2013).

**Costals:** there are 13 fragments of costals that appear to represent nine different costal elements (Pl. 2). It appears that left costals 1–5 and on the right side the costals 2, 4, 5 and 8 are partially preserved. The first left costal is represented by most of its lateral half. The dorsal surface is smooth. In ventral view the typical first costal rib shaft is visible. The costals two and four on both sides (Figs. 3–5, Pl. 1, Figs. 2–4, Pl. 2) are strongly sculptured on the dorsal side by narrowly spaced oblique ridges that are somewhat irregularly arranged. The remnants of rib heads and shafts on the underside of these elements (see Fig. 3B) indicate the positions of the fragments as medial or laterals parts of the costals (Pl. 2). Comparison makes it

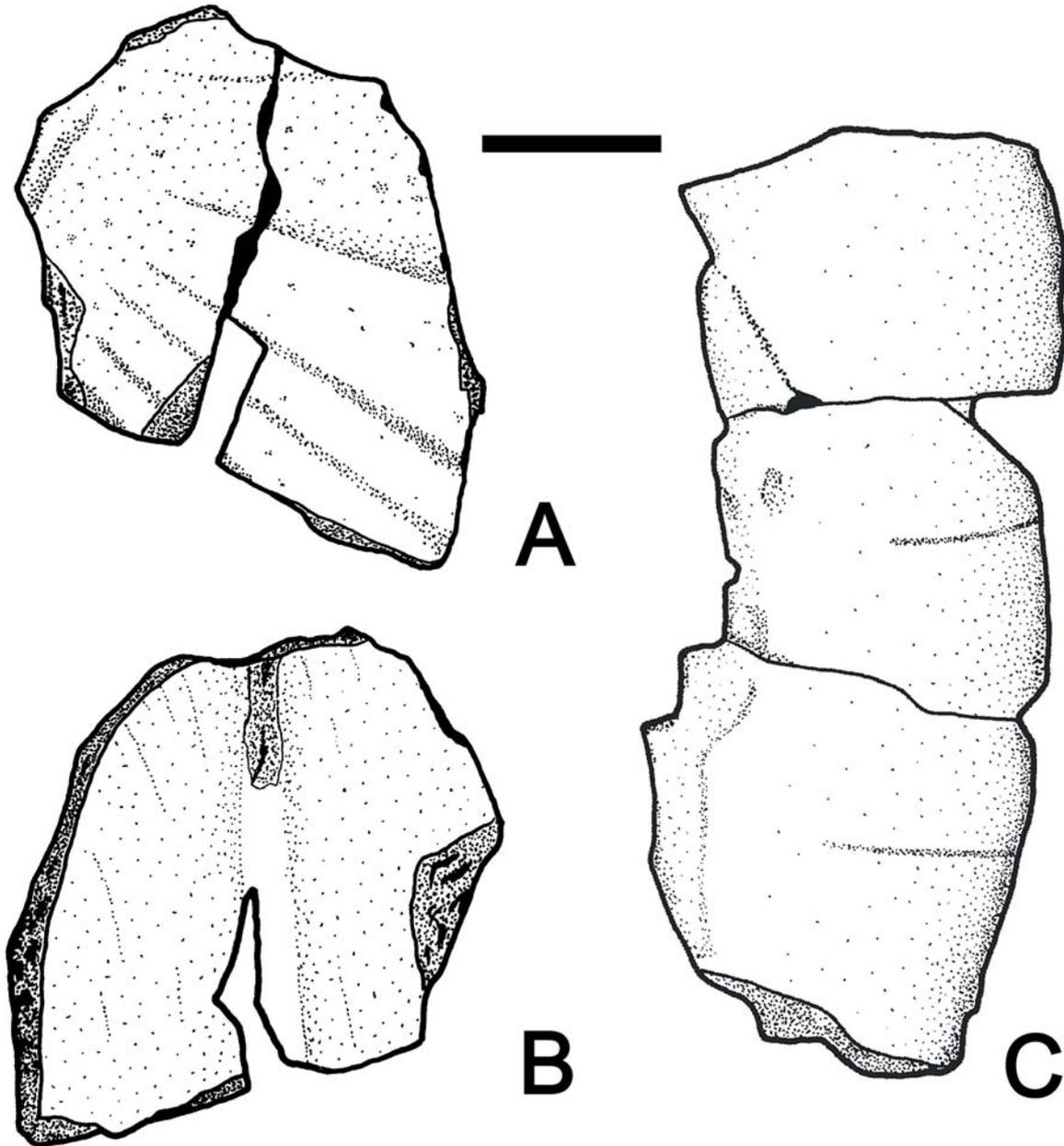


**Fig. 5.** *Xinjiangchelys radiplicatooides* (BRINKMAN et al., 2013), SGP 2001/34, two incomplete costals, A. possibly left costal 3, B: possibly left costal 4, in dorsal view.

likely that the laterally more sculptured fragments belong to the fourth costals, which is quite similar in both *X. radiplicatus* (Pl. 2) and *X. radiplicatoides*.

Few pleural sulci are visible in the posterior halves of the lateral parts of the second and fourth costals. The sulci separate the costals into a smooth anterior and a strongly sculptured posterior part (Figs. 4, 5A, Pl. 1 Figs. 3–4, Pl. 2). The elements here tentatively identified as first, third, fifth and eighth costals have a smooth dorsal surface (Pl. 2) as expected in these positions in the carapax.

**Peripherals:** In total 10 peripherals are preserved (Pl. 2). On the left side the peripherals 2–8 and on the right side the numbers 4–6. Peripherals 2–4 are narrow and have about half of the width of the posterior peripherals such as number seven or eight. This is a typical feature found in most species of *Xinjiangchelys*. There is no formation of a gutter-like lateral margin and the shape of none of the elements resembles a first peripheral of any known xinjiangchelyid. Shallow marginal sulci are seen on most of the elements, being slightly concave anteriorly.



**Fig. 6.** *Xinjiangchelys* ? *radiplicatoides* (BRINKMAN et al., 2013), SGP 2001/35, costal fragment from the turtle-archosaur-amphibian assemblage of Liuhuanggou in A: dorsal, B: ventral view. *Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013), SGP 2001/34, C: three articulated peripherals, possibly 7–9, in dorsal view.

Portions of shallowly impressed lateral marginal scute sulci are seen as well, indicating that the pleural scutes extended onto the peripherals.

#### 4. Discussion

Specimen SGP 2001/34 clearly shows the single apparent synapomorphy of the Xinjiangchelyidae as defined by RABI et al. (2013), namely anal scutes that extend onto the hypoplastra. This feature is not shown by all nominal species of *Xinjiangchelys* (MATZKE et al. 2004), and may be characteristic of a more inclusive group. However, the anal sulcus also has a characteristic omega-shape, just as in *X. radiplicatus*, *X. radiplicatooides*, *X. latimarginalis*, *X. wusu* and *Annemys*. (RABI et al. 2014). It therefore appears most likely that it represents a xinjiangchelyid turtle, although that clade remains poorly defined (RABI et al. 2013, 2014).

Of the numerous described species of *Xinjiangchelys* and related taxa, SGP 2001/34 agrees very closely with *Xinjiangchelys radiplicatus* (YOUNG & CHOW, 1953) from the Middle/Upper Jurassic of Sichuan. This taxon was originally described as *Plesiochelys radiplicatus*, based on a very incomplete specimen (YOUNG & CHOW 1953). Later, YE (1986b) described a more complete specimen, showing the structure of the carapace in more detail. KAZNYSHKIN (1988) referred the species to *Xinjiangchelys*, a genus erected by YE (1986b) on the basis of a specimen from the Middle Jurassic of the Jiangjunmiao area in the Junggar Basin.

Currently, there is current disagreement on the generic placement of *X. radiplicatus*. Whereas both BRINKMAN et al. (2013) and RABI et al. (2010) retain it in the genus *Xinjiangchelys*, TONG et al. (2012) recently proposed that it should better be referred to another xinjiangchelyid genus, *Chengyuchelys*. However, we decide here to follow the more conservative placement of the species in the genus *Xinjiangchelys*, as advocated e. g. by MATZKE et al. (2004), RABI et al. (2010) and BRINKMAN et al. (2013), until a more detailed analysis of xinjiangchelyid interrelationships (currently under way by M. RABI and co-workers) is available.

MATZKE et al. (2004) provided a provisional diagnosis of *Xinjiangchelys radiplicatus*: small turtle, reaching 250 mm carapace length, carapace pear-shaped with its broadest part in posterior third, lateral fontanelles between costals and peripherals, strong dorsal surface ornamentation, two ridges and one prominent groove between all scutes of the carapace, plastron with small inguinal process, anal scute reaches onto hypoplastron, forming an omega-shaped sulcus.

As far as it can be assessed, the specimen from Liuhuanguo shows most diagnostic features of *X. radiplicatus*. It is small (estimated total length not more than 250 mm), shows strong dorsal surface ornamentation and

the typical omega-shaped outline of the anal scute sulcus. The inguinal process of the plastron is incomplete, but appears to have been very similar to the material from Sichuan. It is therefore certainly understandable that the specimen was originally referred to *X. cf. radiplicatus* (MAISCH et al. 2001, 2003).

SGP 2001/34 differs from *X. radiplicatus*, however, in the lack of the characteristic strongly expressed double ridges and grooves of the carapace scutes (YE 1986b) and also in the generally finer sculpture of the carapace. In these respects, it agrees even more closely with a very recently described taxon, *X. radiplicatooides* BRINKMAN et al., 2013, a species based on very complete material from the Upper Shishugou Formation of Pingfengshan in the Wucaiwan field area in the central Junggar Basin.

As *X. radiplicatooides* is morphologically, stratigraphically and geographically extremely close to SGP 2001/34, we feel on safe ground to refer this specimen to *X. radiplicatooides* BRINKMAN et al., 2013 rather than *X. cf. radiplicatus*, as we did previously (MAISCH et al. 2001, 2003).

MATZKE et al. (2004) discussed the possibility that *X. radiplicatus* is a juvenile form, based on the presence of extensive lateral fontanelles in the carapace (YE 1986b). The strong sculpturing of the dorsal armour was also seen as a potentially juvenile feature. Although BRINKMAN et al. (2013) agreed with this suggestion concerning the lateral fontanelles at least in the case of the referred specimen of *X. radiplicatus* (YE 1986b), the plentiful material of *X. radiplicatooides* which they describe demonstrates that the dorsal surface sculpture of the carapace bones is indeed a relevant taxonomic feature in xinjiangchelyids.

Furthermore, except for one doubtful fragment from the Liuhuanguo bonebed (Fig. 5A–B) not a single specimen with the high degree of sculpturing shown by SGP 2001/34 has been discovered among the numerous turtle specimens from Liuhuanguo, which differ considerably in size among each other, it is even more probable to assume that the strong surface sculpture of the carapax is a genuine feature of the taxon.

As far as the limited material allows an assessment, the fauna of xinjiangchelyid turtles from Liuhuanguo contains at least three different taxa that so far each occur in one of three different stratigraphic levels. *X. radiplicatooides* is geologically the oldest. The single specimen, described above, was discovered approximately 105 meters below the mammal-bearing bonebed. The record from the mammal-bearing bonebed itself must be seen as doubtful at the moment, being based on a single carapace fragment. The holotype of *X. chowi* was excavated in the same area, but only about 55 meters below the bonebed, whereas the type specimen of *X. qiguensis* was discovered 60 meters above the bonebed.

*X. qiguensis* is still only represented by the type material, recently re-discussed and accepted as a valid species,

showing several unique postcranial features, by RABI et al. (2013). *X. chowi* has recently been reported from the Upper Shishugou Formation of Pingfengshan in the Wucaiwan area by BRINKMAN et al. (2013), who also accepted it as a valid species, although they cast some doubt on the diagnostic value of the plastral fontanelles that MATZKE et al. (2005) regarded as one of the most characteristic features of the taxon.

The occurrence of both *X. radiplicatoides* and *X. chowi* in more or less the same stratigraphic levels of the southern and central Junggar Basin, respectively, is certainly noteworthy.

Apart from these three clearly determinable taxa, there is a multitude of specimens, most of them unfortunately highly incomplete and indeterminate from several levels of the Qigu Formation (sensu PFRETZSCHNER et al. 2005) of Liuhuanguo. Most were discovered in the mammal-bearing bonebed, the directly underlying TAAA, or in the strata approximately 20 meters below and above that level.

These undescribed specimens contain a taxon that is characterised by strongly upturned lateral margins of the peripherals, a feature shown to a much lesser degree in other species of *Xinjiangchelys*, such as *X. junggarensis* (BRINKMAN & PENG 1993), *X. qiguensis* (MATZKE et al. 2004) and *X. wusu* (RABI et al. 2013). This taxon appears to occur only in the turtle-amphibian-archosaur assemblage and in the strata immediately (up to 15 meters) below.

The data available at present indicate, that the xinjiangchelyid turtles, which are by far the most conspicuous and common body-macrofossils of the Qigu Formation in the southern Junggar Basin, may in the future provide some biochronological potential. The restriction of certain species to certain stratigraphic levels at Liuhuanguo may, however, also reflect climatic and ecological changes. Further research is clearly needed to assess the relevance of the stratigraphic occurrence of the xinjiangchelyids at that locality and elsewhere in the Junggar Basin.

### 5. The fossil vertebrate fauna of Liuhonggou – a short synopsis

The rich fossil deposits of Liuhuanguo were discovered by us in 2000 (MAISCH 2003; MAISCH & STÖHR 2003; MAISCH et al. 2001, 2003). Since then, numerous papers have dealt with the fossil vertebrate fauna from several stratigraphic levels within the Qigu Formation (sensu PFRETZSCHNER et al. 2005) from that locality. MAISCH et al. (2004b) provided a faunal list of what at that time was considered as strata representing both the Toutunhe and Qigu formations, as MAISCH et al. (2003) placed the boundary between these two formation about 15 meters above the TAAA and mammal-bearing bonebed for good sedimentological reasons (to discuss these stratigraphic questions

is beyond the scope of this paper and will be done elsewhere). To facilitate discussion we use the boundary as proposed by PFRETZSCHNER et al. (2005) and ASHRAF et al. (2010), as it has become established in the more recent literature. Since then, numerous additional taxa have been recorded and previously recognised ones were described in more detail.

The stratigraphically oldest find at Liuhonggou is the specimen of *X. radiplicatoides* described above. It was discovered about 105 meters below the mammal-bearing bonebed, i. e. 350 meters above the Toutunhe-Qigu boundary sensu PFRETZSCHNER et al. (2005) (120 meters below the boundary sensu MAISCH et al. 2003). Higher up in the section, the type specimen of *X. chowi* (MATZKE et al. 2005) was recovered about 415 meters above the Toutunhe-Qigu boundary sensu PFRETZSCHNER et al. (2005, i.e. about 70 meters below the boundary sensu MAISCH et al. 2003). An incomplete skeleton of the crocodylomorph *Sunosuchus* sp. (MAISCH et al. 2003) was excavated from strata about 440 meters above the Toutunhe/Qigu boundary sensu PFRETZSCHNER et al. (2005, i. e. about 30 m below the boundary sensu MAISCH et al. 2003). Between these specimens and the TAAA- fauna, only fragmentary remains, were discovered, mostly of xinjiangchelyid turtles.

The TAAA contains a diverse tetrapod assemblage. It includes specimens of an as yet unnamed xinjiangchelyid with strongly guttered peripherals, as discussed above. Amphibians are represented by the temnospondyl *Gobiops desertus* SHISHKIN (MAISCH & MATZKE 2005), a late-surviving trematosauroid temnospondyl (MAISCH et al. 2004b) and a possible urodelan (SKUTCHAS et al. 2009). At least two different taxa of theropod dinosaurs (MAISCH & MATZKE 2003) are known. Ornithischians are represented by a stegosaurian tooth (already listed in MAISCH et al. 2004) and an indeterminate ornithischian tooth similar to the doubtful form-genus "*Ferganocephale*" (see AVERIANOV et al. 2005 and SULLIVAN 2006) which were described by WINGS et al. (2007a).

The bonebed on top of the TAAA contains the most diverse fauna. Most important are several taxa of fossil mammals (MAISCH et al. 2004b, 2005; PFRETZSCHNER et al. 2004, 2005; MARTIN et al. 2007, 2008, 2010). These include the allotherian *Sineleutherus uyguricus* (MAISCH et al. 2005; MARTIN et al. 2010), the docodonts *Dsungarodon zuoi* and *Tegotherium* sp. (PFRETZSCHNER et al. 2004, 2005; MARTIN et al. 2010), an unnamed eutriconodont and the amphitheriid *Nanolestes mackennai* (MARTIN et al. 2010). Further taxa recorded from the bonebed are the hybodontiform sharks *Jiaodontus montalissimus* and *J. vedenemus* (listed as *Polyacrodus* sp. nov. by MAISCH et al. 2004b), as well as *Hybodus* cf. *huangnidanensis* (listed as *Hybodus* sp. nov. by MAISCH et al. 2004b) (KLUG et al. 2010). *Palaeobates*-like teeth are equally known from the bonebed, but were not described by KLUG et al 2010 (cf.

MAISCH et al. 2004b). Squamates are represented by unidentified paramacellodids (RICHTER et al. 2010). A probable choristodere was reported by RICHTER et al. (2010) as well. Crocodylomorphs are represented by cf. *Sunosuchus* sp., *Nominosuchus* sp. and more indeterminate material (WINGS et al. 2010). A tooth of a theriosuchid-like form, reported by MAISCH et al. (2004b) remains undescribed.

Above the bonebed, in the classic redbed facies of the Qigu Formation which MAISCH et al. (2003) considered the Qigu Formation proper, the holotype of *X. qiguensis* was discovered (MATZKE et al. 2004), together with fragmentary remains of a medium-sized brachyopoid temnospondyl not referable to *Gobiops* (MAISCH & MATZKE 2005). These finds were discovered in close proximity in the same horizon about 60 meters above the mammal-bearing bonebed, 530 meters above the Toutunhe-Qigu boundary sensu PFRETZSCHNER et al. (2005; i. e. about 45 meters above the boundary sensu MAISCH et al. 2003). At almost the same stratigraphic level, but a bit lower in the section (about 35 meters above the boundary sensu PFRETZSCHNER et al. 2005) an accumulation dominated by dinosaurs has yielded remains of several taxa, including a well-preserved dorsal vertebra of a stegosaurid ornithischian (WINGS et al. 2007b).

It is certainly interesting to note, that whereas dinosaur fossils are very rare below the TAAA and mammal-bearing bonebed, they occur more frequently in the TAAA and bonebed and are also encountered more constantly in the higher levels of the Qigu Formation. The only exception to this observation are several theropod teeth, associated with the mutilated remains of a larger, undetermined dinosaur (MAISCH & MATZKE 2003), found about 80 meters below the mammal-bearing bonebed, i.e. 390 meters above the Toutunhe/Qigu boundary sensu PFRETZSCHNER et al. 2005). This distribution of dinosaur remains may indicate a slow change towards more dry conditions throughout the Qigu Formation, which were more favourable to sustain a dinosaurian fauna. This may indicate a slow change towards more dry conditions throughout the Qigu Formation, which were more favourable to sustain a dinosaurian fauna.

The dinosaurian material from the higher levels of the Qigu Formation so far include at least one stegosaurian (WINGS et al. 2007), a small and a large theropod (represented by as yet undescribed dental material), and a sauropod (represented by cranial and postcranial fragments). It is thus comparable in composition – although certainly not in diversity – to the dinosaur fauna of the Shishugou Formation of the central Junggar Basin, which consists of diverse theropods and sauropods and a single stegosaur species.

Even though this summary indicates a rich and diverse fauna, much remains to be learned about the fossil vertebrates of Liuhuanguo. The numerous actinopterygian

remains from the mammal-bearing bonebed and underlying TAAA have not received any scientific attention so far. The same is true for the remains of ceratodontid lungfish, pterosaurs and several crocodylomorph and dinosaurian taxa. From the higher levels of the Qigu Formation, only the type of *Xinjiangchelys qiguensis* (MATZKE et al. 2004) the sparse temnospondyl remains (MAISCH & MATZKE 2005) and the single stegosaurian specimen (WINGS et al. 2007) have been described so far. A single specimen of *Sunosuchus* sp. from a roughly coeval horizon, but different locality, about 15 km south of Liuhonggou, was described by SCHELLHORN et al. (2007a, b, 2009). A temnospondyl skull from the same locality was described by MAISCH & MATZKE (2005), but the numerous specimens of large xinjiangchelyid turtle similar to *Xinjiangchelys junngarensis* that we discovered there in 2002 (see SCHELLHORN et al. 2009) are still undescribed. These specimens originate from a horizon about 100 meters above the Toutunhe-Qigu-boundary sensu MAISCH et al. (2003), i.e. about 585 meters above the boundary sensu PFRETZSCHNER et al. (2005) and are therefore probably stratigraphically younger than the finds from Liuhuanguo. Further up in the section, only fragmentary material of dinosaurs, turtles and crocodylomorphs was found (MAISCH et al. 2003). The highest occurrence was recorded about 480 meters above the mammal-bearing bonebed. According to the measurements of ASHRAF et al. (2010), this falls within the Kalaza Formation, as they give a thickness of the Qigu Formation of 731 meters at Liuhuanguo. The sediments in which these remains were contained were still the typical Qigu redbeds, and the conglomerates and sandstones of the Kalaza Formation were only encountered about 180 meters further up in the stratigraphic section. Thus, there appears to be a serious discrepancy in the stratigraphy and a clarification would be much desirable. The most probable explanation is, that Dr. ASHRAF took his sections at somewhat different localities from us. There is also a considerable variation in lateral thickness in the Qigu Formation, even more pronounced due to the strong tectonics in the area (pers. obs.) These facts may easily account for the apparent discrepancies. A further discussion of these stratigraphic problems will be done elsewhere.

At any rate, this short summary underscores the importance of further vertebrate palaeontology studies in the area of Liuhuanguo, a locality which already has opened a hitherto unique window in the late Jurassic ecosystems of the southern Junggar Basin. The occurrence of two species of xinjiangchelyids, *X. radiplicatoides* and *X. chowi* within a stratigraphically restricted part of the Upper Jurassic strata of both the southern and central Junggar Basin certainly points out the faunistic and potential biochronological importance of these turtles, which form only one of the many aspects of the Liuhuanguo fossil vertebrate fauna.

## 6. References

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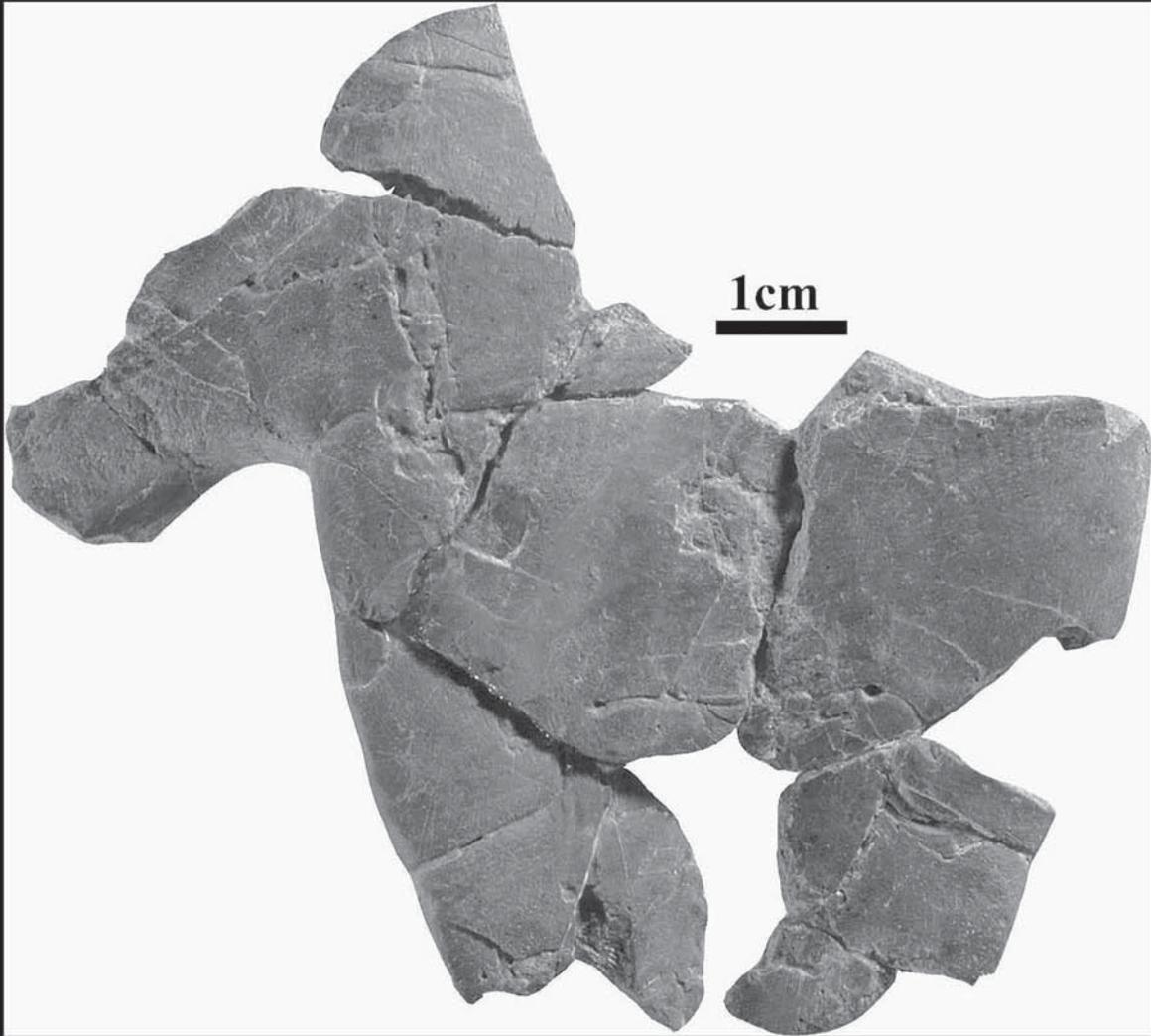
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**Plate 1**

**Fig. 1.** *Xinjiangchelys radiplicatoides* (BRINKMAN et al., 2013), SGP 2001/34, Middle Qigu Formation (Upper Jurassic), Liuhuanggou, Xinjiang Uygur Autonomous Region, People's Republic of China. Plastron in ventral view.

**Figs. 2–4.** Three costal fragments of the same individual, in dorsal view.



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**Plate 2**

*Xinjiangchelys radiplicatoides* (BRINKMAN, 2013), SGP 2001/34, Middle Qigu Formation (Upper Jurassic), Liuhuanguo, Xinjiang Uygur Autonomous Region, People's Republic of China. All carapax elements in dorsal view arranged on the drawing of *X. radiplacatus* from YE (1986b).

