NEW DATA ON THE SOFT-SHELLED TURTLES FROM THE UPPER CRETACEOUS KYRKKUDUK I LOCALITY OF SOUTHERN KAZAKHSTAN

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ABSTRACT
We re-examine one previously described trionychid specimen (a posterior part of a carapace formerly attributed to *Trionyx zakhidovi* Khosatzky, 1966) and describe additional trionychid shell material from the Upper Cretaceous (Santonian – ?Middle Campanian) Kyrkkuduk I locality (= Sary-Agach) in southern Kazakhstan. All material was collected by the Russian geologist and paleobotanist V.D. Prinada in the 1920s. Based on new observations and material, we refer much of the material from Kyrkkuduk I to “*Trionyx* kansaiensis” Vitek et Danilov, 2010, a shell taxon known from the Late Cretaceous of Tadzhikistan and Kazakhstan. The remaining material is assigned to a second trionychid taxon that is similar to some members of the tribe Trionychini from the Late Cretaceous of Asia, but is identified conservatively as Trionychidae indet. Thus, we confirm the presence of at least two forms of trionychids in the Kyrkkuduk I locality, as was previously proposed by earlier authors, although our taxonomic identifications differ. The newly referred material of “*Trionyx* kansaiensis” expands the geographic range of this species and provides new information about its morphology, especially the structure of the xiphiplastron and variation of the neurals.

Key words: Asia, Kazakhstan, Trionychidae, turtles, Upper Cretaceous

НОВЫЕ ДАННЫЕ О ТРЕХКОГТОННЫХ ЧЕРЕПАХАХ ИЗ ВЕРХНЕМЕЛОВОГО МЕСТОНАХОЖДЕНИЯ КЫРККУДУК I ЮЖНОГО КАЗАХСТАНА

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РЕЗЮМЕ
Мы переизучили один ранее описанный экземпляр (задняя часть карапакса, прежде относимая к *Trionyx zakhidovi* Khosatzky, 1966) и описываем дополнительный панцирный материал по трионихидам из верхнего мела (сантона – ?среднего кампана) местонахождения Кырккудук I (= Сары-Агач) в Южном Казахстане. Весь материал был собранны русским геологом и палеоботаником В.Д. Принадой в 1920-е годы. На основе новых наблюдений и материалов мы относим большую часть материала из Кырккудук I к “*Trionyx* kansaiensis” Vitek et Danilov, 2010, «панцирному» таксону, известному из позднего мела Таджикистана и Казахстана. Остальной материал относится ко второму таксону трионихид, который похож на некоторых членов трибы Trionychini из позднего мела Азии, но консервативно определяется как Trionychidae indet. Таким образом, мы подтверждаем присутствие, по крайней мере, двух форм трионихид в местонахождении Кырккудук I, предполагающееся предшествующими исследователями, хотя наши таксономические определения отличаются. Новый материал по “*Trionyx* kansaiensis” расширяет географическое распространение этого вида и дает новую информацию о его морфологии, особенно о строении ксифипластронов и изменчивости невральных пластинок.

Ключевые слова: Азия, Казахстан, Trionychidae, черепахи, верхний мел

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INTRODUCTION

The Trionychidae Gray 1825, or soft-shelled turtles, are a group of highly aquatic cryptodires (Meylan 1987). They first appeared in Asia in the Early Cretaceous (Aptian–Albian), then in North America in the Late Cretaceous (Cenomanian), and spread to most other continents in the Cenozoic (see review by Danilov 2005). The phylogeny and taxonomy of the group are still not entirely understood (Meylan 1987; Engstrom et al. 2004; Joyce and Lyson 2010). This is especially true for Cretaceous trionychids, which are important for understanding the early diversification and evolution of the family. Recently, Danilov and Vitek (2009; in press) published a review of all described and/or figured trionychid specimens from the Cretaceous of Asia. Those reviews demonstrated that only a few Asian Cretaceous taxa of trionychids are based on properly described and figured material, and even fewer of those recognized taxa are named species.

In this paper we redescribe one historical specimen (a posterior part of a carapace formerly attributed to Trionyx zakhidovi Khosatzky, 1966) and report on previously undescribed specimens from the Upper Cretaceous Kykkuduk I locality (= Sary-Agach; see Nessov 1997) in southern Kazakhstan (complete locality and age data are provided below) collected by the Russian geologist and paleobotanist V.D. Prinada in the 1920s. Based on new observations and material, we attribute some of the material to “Trionyx kansaiensis” Vitèk et Danilov, 2010, and identify a second trionychid taxon (Trionychidae indet.) from this locality.

History of study of trionychids from Kykkuduk I locality

Two forms of trionychids from the Kykkuduk I locality (Fig. 1) were reported by Prinada (1927). Plastomenus? jaxarticus nov. sp. (nomen nudum), Aspideretes jaxarticus nov. sp. (nomen nudum) and Aspideretes sp. (several forms) were mentioned but left undescribed by Riabinin (1938), who studied the collections made by Prinada. Khosatzky (1966), who studied the same collection, noted that it was difficult to establish what specimens correspond to what species names. In his paper, Khosatzky established Trionyx zakhidovi Khosatzky, 1966 based on a giant femoral bone (holotype) and a posterior part of a carapace from the Prinada’s collection. He also mentioned that the same collection contained several fragments of costals of large trionychids, which probably belong to T. zakhidovi.

Two new species, Paleotrionyx riabinini Kuznetsov et Chkhikvadze, 1987 and Trionyx riabinini Kuznetsov et Chkhikvadze, 1987, were described by Kuznetsov and Chkhikvadze (1987) from the Upper Cretaceous of Shakh-Shakh locality in Kazakhstan (Fig. 1). These authors noted that the generic attribution of T. zakhidovi is unclear, because the current state of knowledge does not allow distinguishing trionychid species by femoral bones. They also supposed that the posterior part of a carapace described by Khosatzky (1966), probably, belongs to T. riabinini. This opinion was shared by Kordikova (1991).

Later, two taxa of trionychids from Kykkuduk I locality (as Sary-Agach; lower part of Darbazar Svita) were listed as “probably, cf. Paraplastomenus riabinini” (Kuznetsov et Chkhikvadze, 1987), cf. Axestemys sp.” (Kordikova 1994). Thus, she proposed the correspondence of Plastomenus? jaxarticus and Aspideretes jaxarticus to Trionyx (as Paraplastomenus) riabinini and Paleotrionyx (as Axestemys) riabinini.

Nessov (1997, p. 107) also mentioned only two trionychid taxa from Kyrkkuduk I locality: “Trionyx” zakhidovi Khosatzky, 1966 and cf. Paraplastomenus sp. The name cf. Paraplastomenus sp. was used for the posterior part of a carapace described by Khosatzky (1966). Nessov (1997) also noted that trionychid remains, probably, come from the Syuk-Syuk Formation rather than from Darbaza Formation (= Darbazar Svita) as indicated by Kordikova (1994).

Chkhikvadze (2007) placed Trionyx zakhidovi in Trionychidae incertae sedis, although supposed its synonymy with Paleotrionyx (as Eurycephalochelys) riabinini based on large size.

Vitek and Danilov (2010) described new trionychid material from the Upper Cretaceous of Tadzhiistan and Kazakhstan (Kansai and Shakh-Shakh localities respectively; Fig. 1), which allow attribution of Trionyx riabinini to the genus Aspideretoides Gardner et al., 1995 and description of the new species “Trionyx” kansaiensis Vitek et Danilov, 2010; taxonomic assignment of Paleotrionyx riabinini was considered unclear. These authors (Danilov and Vitek 2009; Vitek and Danilov 2010) agreed with some previous researchers that the limb bones of trionychids are non-diagnostic below the family level and suggested that Trionyx zakhidovi be considered a...
nomen dubium within Trionychidae. In addition, the posterior part of a carapace described by Khosatzky (1966) was referred to as Trionychinae indet. 1 or Trionychinae gen et sp. indet. and considered similar to "Trionyx" kansaiensis (Danilov and Vitek 2009; in press; Vitek and Danilov 2010).

To summarize, although opinions about composition and attribution of trionychids from Kyrkkuduk I locality were expressed in many publications, the relevant material was described only in one of them (Khosatzky 1966) and has never been re-examined. In our paper we re-examine one previously described specimen and describe additional shell material from this locality.

Institutional abbreviations. CCMGE, Chernyshev's Central Museum of Geological Exploration, Saint Petersburg, Russia. ZIN PH, Paleohertpetological collection, Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia.

SYSTEMATICS

Trionychidae Gray, 1825
Trionychinae Gray, 1825
Trionyx Geoffroy, 1809 sensu lato
"Trionyx" kansaiensis Vitek et Danilov, 2010 (Fig. 2A–G)

Synonymy for Kyrkkuduk I material
Trionyx zakhidovi: Khosatzky 1966, p. 151, fig. 1 (part.).
Fig. 2. Trionychid specimens from the Kyrkkuduk I locality (photos): A–G – “Trionyx” kansaiensis: A –posterior part of carapace, CCMGE 522/1341, in dorsal view; B, C –partial costal 1, CCMGE 590/1341, in dorsal (B) and ventral (C) views; D –partial costals 7 and 8, CCMGE 589/1341, in dorsal view; E –costal 8, CCMGE 598/1341, in dorsal view; F –partial hypoplastron, CCMGE 441/1341, in ventral view; G –xiphiplastron, CCMGE 1341, in ventral view; H–J –Trionychidae indet.: H –partial costals 5 and 6, CCMGE 432/1341, in dorsal view; I –partial hypoplastron, CCMGE 343/1341, in ventral view; J –partial lateral hypoplastron, CCMGE 428/1341, in ventral view. Solid lines indicate sutures and dashed lines indicate inferred margins of bones. All specimens at same magnification.

Abbreviations: ar1 –attachment site of rib 1; c1, 6–8 –costals 1, 6–8; n7 –neural 7.

Trionychinae indet. 1: Danilov and Vitek 2009, p. 54.

Trionychinae gen. et sp. indet.: Vitek and Danilov 2010, p. 392.

Referred material. CCMGE 441/1341, partial hypoplastron; CCMGE 522/1341, posterior part of a carapace; CCMGE 589/1341, partial costals 7 and 8; CCMGE 590/1341, partial costal 1 (originally labeled as “Costal of a turtle of the Aspideretes ellipticus (?) like form”); CCMGE 598/1341, costal 8; CCMGE 1341 (the only number indicated on the specimen), xiphiplastron (originally labeled as “Chelonia, g. et sp. ind. Part of the plastron (xiphiplastron)”). All specimens come from the Kyrkkuduk I locality (= Sary-Agach; Riabinin 1938; = area of Kyrkkuduk Well; Danilov and Vitek 2009, in press), area about 2 km in length along the northern slope of Alymtau Ridge, 6–7 km south from the well and also 3–5 km south-west from the well, Circum-Tashkent Chul, South Kazakhstan Province, Syuk-Syuk Formation and, probably, the lower part of the Darbaza Formation, Santonian – ?middle Campanian (Nessov 1997).

Description. Sculpturing is identical to that of “Trionyx” kansaiensis from Kansai and Shakh-Shakh (Vitek and Danilov 2010, figs. 6, 7). Based on the posterior part of a carapace (CCMGE 522/1341; Fig. 2A), carapace length was as long as 70 cm. The outline of the posterior border of the carapace as visible in CCMGE 522/1341 is truncated, similar to “T.” kansaiensis (Vitek and Danilov 2010, fig. 3C). The medial margin of costal 1 (CCMGE 590/1341; Fig. 2B, C) does not indicate a preneural. In both CCMGE 522/1341 and CCMGE 589/1341 (a fragment of costals 7 and 8; Fig. 2D), both costals 7 and 8 meet at the midline, with costals 8 meeting fully. This arrangement indicates that there were only seven neurals. The anteromedial margin of a costal 8 (CCMGE 598/1341; Fig. 2E) is ambiguous as to whether there was a neural 8. Otherwise, it is similar to other material of “T.” kansaiensis in its large size and triangular shape (Vitek and Danilov 2010, fig. 6N).

A medial hypoplastron fragment (CCMGE 441/1341; Fig. 2F) has sculpturing identical to the carapace. Towards the medial margin the sculpturing fades away, leaving a wide, unsculptured medial border on the hypoplastron. This pattern is also similar to “Trionyx” kansaiensis (Vitek and Danilov 2010, fig. 6R, S).

A large, nearly complete xiphiplastron (CCMGE 1341, Fig. 2G) is referred to this species. It is narrow, has a relatively straight lateral margin, a very short medial process, and is covered by an unsculptured callosity. In these characters it is identical to a partial xiphiplastron from Kansai (Vitek and Danilov 2010, fig. 6U, V). This specimen was not referred to any species, but both it and the xiphiplastron from Kyrkkuduk I differ from the sculptured xiphiplastron of Aspideretoides riabinini that have rounded lateral margins (Vitek and Danilov 2010, fig. 4W, X).

Trionychidae indet.

(Fig. 2H–J)

Referred material. CCMGE 343/1341, partial lateral hypoplastron; CCMGE 425/1341 and 428/1341, partial lateral hypoplastra; CCMGE 432/1341, partial costals 5 and 6 (originally labeled as “Costals of Trionychidae of the Aspideretes foveatus-like form”). All specimens come from the Kyrkkuduk I locality (see above).

Description. Sculpturing is identical to that of Aspideretoides riabinini from Kansai and Shakh-Shakh, which is in pattern of thin connected ridges forming a honeycomb or netlike pattern (Vitek and Danilov 2010). Estimation of carapace length based on a partial costals 5 and 6 (CCMGE 432/1341; Fig. 2H) is approximately 40 cm. long, smaller than A. riabinini. The width and lateral outline of costals 5 and 6 indicate that both costals 7 and 8 made up the midline. It is probable that costals 8 were reduced.

A partial lateral hypoplastron (CCMGE 343/1341; Fig. 2I) shows the same type of sculpturing as the carapace. In addition, the lateral hyoplastral lobe is not significantly lengthened relative to the bridge, as it is in “Trionyx” kansaiensis (Vitek and Danilov 2010, fig. 3D).

A partial lateral hypoplastron (CCMGE 428/1341; Fig. 2J) is similar in shape to those of Aspideretoides riabinini (Vitek and Danilov 2010, fig. 4V) in having sculptured callosity which narrows distally, rather than being rounded as in “Trionyx” kansaiensis. CCMGE 425/1341 (not figured) is identical to CCMGE 428/1341 in morphology.

DISCUSSION

As was mentioned above the material from the Kyrkkuduk I assigned to “Trionyx” kansaiensis is similar to the originally described material of “T.”
Kansaiensis, a shell taxon previously known from the Late Cretaceous of Tadzhikistan and Kazakhstan (Vitek and Danilov 2010). Both groups of specimens share a similar pattern of sculpturing, outline of the posterior border of the carapace, and morphology of costals 8 and xiphiplastra (see Description). The only difference between them is the number of neurals: eight in the original material of "T. kansaiensis" and seven in the specimens from Kyrkkuduk I. Although neither collection of specimens contains enough complete material to demonstrate variation in neural count within a single locality, the character is known to be variable in extant trionychids (Meylan 1987). In fact, a close examination of neural count shows that a species is more likely to be variable in this character than invariable (Meylan 1987; Gardner and Russell 1994). Therefore, the differing number of neurals is more likely indicative of variation than of multiple species. The material from Kyrkkuduk I presents the first xiphiplastron that we can confidently assign to the species. The lack of sculpturing and smooth external surface on the xiphiplastral callosity is notably similar to the smooth sculpturing and smooth external surface on the xiphiplastra of *Oliveremys uintaensis* (Leidy, 1872) and *Axestemys byssina* Cope, 1872, both extinct trionychid species from North America (Vitek 2011, in press). The Kyrkkuduk I locality lies between Kan- sansai and Shakh-Shakh (Fig. 1), the two localities from which the original material of "T. kansaiensis" and seven in the specimens from Kyrkkuduk I. Although neither collection of specimens contains enough complete material to demonstrate variation in neural count within a single locality, the character is known to be variable in extant trionychids (Meylan 1987). In fact, a close examination of neural count shows that a species is more likely to be variable in this character than invariable (Meylan 1987; Gardner and Russell 1994). Therefore, the differing number of neurals is more likely indicative of variation than of multiple species. The material from Kyrkkuduk I presents the first xiphiplastron that we can confidently assign to the species. The lack of sculpturing and smooth external surface on the xiphiplastral callosity is notably similar to the smooth sculpturing and smooth external surface on the xiphiplastra of *Oliveremys uintaensis* (Leidy, 1872) and *Axestemys byssina* Cope, 1872, both extinct trionychid species from North America (Vitek 2011, in press). The Kyrkkuduk I locality lies between Kan- sansai and Shakh-Shakh (Fig. 1), the two localities from which the original material of "T. kansaiensis" was described. Thus, this new material not only improves our understanding of the morphology of this species, but helps fill in its geographic range.

Vitek and Danilov (2008) suggested that "Tri- onyx" kansasensis may belong to the skull-based genus *Khunnuchelys* Brinkman et al., 1993, based on two lines of evidence, namely that both taxa co-occur in the Bostobe Formation and are known from similarly large specimens. However in more recent publications we refrained from formally synonymizing the two taxa pending new discoveries and attributions of these forms. In this paper the collection of Prinada (CCMGE 1341) includes a number of undetermined shell fragments of trionychids. Some of them were labeled as "Aspi- deretes-like", and probably correspond to Riabinin's (1938) *Aspideretes* sp.

Thus, our study confirms presence of at least two forms of trionychids at Kyrkkuduk I, as was suggested by most previous authors (Prinada 1927; Riabinin 1938; Kuznetsov and Chkhikvadze 1987; Kordikova 1994; Nessov 1997; Chkhikvadze 2007), although our study disagrees with them in taxonomic attribution of these forms.

In addition to trionychid specimens described in this paper the collection of Prinada (CCMGE 1341) includes the giant femur (the holotype of *Trionyx zakhidovi*, see Introduction) most probably belongs to "T. kansasensis", because of its large size. However we repeat here our previous suggestion (Vitek and Danilov 2008; Danilov and Vitek 2009, Vitek and Danilov 2010; Danilov and Vitek in press) that the name *T. zakhidovi* be considered a nomen dubium within Trionychidae.

In addition to trionychids, the turtle assemblage of Kyrkkuduk I consists of the following taxa: Ado- cidae: *Shachemys* sp. (Danilov et al. 2011; formerly Dermatemydidae? gen. et sp. indet.: Riabinin 1938; *Shachemys babolatica* Kuznetsov, 1976; Nessov 1997); Lindholmemydidae: *Lindholmemyx* sp. (Nessov 1997; formerly Amphichelydia? (fam. Baenidae? gen. et sp. indet.): Riabinin 1938). Riabinin (1938) also mentioned from there two forms of "Chelonia incertae sedis". Examination of original labels of the Prinada’s collection (CCMGE 1341) reveals that the first form of Riabinin’s "Chelonia incertae sedis" was based on xiphiplastron (CCMGE 1341) attributed by us to "T. kansasensis" (see Referred material section on this species). The second form of Riabinin’s "Chelonia incertae sedis" probably was based on a pelvic fragment (without a number) labeled as “Chelonia g. indet.” This fragment represents the left half of a pelvis, consisting of articulated, proximal parts of the ilium, pubis and ischium. Because the ilium is curved posteriorly, which is a trionychid synapomorphy (Meylan 1987), this fragment certainly belongs to the Trionychidae, but the specimen cannot be identified any more precisely.
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