Proceedings of the Zoological Institute RAS
Vol. 313, No. 2, 2009, pp. 143–148

УДК 57.072:551.762

THE CO-OCCURRENCE OF NON-LISSAMPHIBIAN TEMNOSPONDYLS AND SALAMANDERS IN THE LATE JURASSIC OF THE SOUTHERN JUNGGAR BASIN (XINJIANG AUTONOMOUS REGION, NW CHINA)

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ABSTRACT

So far, the Jurassic co-occurrence of non-lissamphibian temnospondyls and early temnospondyl lissamphibians was known only for the Middle Jurassic Balabansai Svita in the Fergana Depression, Kyrgyzstan and the Peski Quarry near Moscow, Russia. Here we report the co-occurrence of non-lissamphibian temnospondyls and lissamphibians (salamanders) from the Late Jurassic (Oxfordian) Qigu Formation of the Liuhuanggou locality in the southern Junggar Basin, China. This represents a considerable temporal and geographical range extension for the non-lissamphibian temnospondyl-early lissamphibian faunal association.

Key words: Caudata, China, Jurassic, Qigu Formation, Temnospondyli

Submitted January 28, 2009; accepted March 31, 2009.

СОВМЕСТНОЕ НАХОЖДЕНИЕ НЕЛИССАМФИБИЙНЫХ ТЕМНОСПОНДИЛОВ И САЛАМАНДР В ПОЗДНЕЙ ЮРЕ ЮГА ДЖУНГАРСКОГО БАССЕЙНА (СИНЬЦЗЯН-УЙГУРСКИЙ АВТОНОМНЫЙ РАЙОН, СЗ КИТАЙ)

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РЕЗЮМЕ

До сих пор совместное присутствие нелиссамфибийных темноспондилов и ранних темноспондильных лиссамфибий в юре было известно только для среднеюрской балабансайской свиты в Ферганской долине, Киргизия и среднеюрского местонахождения Пески возле Москвы, Россия. В статье сообщается о совмест-

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ном присутствии нелиссамфибийных темноспондилов и ранних лиссамфибий (хвостатых амфибий) в позднеюрском (оксфорд) местонахождении Лиухуангоу, формация Кигу, южная часть Джунгарского бассейна, Китай. Эти данные значительно расширяют наши представления о временном интервале и географическом распространении фаунистической ассоциации нелиссамфибийных темноспондилов и ранних лиссамфибий.

Ключевые слова: Caudata, Китай, юра, формация Кигу, Temnospondyli

Представлена 28 января 2009; принята 31 марта 2009.

INTRODUCTION

The Jurassic continental vertebrate faunas of Laurasia are characterized by the retention of relic non-lissamphibian temnospondyls which survived the end of the Triassic and the appearance of temnospondyl lissamphibians (salamanders, frogs, and albanerpetontids). Here we report the co-occurrence of non-lissamphibian temnospondyls and early lissamphibians (salamanders) from the Late Jurassic Liuhuanggou locality in the Junggar Basin, Xinjiang Uygur Autonomous Region of the People's Republic of China (Fig. 1). This is the geologically youngest non-lissamphibian temnospondyl-early lissamphibian faunal association.

Abbreviation. SGP, Sino-German Project collection number. The specimens are currently studied at the University of Bonn, Steinmann-Institut für Geologie, Mineralogie und Paläontologie, Bonn, Germany. The specimens are property of the People's Republic of China and will be transferred to a public Chinese collection after the scientific studies are completed. The final repository will be announced in an internationally accessible journal.

Locality. The non-lissamphibian temnospondyl and salamander remains were recovered from the Qigu Formation at the Liuhuanggou locality, 40 km SW of Urumqi city at the southern margin of the Junggar Basin. The Qigu Formation has been dated as Oxfordian based on spores and palynomorphs

Fig. 1. Map showing all known occurrences of the non-lissamphibian temnospondyl-salamander faunal associations: 1 – Peski Quarry, Middle Jurassic (Bathonian); 2 – Balabansai Svita, Middle Jurassic (Bathonian); 3 – Liuhuanggou locality, Late Jurassic (Oxfordian). Map is modified from http://maps.google.ru/maps.

(Ashraf et al. 2004). The Liuhuanggou microvertebrate locality also produced disarticulated, but well preserved remains of hybodontid sharks, actinopterygian fishes, turtles, crocodiles, dinosaurs, and mammals that appeared in lenses in a series of greenish siltstones and fine sandstones and were obtained by screen-washing (Maisch et al. 2001, 2003, 2004; Martin and Pfretzschner 2003; Pfretzschner et al. 2005; Wings et al. 2007; Martin et al. 2008). Notably, all vertebrates in the assemblage indicate freshwater or terrestrial habitats including the hybodontid sharks.

SYSTEMATICS

Amphibia Linnaeus, 1758

Temnospondyli von Zittel, 1887–1890

Temnospondyli indet.

(Fig. 2)

Material. SGP2005–10, SGP2005–11, jaw fragments with teeth.

Description. The tooth of SGP2005–10 (Fig. 2A–D) is conical and slightly curved, with a bluntly pointed crown. It is nearly round in cross section and has well pronounced labyrinthine infoldings along two thirds of its height (near the tip infoldings are absent). The surface of the bony base is highly perforate and pitted. The tooth of SGP2005–11 (Fig. 2E–F) generally resembles that of SGP2005–10 but is mediolaterally more expanded. The tip is broken off revealing a relatively large pulp cavity.

Comparison. Specimens SGP2005–10 and SGP2005–11 are referred to Temnospondyli on the basis of the labyrinthodont pattern of dentine infoldings. This pattern is characteristic for sarcopterygian fishes (except dipnoans and actinistians) and for most temnospondyl taxa, except some small dissorophoids and temnospondyl lissamphibians (frogs, salamanders, and albanerpetontids) (Schultze 1970; Bolt 1977; Boy and Sues 2000; Carroll 2007). Only two sarcopterygian groups, actinistians and dipnoans, survived into the Mesozoic (Schultze 2004). The dipnoans have a unique dentition consisting of tooth plates, and actinistians have no dentine infoldings. This group is unknown from the Jurassic continental deposits of Asia (Schultze 1970, 2004), so it is highly unlikely that the Liuhuanggou material is referable to one of these fish groups. The presence of non-lissamphibian temnospondyls in the Qigu Formation was reported earlier based on vertebrae (Maisch et al. 2003), and therefore the assignment of SGP2005–10 and SGP2005–11 to the non-lissamphibian temnospondyls is the most parsimonious assumption. Because specimens SGP2005–10 and SGP2005–11 are not very informative taxonomically, we refer these fragments with teeth from the Liuhuanggou locality to Temnospondyli indet.

Caudata Scopoli, 1777

Caudata indet.

(Fig. 3)

Material. SGP2005–9, right femur proximal fragment.

Description. The proximal head of the femur is dorsoventrally compressed, kidney-shaped in proximal view due to the presence of a relatively deep ventral depression. The posterior edge is rounded and has no sharp edge. The trochanter and trochanteric ridge are well-developed. The shaft of the bone is thin and round in cross section.

Comparison. The most diagnostic features of SGP2005–9 are the presence of a well-developed trochanter and a trochanteric ridge. These features can be found in salamanders (Milner 2000) and larvae of non-lissamphibian temnospondyls (Averianov et al. 2008). The femur from the Liuhuanggou locality differs significantly from that of larvae of non-lissamphibian temnospondyls in being less dorsoventrally compressed, in lacking a posterior sharp edge and subvertical parallel ridges on the ventral surface (Averianov et al. 2008), and therefore can be assigned to the Caudata. The femur from Liuhuanggou differs from that of karaurid *Kokartus* (Balabansai Svita, Kyrgyzstan), the possible karaurid *Comonecturoides* (Late Jurassic Morrison Formation, USA) and Caudata indet. from Berezovsk Quarry (Middle Jurassic Upper Member of the Itat Svita, Russia) in its more strongly dorsoventrally compressed shape and deeper ventral depression (Hecht and Estes 1960; Skutschas 2006; Averianov et al. 2008). Comparisons with other Jurassic salamanders are difficult because detailed information on the structure of the femora in those taxa is limited or unknown. Thus, the femur from the Liuhuanggou locality currently cannot be determined more precisely than Caudata indet.

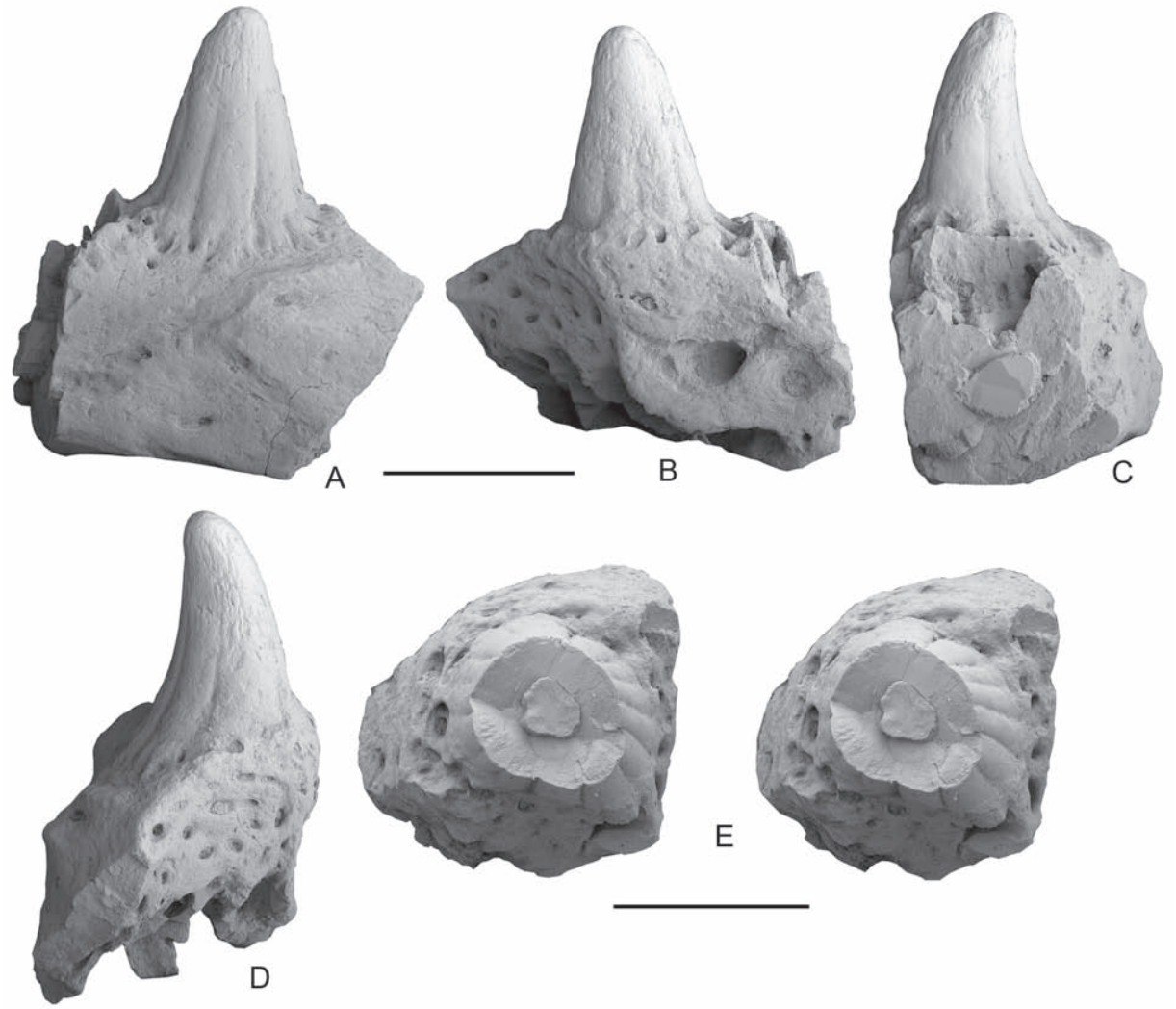

Fig. 2. Jaw fragments with teeth of Temnospondyli indet. from the Late Jurassic (Oxfordian) Qigu Formation of the Liuhuanggou locality, southern margin of the Junggar Basin, Xinjiang Uygur Autonomous Region of the People's Republic of China: A–D – SGP2005–10 in lateral (A), medial (B), anterior? (C) and posterior? (D) views; E (stereo-pair) – SGP2005–11 in occlusal view. Scale bar = 1 mm.

DISCUSSION

Among Jurassic localities there are sites with a dominance of non-lissamphibian temnospondyls (Shar Teg in Mongolia and some localities in the Junggar Basin), anurans (some levels at the Dinosaur National Monument and Garden Park in the western US), albanerpetontids (Guimarota in Portugal), albanerpetontids and salamanders (Kirtlington in England), and salamanders (Skye in Scotland, Daohugou in Inner Mongolia, Fengshan in Hebei Province, China, and Berezovsk Quarry in Krasnoyarsk Territory, Russia) (Hecht and Estes 1960; Evans et al. 1988, 2005; Shishkin 1991; Evans and Milner 1993; Evans and Waldman 1996; Wiechmann 2000; Gao and Shubin 2001, 2003; Maisch et al. 2001, 2003; Skutschas 2006; Averianov et al. 2008). There are only two Jurassic vertebrate faunas (both Middle Jurassic age) that contain both late and relic non-lissamphibian temnospondyls and some of the earliest lissamphibians (salamanders): the fauna of the Peski Quarry near Moscow, Russia (Shishkin 2000; Alekseev et al. 2001; Gambaryan and Averianov 2001) and the fauna of the Balabansai Svita in the Fergana Depression, Kyrgyzstan (see Averianov et al. 2005, 2008 and references therein).

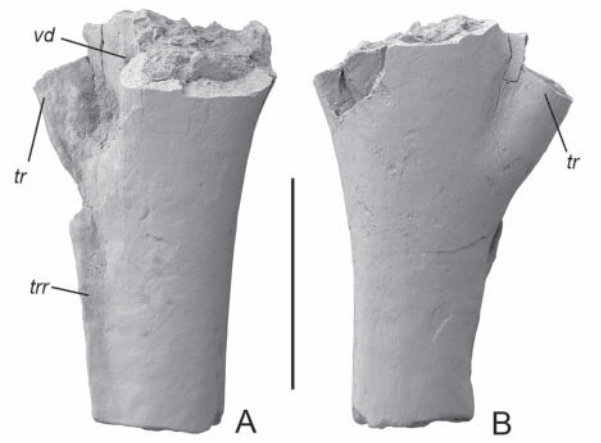

Fig. 3. SGP2005–9, right femur proximal fragment of Caudata indet. from the Late Jurassic (Oxfordian) Qigu Formation of the Liuhuanggou locality, southern margin of the Junggar Basin, Xinjiang Uygur Autonomous Region of the People's Republic of China, in posteroventral (A) and anterodorsal (B) views. *Abbreviations*: *tr* – trochanter; *trr* – trochanteric ridge; *vd* – ventral depression. Scale bar = 1 mm.

The Balabansai non-lissamphibian temnospondyl-salamander faunal association is represented by the brachyopoid *Ferganabatrachus* Nesov, 1990 and the karaurid salamanders *Kokartus* and Karauridae indet. (Nesov 1990, Shishkin 2000; Averianov et al. 2008). In the Peski fauna this association is represented by the brachyopoid cf. *Gobiops* Shishkin, 1991 sp. and indeterminate salamanders (Shishkin 2000; Alekseev et al. 2001; Gambaryan and Averianov 2001).

The reason for occurrence of different distribution patterns of the non-lissamphibian temnospondyls and lissamphibians in the Jurassic localities is unclear. Averianov et al. (2008) suggested that in the Fergana Depression, Kyrgyzstan, non-lissamphibian temnospondyls were more common in estuarine and salamanders in freshwater environments.

The amphibian remains reported here extend the stratigraphic range of the non-lissamphibian temnospondyl-salamander faunal association from the previously youngest record in the Bathonian of Kyrgyzstan and European Russia to the Oxfordian. They also extend the known geographical range of this association, demonstrating that the non-lissamphibian temnospondyls coexisted with salamanders in Europe and in different parts of Asia at that time. Future studies may show that of the non-lissamphibian temnospondyl-salamander association was even more widespread in Jurassic ecosystems.

ACKNOWLEDGMENTS

We thank Prof. Zuo Xue-Yi, head of the Information Division of the Geological Bureau of Xinjiang in Urumqi, at the time director of the Xinjiang Geological Survey No. 1, for his extensive technical support of our fieldwork. The paper benefited from constructive reviews by Drs. Susan Evans (University College London) and Mikhail A. Shishkin (Paleontological Institute, Moscow). Georg Oleschinski (Bonn) took the SEM photographs. The project was supported by technical grants MA 1643/11 and PF 219/21 of the Deutsche Forschungsgemeinschaft (DFG) and a postodoctoral fellowship from the Alexander von Humboldt Foundation to PS.

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