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A Temnospondyl tooth from the Middle Triassic of the Ordos Basin, Shaanxi Province

WU Rui[1*] TU Li[2] HAN Feng-Lu[1*]

(1 *School of Earth Sciences*, *China University of Geoscience* (*Wuhan*) Wuhan 430074
* Corresponding authors: ruicug@163.com; hanfl@cug.edu.cn)
(2 *Exploration & Development Research Institute*, *Henan Oil field Company SINOPEC* Nanyang 473132)

Abstract An isolated large temnospondyl tooth was discovered from the Middle Triassic Tongchuan Formation, Weibei Oilfield, Ordos Basin, Shaanxi Province of China. Compared with the teeth of crocodylomorphs, plesiosaurs and temnospondyls, the tooth can be referred to temnospondyl based on the following features: the crown is elongated and recurved with a circular cross-section; there are no denticles or carinae on the crown; well-marked apicobasal grooves are shown on the crown surface. This tooth represents the first temnospondyl found in the Middle Triassic Tongchuan Formation and is the youngest fossil record of temnospondyls in the North China Block.

Key words Ordos Basin, Middle Triassic, Tongchuan Formation, Temnospondyli, tooth

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An isolated large temnospondyl tooth (CUGW VH100) was collected from the 7th member of the Yanchang Formation in the 5th Well of Weibei Oilfield, Ordos Basin, Shaanxi Province, China, which corresponds to the Member II of the Tongchuan Formation (Li et al., 2016; Liu et al., 2018; Tong et al., 2019). The Tongchuan Formation was deposited during the late Middle Triassic and abundant vertebrate fossils have been collected there, including the fishes *Hybodus*, *Triassodus* and *Boreosomus* (Liu, 1962; Su, 1984; Yang et al., 2016; Deng et al., 2018) and the Archosauriformes *Yonghesuchus sangbiensis* (Liu et al., 2001; Wu et al., 2001). The *Sinokannemeyeria*-Fauna also extends to the Member I of the Tongchuan Formation in the Ordos Basin (Liu et al., 2018). The tooth is referred to Temnospondyli based on the following features: slender, conical tooth with a circular cross-section, slightly recurved crown, no denticles or carinae on the crown, and well-marked apicobasal grooves on the surface. It represents the youngest fossil record of temnospondyls in the North China Block.

Institutional abbreviations CUGW, China University of Geosciences (Wuhan), Wuhan, China; IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese

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Academy of Sciences, Beijing, China; SMNS, Staatliches Museum für Naturkunde Stuttgart, Stuttgart, Germany.

Description The tooth crown of CUGW VH100 is slender and recurved, with a nearly circular cross-section. The crown tip is cone-like, and slightly worn, with several homocentric dark growth lines. The maximum preserved length and crown height (CH) are 44 mm and 35 mm, respectively (Fig. 1A). Only a small part of the root is preserved (9 mm) on the lingual side (Fig. 1C).

Both the anterior and posterior carinae are not shown, and there are no serrations. Numerous grooves are clearly shown on the crown surface and are nearly parallel to each other (Fig. 1F). There are two types of grooves. The long grooves extend up two-thirds of the crown's height, whereas the short grooves only extend to the mid-region (Fig. 1A). Between these grooves, some weak wrinkles are mainly longitudinally arranged on the convex surface. Generally, these wrinkles are short compared to the grooves and are closely arranged but not parallel to each other (Fig. 1G).

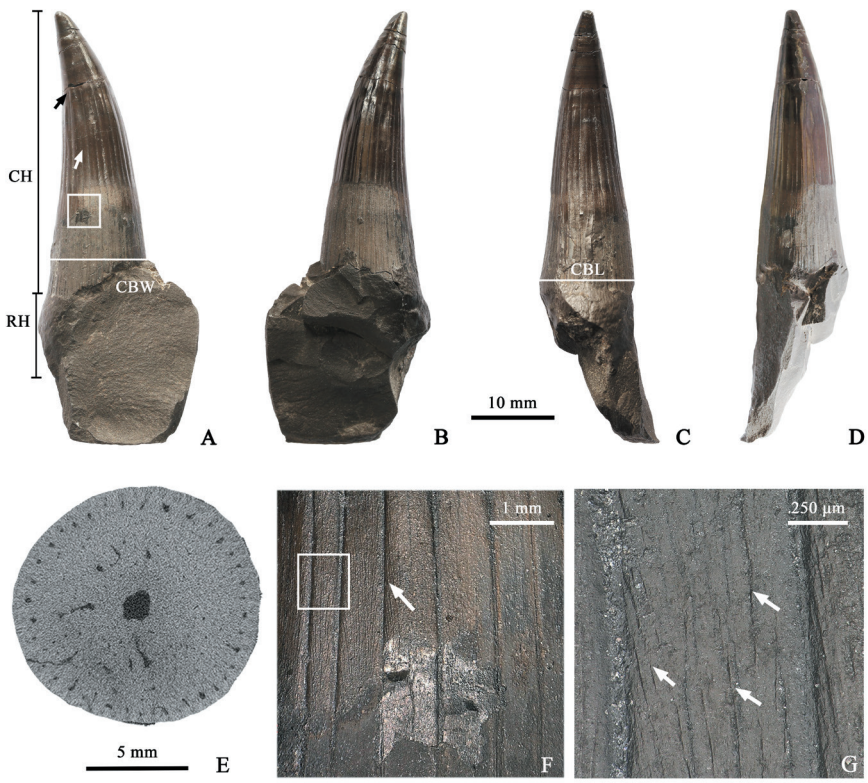

Fig. 1 Photographs of the tooth fossil from the Tongchuan Formation, Ordos Basin (CUGW VH100)
A. anterior (or posterior) view; enamel surface showing two types of grooves: short grooves extending to the mid-region of the crown (white arrow), and long grooves extending two-thirds up the crown (black arrow); B. posterior (or anterior) view; C. lingual view; D. labial view; E. CT image of the cross-section at the base (white line in A); F. enlargement of white square in A, showing longitudinal parallel grooves (arrow); G. enlargement of white square in F, showing radial tiny wrinkles between grooves (arrows)
Abbreviations: CBL. crown base length; CBW. crown base width; CH. crown height; RH. root height

In CT images, several longitudinal channels with regular distribution can be observed around the transverse section of the crown base (Fig. 1E). Some radial channels are shown in the inner region, and these radial channels vary longitudinally along the long axis of the crown.

Comparison and discussion The conical shape of the tooth and the longitudinal ornamentations along the crown are widespread in different tetrapod groups from the Triassic to the Late Cretaceous, including some crurotarsal archosaurs, crocodylomorphs, temnospondyls, pistosauroids and plesiosaurs; however, the teeth of the different groups differ in the morphology of ornamentations, their arrangements on the crown surface, the development of the carinae, and the distributions of serrations on the anterior and posterior edges (Cheng et al., 2006; Moser and Schoch, 2007; Baczko and Ezcurra, 2016). The absence of serrations differs from most crurotarsal archosaurs and crocodylomorphs (Hungerbühler, 1998; Clark and Sues, 2002; Sulej, 2010). The crown shape and surface ornamentations of CUGW VH100 differ from those of plesiosaurs and pistosauroids in which the crown is more slender with numerous longitudinal ridges rather than grooves (Yang, 1965; Rieppel, 1999; Cheng et al., 2006; Kear et al., 2006; Vecchia, 2006; Sato et al., 2007).

Combined with morphological characteristics and geological age, CUGW VH100 is most similar to a fossil tooth (SMNS 55911) of *Mastodonsaurus* (Temnospondyli, Capitosauroidea), which is conical in shape and has no carinae or serrations, with obvious groove-like ornamentations that do not extend to the tip (Moser and Schoch, 2007). However, SMNS 55911 has an irregular “labyrinthine structure” on the cross-section, which is an external expression of the dentine folding inside the tooth (Romer, 1956). Dentine folding is common in the amniote, especially in some basal groups, including the sarcopterygians (*Latimeria chalumnae*), the actinopterygians (*Lepisosteus*), some basal tetrapods and some ichthyosaurs (Maxwell and Lamoureux, 2011; Meunier et al., 2015), and the shape of dentine folding varies greatly longitudinally along with the crown (Moser and Schoch, 2007). CUGW VH100 lacks any apparent “labyrinthine structure” in the CT image. This may be affected by the preservation and small density discrepancy between enamel and dentine. This tooth is here identified as a temnospondyl tooth.

Although the temnospondyls survived to the Jurassic in Sichuan, the youngest record in the North China Block was from the Ermaying Formation (Li et al., 2008). CUGW VH100 represents the youngest fossil record of temnospondyl from the North China Block. The tooth crown with conical shape and circular cross-section is highly adapted to fishing (Damiani et al., 2000; Dias and Schultz, 2003; Moser and Schoch, 2007), and the coexistence *Hybodus youngi* fish fauna can provide enough food for it.

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陕西鄂尔多斯盆地中三叠统一离片椎类牙齿化石

武　瑞[1]　　涂　黎[2]　　韩凤禄[1]

(1 中国地质大学(武汉)地球科学学院 武汉 430074)

(2 中国石化河南油田分公司勘探开发研究院 南阳 473132)

摘要：陕西省鄂尔多斯盆地渭北油田中三叠统铜川组发现一枚牙齿化石。该枚牙齿具有如下特征：牙齿细长，外形呈圆锥形，齿冠基部横截面为圆形，齿冠整体较直，沿长轴稍微向后缘弯曲，齿冠表面无齿脊和锯齿分布，发育纵向延伸的沟槽状纹饰。通过与鳄型类、蛇颈龙类和离片椎类的牙齿比较，该标本可以归入离片椎类。这枚牙齿化石为这一类群在中三叠统铜川组的首次发现，代表了离片椎类在华北板块最晚的化石记录。

关键词：鄂尔多斯盆地，中三叠世，铜川组，离片椎类，牙齿

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