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## First discovery of dinosaur eggs in Nanhu Gebi of Hami, Xinjiang, China

WANG Qiang<sup>1</sup> XING Hao<sup>2\*</sup> SHI Hai-Tao<sup>2</sup> FANG Kai-Yong<sup>1</sup>  
ZHU Xu-Feng<sup>1,3</sup> ZHOU Ming-Xiao<sup>1,3</sup> WANG Xiao-Lin<sup>1,3</sup>

(1 Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences Beijing 100044)

(2 Urumqi Natural Resources Comprehensive Survey Center, China Geological Survey Urumqi 830011)

(3 College of Earth and Planetary Sciences, University of Chinese Academy of Sciences Beijing 100049)

\* Corresponding author: xinghao@mail.ecgs.gov.cn

**Abstract** Here we report the first dinosaur eggshells found in the Nanhu Gebi of Hami, including *Elongatoolithus elongatus* and *Ovaloolithus* oosp. The discovery of these dinosaur eggs not only enlarge the palaeogeographic distribution of elongatoolithid and ovaloolithid eggs, but also indicate the geological age of egg-bearing strata to be the end of Late Cretaceous. Whether the strata can be correlated with the Subashi Formation in Turpan Basin remains to be clarified.

**Key words** Nanhu Gebi, Hami, Xinjiang; Late Cretaceous; dinosaur eggs

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Nanhu Gebi is in the southeastern part of the Turpan-Hami Basin. In 2020, we discovered dinosaur bones for the first time in the Middle Jurassic Xishanyao Formation. In 2021, we found dinosaur eggshells for the first time during the investigation of dinosaur-producing strata and geological relics surrounding areas in Nanhu Gebi, providing new paleontological evidence for the division and correlation of red strata in the area. A total of three sites yielded dinosaur eggshells, but no complete egg fossils were found. All of the eggshells were preserved in the weathering layer.

All eggshells collected in the field were cleaned by ultrasonic, and the eggshells with well-preserved internal and external surfaces were selected to make microscopic slices. A total of twenty radial thin sections were made to determine the type of eggshells. Thin sections were observed and photographed by using polarizing microscope. All the experiments were done in Key Laboratory of Vertebrate Evolution and Human Origins, Chinese Academy of Sciences. Herein we have a brief description of these dinosaur eggshells.

### Oofamily *Elongatoolithidae* Zhao, 1975

#### Oogenus *Elongatoolithus* Zhao, 1975

#### Oospecies *Elongatoolithus elongatus* Zhao, 1975

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**Specimens** Eggshell slices in IVPP V 31375.2–6, and fifteen eggshells (V 31375.1).

**Locality and horizon** Nanhu Gebi, Hami; Subashi Formation (?), Upper Cretaceous.

**Description** The outer surface of the eggshell is sculptured with ridge, nodular ornamentation, or smooth. In radial section of the eggshell, it can also be seen that the outer surface ornamentation of the eggshell is unevenly distributed, with slight differences showing different of the egg position respectively (Fig. 1A–E). The eggshell is composed of a cone layer and a columnar layer, with an undistinguished boundary between them. According to the eggshell thickness of the eggshell (excluding ornamentation), all eggshells can be divided into two groups. The thinner group is 0.65–0.80 mm. Thickness of the cone layer is 0.18–0.23 mm, about a quarter or a third of the thickness of the eggshell. The thicker group is 1.13–1.30 mm, can be up to 1.54 mm including ornamentation. Thickness of the cone layer is 0.24–0.33 mm, about a quarter of the thickness of the eggshell. The cones are short-cone-shape. The gap between the cones is obvious, and several cones are gathered (Fig. 1A–B, D–E). The pore canals are straight tubular in radial view (Fig. 1B).

#### **Ovaloolithidae Mikhailov, 1991**

##### ***Ovaloolithus* Zhao, 1979**

##### ***Ovaloolithus* oosp.**

**Specimens** Eggshell slice in IVPP V 31376.2–4, and twelve eggshells (V 31376.1).

**Locality and horizon** Nanhu Gebi, Hami; Subashi Formation (?), Upper Cretaceous.

**Description** The thickness of the eggshells is 2.35–2.47 mm. The eggshell microstructure is compact and composed of the cone and columnar layers (Fig. 1F–H). The cone layer is not complete in radial section due to weathering. The columnar layer consists of the inner and outer zones. The inner zone which is composed of slender prismatic calcite crystals is 1.00 mm thick, approximately 2/5 of the eggshell thickness. The outer zone of columnar layer is fan-shaped or pinna-shaped, of which the calcite crystals are radially arranged. The pore canals are almost straight, and uneven distributed in radial section (Fig. 1G, H).

Eggshell microstructure has the typical ovaloolithid's characteristics. The oospecies of ovaloolithid eggs are distinguished by the position and number of stripes in the inner and outer zone of columnar layers. But as more and more thin sections were observed, we found that the stripes in the eggshells are unstable characteristics and not suitable for the identification of the oospecies of Ovaloolithidae. The classification of ovaloolithid found in the world including the Hami specimens will be discussed in detail in another article, so the eggshells discovered in Hami are considered as an undetermined oospecies here.

**Discussion** Dinosaur eggs in Xinjiang were first discovered in the 1960s (Zhao, 1980). Fang et al. (2009) described the dinosaur eggshells (*Pinnatoolithus sangequanensis*) found in the Wulunguhe Formation (Upper Cretaceous) from the Junggar Basin. Zhao et al. (2015) suggested that the *Pinnatoolithus* was a synonym of *Ovaloolithus*, and revised the specimens from the Junggar Basin as *Ovaloolithus sangequanensis*. Zhang and Wang (2010) described the dinosaur eggs found in the Subashi Formation from the Turpan Basin (Zhai et al., 1978),

named as *Ovaloolithus turpanensis*. The first discovery of dinosaur eggshells in Nanhu Gebi is a major paleontological breakthrough following the discovery of dinosaur bones in 2020. The dinosaur eggshells from Nanhu Gebi include *Elongatoolithus elongatus* and ovaloolithids, enlarging the palaeogeographic distribution of these two ootaxa of dinosaur egg. According to the composition of the dinosaur egg faunas from China, elongatoolithids and ovaloolithids were found in the Pingling Formation of the Nanxiong Basin, the Jingangkou Formation of the Laiyang Basin and the Sigou Formation of the Xichuan Basin. All these strata are middle-late Late Cretaceous in age (Campanian-Maastrichtian) (Wang et al., 2012). Therefore, the geological age of the egg-bearing strata in Nanhu Gebi should also be the middle-late Late Cretaceous. Whether the egg-bearing strata can be compared with the Subashi Formation in the Turpan Basin remains to be clarified.

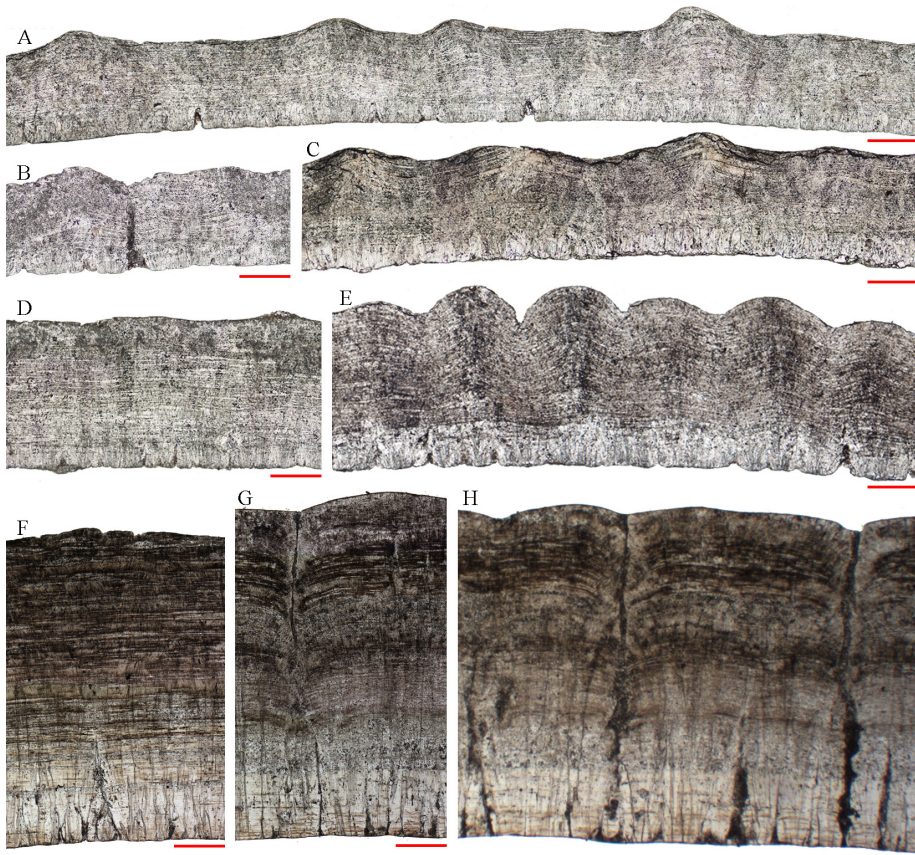


Fig. 1 Microstructure in radial section of the dinosaur eggshell found in Hami  
 A–E. *Elongatoolithus elongatus*: A–C. thinner eggshell (0.85–1.12 mm), that is composed of the cone and the columnar layers, with an undistinguished boundary between them, several cones are gathered, with clear cone gaps, and straight tubular pore canals (B); D–E. thicker eggshell (including ornamentation 1.42–1.54 mm), ornamentation of the eggshell is unevenly distributed, with slight differences undulating (E);  
 F–H. *Ovaloolithus oosp.*: incomplete cone layer, the inner and outer zones of the columnar layer, slender prismatic calcite crystals in inner zone and fan-shaped or pinna-shaped crystals in outer zone, almost straight pore canals (G), unevenly distributed pore canals (H)

A–E. IVPP V 31375.2–6, F. V 31376.2, G–H. V 31376.3. Scale bars=200  $\mu$ m

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## 哈密南湖戈壁首次发现恐龙蛋

王 强<sup>1</sup>      邢 浩<sup>2</sup>      石海涛<sup>2</sup>      方开永<sup>1</sup>  
朱旭峰<sup>1,3</sup>      周明笑<sup>1,3</sup>      汪筱林<sup>1,3</sup>

(1 中国科学院古脊椎动物与古人类研究所, 中国科学院脊椎动物演化与人类起源重点实验室 北京 100044)

(2 中国地质调查局乌鲁木齐自然资源综合调查中心 乌鲁木齐 830011)

(3 中国科学院大学地球与行星科学学院 北京 100049)

**摘要:** 报道了新疆哈密南湖戈壁首次发现的恐龙蛋, 包括长形长形蛋(*Elongatoolithus elongatus*)和椭圆形蛋未定种(*Ovaloolithus* oosp.)。这些恐龙蛋的发现不仅扩展了长形蛋类和椭圆形蛋类的古地理分布, 而且表明南湖戈壁含蛋岩层地质时代为晚白垩世末期; 该地层是否可与吐鲁番盆地的苏巴什组进行对比还有待进一步工作确认。

**关键词:** 新疆哈密, 南湖戈壁; 晚白垩世; 恐龙蛋

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