

中国的伤齿龙类恐龙化石

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伤齿龙类是手盗龙类中较为独特的一支, 时代从中侏罗世到晚白垩世, 主要分布于亚洲(东部和中部)以及北美地区。本文基于前人的研究成果, 结合新标本, 对中国伤齿龙类的系统分类、骨骼形态、骨组织、系统发育关系和古生物地理等方面进行了全面深入的评估与探讨。

对已正式发表的中国伤齿龙类恐龙进行概括并通过详尽的骨骼形态学对比, 分别对这些属种的鉴定特征进行了修订与补充, 对每个分类群的系统发育研究做了简要回顾。

根据发现于中国辽宁早白垩世义县组的两件保存完好的伤齿龙类新标本, 描述并命名为辽宁大连龙(*Daliansaurus liaoningensis* gen. et sp. nov.)和柯氏辽宁猎龙(*Liaoningvenator curriei* gen. et sp. nov.)。利用支序系统学对这两个属种分别进行了分析, 初步结果显示, 辽宁大连龙与巨齿曲鼻龙(*Sinuso nasus magnodens*)构成姊妹群关系; 柯氏辽宁猎龙与短羽始中国羽龙(*Eosinopteryx brevipenna*)互为姊妹群。

对描述的新标本——辽宁大连龙和柯氏辽宁猎龙进行了骨组织学研究。首次在伤齿龙类中(或近鸟类中)使用高分辨率同步加速显微断层成像技术进行研究。根据其骨组织显微结构特点, 我们认为辽宁大连龙已达到稳定生长阶段, 死亡时年龄至少约

4~5 岁。对柯氏辽宁猎龙的骨组织学分析发现, 个体在早期发育阶段生长迅速。但在由第 2 区过渡到第 3 区期间(本文中设定的分区), 生长模式呈指数式下降, 这可能与达到性成熟或出现较差的生理条件有关。根据骨组织研究结果, 推测辽宁猎龙死亡时至少 4 岁。

本文系统发育分析选取虚骨龙类 157 个分类单元, 853 个特征, 首次包括了所有中国伤齿龙类 14 属 14 种(包括本文的两个新属, 新种)。建立并命名 2 个新亚科: 中国猎龙亚科 *Sinovenatorinae* subfam. nov., 包括龙寐(*Mei long*)、张氏中国猎龙(*Sinovenator changii*)、巨齿曲鼻龙(*Sinuso nasus magnodens*)和辽宁大连龙(*Daliansaurus liaoningensis*); 近鸟类亚科 *Anchiorninae* subfam. nov., 包括赫氏近鸟类(*Anchiornis huxleyi*)、郑氏晓廷龙(*Xiaotingia zhengi*)、短羽始中国羽龙(*Eosinopteryx brevipenna*)和徐氏曙光鸟(*Aurornis xui*)。

最后, 本文探讨了伤齿龙类恐龙的生活习性和古地理分布, 提出北美侏罗纪发现的伤齿龙类可能与中国伤齿龙类的迁移扩散有关, 此次扩散可能是通过连接少部分东亚和劳亚大陆的陆桥完成。晚白垩世随着大陆板块之间动物群交流增加, 扩散可能更为广泛, 这次扩散可能与泛大陆的裂解最终导致蒙古—鄂霍茨克海的关闭有关。

关键词: 伤齿龙类; 新属种; 骨组织学; 系统发育分析; 古地理分布

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The Troodontids from China

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Troodontidae is a unique clade of maniraptoran theropods known from Middle Jurassic to Late Cretaceous, and were mainly discovered in Eastern and Central Asia and North America. Based on the published taxa, the taxonomy, morphology, bone histology, phylogeny and biogeography of Chinese troodontids are comprehensively evaluated and explored.

All the published Chinese troodontid dinosaurs are summarized in this study. A detailed comparison of skeleton morphology are summarized among these troodontids. Some diagnoses of these taxa were emended and added. The phylogenetic analysis for each taxon are briefly reviewed.

Two new troodontid dinosaurs *Daliansaurus liaoningensis* gen. et sp. nov. and *Liaoningvenator curriei* gen. et sp. nov. are erected based on nearly complete specimens from the Lower Cretaceous Yixian Formation of Liaoning Province, China. A phylogenetic analysis recovers that *Daliansaurus liaoningensis* and *Sinuserosaurus magnodens* form a sister group within a subclade that includes *Sinovenator changii*, *Sinuserosaurus magnodens* and *Mei long*. *Liaoningvenator curriei* was recovered to be sister group with *Eosinopteryx brevipenna*.

Bone microstructures of *Daliansaurus liaoningensis* and *Liaoningvenator curriei* are analyzed in this thesis. The high-resolution synchrotron microtomography is applied for troodontids, or paravians in general, for the first time. According to our observation, we hypothesize that *Daliansaurus liaoningensis* perished when it reached the stationary stage of development (a maximum body size) and was likely at least 4 or 5 years old at the time of death. The microstructures of *Liaoningvenator curriei* show that the individual has grown rapidly at earlier ontogenetic stage. The exponential growth decreased in the specimen sharply during transition from the zone 2 to 3, might be explained either by reaching a sexual matur-

ity or due to poor physiological conditions. According to the histological outcomes, we hypothesize that *Liaoningvenator curriei* was at least four years old when it perished.

157 taxa and 853 characters were chosen from coelurosaurian theropods as a dataset for phylogenetic analysis, which is the first time to include all troodontids (14 genera and 14 species) found from China. Based on the phylogenetic analysis, two new subfamilies are erected: *Sinovenatorinae* subfam. nov., including *Mei long*, *Sinovenator changii*, *Sinuserosaurus magnodens*, and *Daliansaurus liaoningensis*, *Anchiorninae* subfam. nov., including *Anchiornis huxleyi*, *Xiaotingia zhengi*, *Eosinopteryx brevipenna* and *Aurornis xui*.

A preliminary discussion of living behavior and paleogeographic distribution of troodontid dinosaurs is also discussed here. We propose that the Jurassic troodontids from North America are possibly related to the dispersal event of troodontids from China, and this dispersal might be contributed by the land bridge that connected few parts of the East Asia to the Laurasia. The dispersal is more widely with the increase of vertebrate assemblages among the tectonic plates during the late Cretaceous period, due to the Pangaea breaking apart and resulted in the closure of the Mongolian—Okhotsk Sea finally.

Key words: troodontid; new genus and species; bone microstructures; phylogenetic analysis; paleogeographic distribution

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