

## Luoping Biota: Representative of the Third Biological Radiation

HAO Ziguo<sup>1,2</sup>, FEI Hongcai<sup>1,2</sup>, HAO Qingqing<sup>3</sup> and LIU Lian<sup>1,2</sup>

<sup>1</sup> Chinese Academy of Geological Sciences, Beijing 100037, China

<sup>2</sup> Editorial Office of Acta Geologica Sinica (English Edition), Geological Society of China, Beijing 100037, China

<sup>3</sup> Editorial Office of Geology and Exploration, Institute of Mineral Resources Research, China Metallurgical Geology Bureau, Beijing 101300, China

The third biological radiation refers to the Middle Triassic biological radiation in the world. In 2007, the China Geological Survey during field investigations of the project “Regional Geological Survey in Datong, Guishan, Luoping County and Pengzha at a scale of 1:50000 in Yunnan Province” first discovered and named the Luoping Biota (Fig. 1). This Middle Triassic biota emanates from the Pelsonian substage of the Anisian and is mainly distributed in the Luoping, Luxi and Qiubei areas northwest of the Nanpanjiang–Youjiang Basin, and its

main distribution covers an area of nearly 200 km<sup>2</sup>, centering on Dawazi village in Luoping County. A total of six phyla, 40 genera, 113 fossil species, and 32 newly named fossils have been discovered in the Luoping Biota, which is regarded as one of the most abundant marine fossil libraries in the world.

(1) The underground foraging remains of marine reptiles, such as *Dianopachysaurus dingi* and *Nothosaurus zhang*, were first discovered in this biota, indicating a full recovery of the global middle Triassic marine ecosystem.



*Dianopachysaurus dingi*



*Koryncheiros luopingensis*

Fig. 1. Photos of Luoping Biota.

\* Corresponding author. E-mail: haoziguo@126.com

The marine reptiles currently discovered in the Luoping Biota generally comprise the major Triassic clades including Ichthyopterygia, Sauropterygia, Protorosauria and archosaurs, and the *D. dingi* and *N. zhang*i are the most representative. A newly discovered *N. zhang*i has the largest estimated body length of 5–7 m, and has large and sharp conical canines. Before this specimen was discovered, giant top predators were absent from the Mesozoic Eastern Tethys Ocean, at a time when the global synchronization of ecosystem recovery has always been a problem to be solved by geoscientists. The discovery of *N. zhang*i supports the idea that ecosystem recovery in the Eastern and Western Tethys shallow oceans of the Anisian age was synchronous.

(2) A total of five orders, seven families, 21 genera and 26 species of fishes have been distinguished, including the typical Triassic fish fossils, such as Palaeonisciformes, Saurichthyiformes, Peltopleuriformes, Perleidiformes, Semionotiformes and Coelacanthiformes. New genera and species of *Luoxiongichthys hyperdorsalis*, *Luopingcoelacanthus eurylacrimalis* and *Saurichthys yunnanensis* were newly named. A new understanding that the Neopterygii realized a full radiation in the Anisian age has been put forward by China Geological Survey. Both the quantity and diversity of fish fossils in the Luoping Biota are far more than those of other biota in the Triassic.

(3) Three subphyla (Crustacea, Chelicerata and Myriapodia), six classes and eight orders of arthropods have been discovered, and six new genera and nine new species were named.

Arthropods account for greater than 90% of the fossils in the Luoping Biota, of which the Crustacea including Decapoda, Isopoda and conchostracans form a huge arthropod family, indicative of the character of the Anisian explosive radiation. Many Luoping Biota arthropod groups, such as the Limulacea (Merostomata: Chelicerata), millipedes (Diplopoda: Myriapoda), Isopoda, Palinura and

primitive crabs were also discovered for the first time in China.

During geological time, at least five massive biological extinction events have occurred, and that which occurred in the late Permian had the largest scale, involving the greatest biomass. This had the most profound effect, resulting in the extinction of more than 95% of marine species. The end-Permian global biological extinction and the subsequent ecosystem recovery and biological radiation in the Early and Middle Triassic are research focuses in recent years among paleontologists, with southwestern China providing just an ideal area for research into Triassic stratigraphy and paleontology.

In the southwestern region in Yunnan, the Triassic Xingyi Biota, Panxian Biota and Guangling Biota have all been discovered; all are dominated by marine reptiles, associated with some fish, crinoids and bivalves, and with very few other animals such as arthropods. The newly discovered fossils in the Luoping Biota are principally marine reptiles, fish, and arthropods, associated with more than ten types of marine fossils such as echinoderms, ammonites, bivalves, gastropods, brachiopods and plants, but predominantly fish and arthropods. Both the quantity and types of fossils in the Luoping Biota greatly exceed others of the same period of Triassic biota, and well reflect the marine biological diversity. The Luoping Biota, which is about 20 million years earlier in age than the famous Guanling Biota, thus ranks highly as one of the known Triassic marine fossil libraries with the largest fossil differentiation. The Luoping Biota is therefore a typical representative of the third biological radiation.

## Acknowledgement

Thanks are given to Susan Turner for her improvement of English.