The Semi-humid Environment of the Middle Triassic Ermaying Formation in North China: Implications for Ecosystem Recovery After the End-Permian Crisis



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Abstract: The delayed recovery in the Early to Middle Triassic strata is an important issue after the terrestrial Permian-Triassic crisis in North China (Fig. 1). However, the sedimentary environment evolution during this period has not been studied in detail. In this study, a comprehensive analysis of the Middle Triassic Ermaying Formation was applied along the Yellow River in Shaanxi Province, North China. Field observation confirmed that the Ermaying Formation is characterized by a suite of meandering deposits in which cross-bedded and coarsegrained sandstone were often overlaid by grey mudstone (Fig. 2). Typical meandering sequences of channel, point bar, and floodplain deposits are common. They suggest that the Ermaying Formation was deposited in a semi-humid environment. Plenty of fossils such as plants, tetrapods, tetrapod burrow, and bioturbations in the Ermaying Formation reveal a well-developed ecosystem at that time. Moreover, the burrow is comparable to those produced by Reniformichnus katikati, which is helpful to confine the relatively warm and semi-humid paleoenvironment and can be compared with similar Triassic sequences in the world (e.g. Karoo Basin, Russia, etc.). Zircon U-Pb dating for samples from the tuff layer in the Ermaying Formation give quite identical mean $^{206}\text{Pb}/^{238}\text{U}$ age of 241.7 \pm 0.5 Ma (Fig. 3), which confirmed the depositional age of the Ermaying Formation at









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Fig. 3. Photographs of the Ermaying Formation in the field.

(a) Overlook for the sedimentary sequences in the Ermaying Formation, which were mainly deposited in meandering river environment; (b) The parallel bedding and overlying planar cross-beddings; (c) Plant (root) fossils preserved in the medium-grained sandstone; (d, e, f) tetrapod fossils found in the Ermaying Formation Formation; (g) Tetrapod fossil in the Ermaying Formation; (h) Cross section for the tetrapod fossil; (i) Tuff layer in the Ermaying Formation

Ladinain of the Middle Triassic. Therefore, it is convincible to infer that the paleoecosystem in the Middle Triassic of Ermaying Formation has been greatly recovered. A warm and humid ecosystem with prosperous vegetation may provide ample food sources for the prosperity of tetrapods.

Key words: Ecosystem recovery, Middle Triassic Ermaying Formation, End-Permian crisis, Palaeoenvironment, North China

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References

- Grauvogel-Stamm, L. and Ash, S.R., 2005. Recovery of the Triassic land flora from the end-Permian life crisis. *Comptes Rendus Palevol*, 4: 593–608.
- López-Gómez, J., Galán-Abellán, B., de la Horra, R., Barrenechea, J.F., Arche, A., Bourquin, S., Marzo, M. and Durand, M., 2012. Sedimentary evolution of the continental Early–Middle Triassic Cañizar Formation (Central Spain): Implications for life recovery after the Permian–Triassic crisis. *Sedimentary Geology*, 249–250: 26–44.
 Smith, R. and Botha, J., 2005. The recovery of terrestrial
- Smith, R. and Botha, J., 2005. The recovery of terrestrial vertebrate diversity in the South African Karoo Basin after the end-Permian extinction. *Comptes Rendus Palevol*, 4: 623– 636.

Yang, Jiasheng., Yi, Jian., Dong, Liyang., and Liu, Jun., 2018. Tetrapod burrows from the Triassic Ermaying Formation of Shaanxi, China. Vertebrate Palasinatica, 56: 147–156.

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