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A Paleobiogeographic Problem of the Late Paleozoic Tetrapods in East Eurasia

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Abstracts: Tetrapod fossils have been found in the middle to late Permian and Triassic continental deposits of China (Li, 2001; Müller et al., 2008; Liu et al., 2010; Reisz et al., 2011; Liu et al., 2012; Liu and Abdala, 2017a, 2017b; Liu and Bever, 2018), but almost no tetrapod fossils had been reported from the Carboniferous to early Permian strata in China yet. There are two major groups that are missing in Chinese Carboniferous and early Permian sediments. One is the reptiles, like the eureptile captorhinids and parareptiles, the other are the basal synapsids, the so-called pelycosaurs. Consequently, the natural question arises - is there a regional 'Carboniferous-early Permian Gap (C-P_1 Gap)' for tetrapods in the east Eurasia? If it is true, there would be an important biogeographic issue with the late Paleozoic evolution of Paleo-Asian Ocean, and the formation of super-continent Pangaea. Otherwise, there would be some potentialities to find tetrapod fossils from deposits of that period in China. This question would lead to an interesting project for gaining a better understanding of the paleobiogeography of early tetrapods during the Late Paleozoic. For example, the synapsid amniotes, colloquially called pelycosaurs, which successfully lived in North America and western Europe are mainly found in Pennsylvanian to early Permian strata in North America and Europe (Reisz et al., 1982, 1996; Reisz 1997), with some surviving late into the middle Permian in Russia and South Africa, but have not been found in China yet. Only Late Permian therapsid synapsids have been discovered, pointing to a major gap in the fossil record of China (Müller et al., 2008; Reisz et al., 2011; Liu et al., 2012). Therefore, it is reasonable to consider the geological constrains from the convergence of separated continents to form the supper-continent Pangaea. Despite the paleogeographic distribution in China, the terrestrial tetrapod fauna of the early Permian and middle-late Permian are different worldwide (Reisz, 1997; Kemp, 2006). From the middle Permian, the pelycosaurian-grade synapsids-dominated fauna was replaced by therapsid-dominated fauna, the diversity of Parareptile increased and the amphibian diversity was conspicuously reduced (Brocklehurst et al., 2017). This transition may be closely related to the contemporary termination of Permo-Carboniferous glaciation (Rees et al., 2002). Therefore, the effects of paleoclimate on faunas distribution should also be considered.

After the emergence of the theory 'Plate Tectonics' which evolved from the Wegern's 'Continental Drift Theory' and of 'Phylogenetic Systematics' put forward by Willi Hennning and others, many new concepts and methods for biogeographic analyses were brought out, and finally lead to 'Phylogenetic Biogeography' or 'Cladistic Biogeography'. 'Vicariance Biogeography' also developed during the 20th century, with close relationships to the 'Panbiogeography'. Those theories are based on the integrative analysis of general distribution patterns and evolutionary histories of biotic realms, as well as studies of interrelationships between different groups based upon the concept of descent from hypothesized common ancestor. The advantages of these theories rest on the strengths of rigorous cladistic analyses of the biota, their underlying relationships and built upon paleogeographic data on both regional and global scales. Thus, the cosmopolitan distribution of anomodont therapsid *Lystrosaurus* in the Early Triassic provides strong evidence for Pangaea, while its formation would be also recorded in the history of diversification and distribution of tetrapods. As the data of tectonics, geochronology, and fossil record had been up-dated so fast, it is time to test some original biogeographic viewpoints on Late Paleozoic tetrapods.

Keywords: Carboniferous, Permian, Pangaea, fossil record, vertebrate paleontology

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