



Formation of the soft-sediment deformation structures and its constraints on dinosaur fossil burial of the Cretaceous in Zhucheng, Shandong province, East China

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The triangular-shaped Zhucheng depression is located in the southwestern part of the Jiaolai basin, Jiaodong peninsula, East China. Various soft-sediment deformation structures are recognized in the southern Zhucheng depression, which have behaviour are plastic and/or brittle. Soft-sediment deformation structures mainly include undulate fold, mound and sag, diapir, convolute deformation and seismic-unconformity in the Lower Cretaceous, which are composed of fine-grained sediments in lacustrine environment, while load structure, ball and pillow structure, plunged sediment mixtures structure, fault-graded occurred in the Upper Cretaceous, which formed in a conglomeratic or coarse arenaceous alluvial fan and flood-plain setting. These soft-sediment deformation structures are proposed triggered by paleoearthquake. The deformed layers and undeformed layers developed in intervals, suggesting frequent seismic activities. In studied area, numerous giant hadrosaurid skeleton fossils have been found in the Upper Cretaceous Wangshi Group since 1958, and unusual and abundant dinosaur track fossils have been discovered in the Lower Cretaceous Yangzhuang Formation of Laiyang Group. The widespread identified soft-sediment deformation structures are proximately underlying or overlying these dinosaur fossil bearing strata. The depositional setting changed while multiple paleo-seismic events and tectonic activity happened. In the Early Cretaceous, after the occurrence of paleo-earthquakes and environmental changes, dinosaurs migrated and a lot of tracks with similar orientation on lacustrine offshore were preserved. In the Late Cretaceous, a large-scale dinosaur fossil layers and paleo-earthquake records occurred in intervals, indicating that the dinosaur fossils may be associated with large-scale debris flow and frequent earthquake events. Based on regional tectonic setting, distribution of soft-sediment deformation structures and predicted magnitude of paleo-earthquakes, the seismogenic fault is suggested to possibly be the Wulian Faults.