Objective

The latest Cretaceous strata of the Jiaolai Basin were studied in two scientific cores, including LK-1 drilled by the Institute of Geology, Chinese Academy of Geological Sciences (Li et al., 2018; Li et al., 2020), and JK-1 drilled by the Shandong Institute of the Geological Survey and Institute of Geology, Chinese Academy of Geological Sciences (Xu et al., 2017). However, outcrop sections were poorly studied, and the latest Cretaceous charophyte flora in particular had not previously been adequately documented from outcrops in the Jiaolai area. In this paper, we report new micropaleontological and paleoecological data from an outcrop section near Jiankou Village of Zhucheng City, Shandong Province (coordinates: 36°00'27.51'' N, 119°18'16.66'' E).

Methods

The strata in the Jiankou section belong to the Jiaozhou Formation, mainly consisting of muddy siltstones, siltstones, silty claystones, and claystones, interbedded with sandstones in the lower part and of limestones in the upper part. The Jiankou section is ca. 40 m thick, with eighteen samples collected in muddy siltstones, siltstones, silty claystones, and claystones. One kilogram of sediment per sample was disaggregated in water for several weeks prior to sieving through two sieves of mesh sizes 125 and 1,430 μm. Gyrogonites were hand-picked under a binocular microscope. Fossils were obtained from 12 out of 18 samples, including charophytes from 10 samples. Selected gyrogonites were photographed with a scanning electron microscope (SU3500) at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, China.

Results

Charophytes from Maastrichtian deposits of the Jiankou section in the Jiaolai Basin were studied from the perspectives of taxonomy and paleoecology. The flora is composed of Tolypella grabastii Uliana et Musacchio, Microchara cristata Grambast, Microchara prolixa (Wang et al.) Li et al., Nemegtichara prima Karcewska et Ziembinska-Tworzydlo, Nodosochara (Turbochara) specialis (Wang) Li et al., Lychnothamnus aff. vectensis (Goves) Soulé-Märscbe, and Collichara taizhouensis Wang & Zhang in Wang et al. (Fig. 1). The section is divided into three intervals. The first interval (0–3 m) is composed of green muddy siltstones, deposited in a shallow lacustrine environment. The second interval (3–22

Fig. 1. Charophytes from the Jiaolai Basin. (A–D) C. taizhouensis; (A) Apical view; (B–C) Lateral view; (D) Basal view; (E–G) T. grabastii; (E) Apical view; (F) Lateral view; (G) Basal view; (H–I) M. cristata; (H) Apical view; (I) Lateral view; (J–L) N. (T.) specialis; (J) Apical view; (K) Lateral view; (L) Basal view; (M–O) L. aff. vectensis; (M) Apical view; (N) Lateral view; (O) Basal view.
m) is interpreted as river-dominated delta deposits, including distributary channel deposits of grayish yellow pebbly coarse sandstones and gray fine sandstones, flood plain deposits of grayish green muddy siltstones and siltstones and red silty claystones, and delta front deposits of gray siltstones and claystones with developed foreset beds. The third interval (22–40 m) is composed of grayish green claystones, occasionally interbedded with grayish green siltstones and limestones, deposited in a shallow lacustrine environment.

Conclusion

Charophytes from the Maastrichtian Jiaozhou Formation at the Jiankou section were studied for the first time, providing new data for the exploration of the paleoecology of the charophyte flora. Seven species belonging to six genera were identified. In the second interval, gyrogonites are well preserved, suggesting that these fossils are autochthonous. The flora includes *T. grambastii*, *M. cristata*, *N. (T.) specialis*, and *L. aff. vectensis*, which lives in a deltaic environment. In the third interval, most gyrogonites are well preserved, although some gyrogonites show evidence of erosion and are thought to be parautochthonous to autochthonous. The flora includes *T. grambastii*, *M. cristata*, *M. prolixa*, *N. prima*, *N. T. specialis*, and *C. taizhouensis*, representing a more diverse flora that lives in a shallow lacustrine environment.

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