The Climate Records and Organic Matter Enrichment Conditions of Lower Cretaceous Oil Shale Sequences of Beipiao Basin (NE China)

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Abstract: Beipiao Basin, a large-scale Cretaceous continental basin located in western Liaoning Province, NE China, is adjacent to Chifeng-Kaiyuan Fault in the north and Taohuatu Uplift in Jianchang Basin in the south. It has attracted extensive attention due to the development of oil shale sequences of great thickness in lower Cretaceous K_1jf^3 (Liu et al., 2006; Yu et al., 2013). The thick and uninterrupted oil shale sequence with an average cumulative thickness of 170 m and a maximum cumulative thickness of 350 m provides abundant paleoclimate evolution information, and effective basis for the study of organic matter (OM) enrichment model.Beipiao Basin is a basin group composed of severaldepressions, but these depressions are influenced by different sedimentary systems and there are distinct differences in sedimentation. Previous research on lower Cretaceous oil shale sequences has focus on the southern depressions of the basin (Wang et al., 2013), while the research on the northern part of the basin is relatively few. The present paper discussed the influencing factors of paleoclimate evolution as well as the sources of OM and lake water environment in K_1jf^3 oil shale sequence and established an OM enrichment model, on the basis of abundant organic and in organic geochemical data collected fromthe developing open-pit oil shale quarry of Beitazi

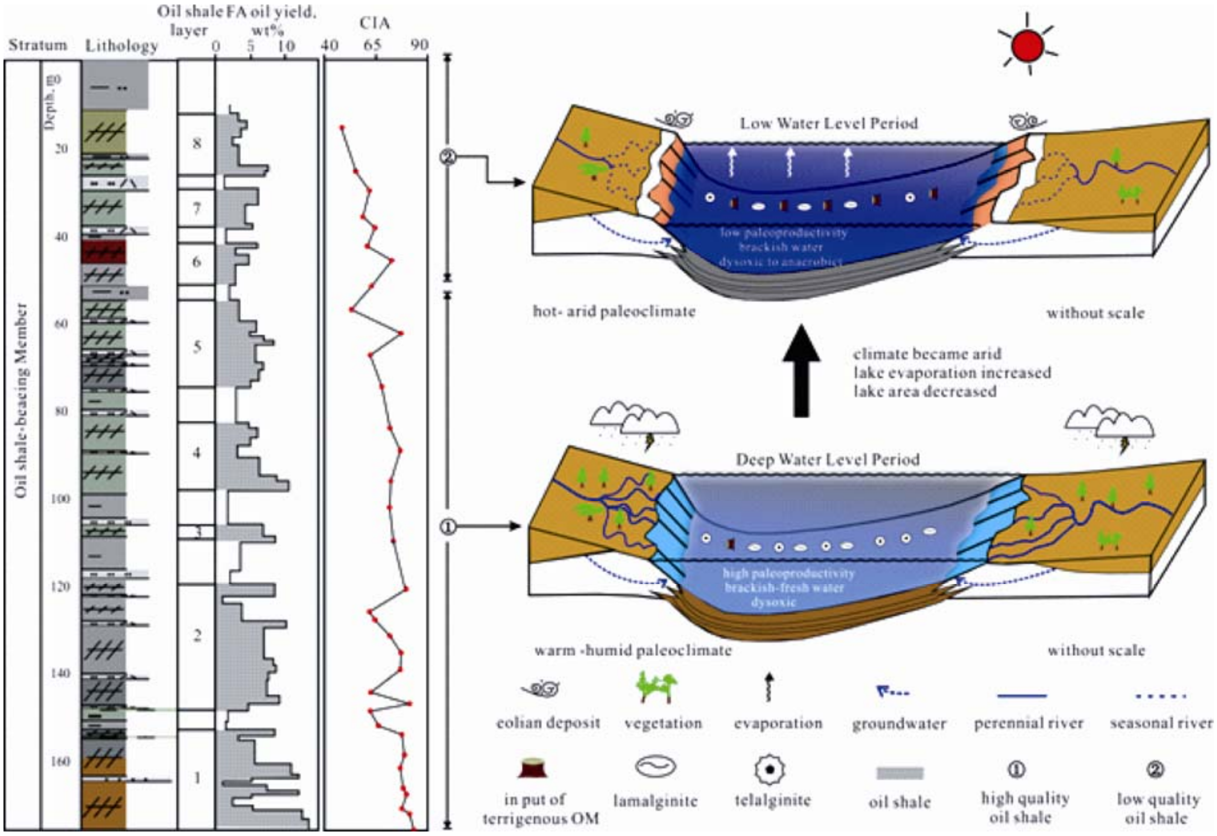

Fig. 1. The paleoclimate evolution and OM enrichment models of K_1jf^3 within Beipiao Basin

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located in the northern part of Beipiao Basin.

According to the organic geochemical data, the TOC content of oil shale in K_1jf^3 is high (avg. 7.61 wt. %). These oil shales are classified as high quality (FA ≥ 5wt.%) and low-quality (5wt.% > FA ≥ 3.5wt.%)by oil yield (FA), among which the former is of sapropel type with alginite (70%) being the main source of organic matter (although the content of exinite (20%) is high)and the latter is of humic sapropel type with the organic matter composed of alginite (54%), exinite (33%), and vitrinite (13%). The CIA and Sr/Cu ratio are used to reflect the paleoclimate (Nesbitt et al., 1982), indicating that the high quality oil shale sequence is in a warm and humid paleoclimate, while during the deposition of low-quality oil shale sequence, the paleoclimate became hot and arid which is also confirmed by sporo-pollen assemblages data (Wang et al., 2016). According to the Sr/Ba, Ca/(Ca+Fe) and HI,V/(V+Ni),Cu/Zn ratio, fresh water and anoxic conditions dominated during the deposition of K_1jf^3 high-quality oil shale sequence. In contrast, the K_1jf^3 low quality oil shale was deposited in brackish water and partially dysoxic conditions. Moreover, strong weathering in humid paleoclimate resulted in the input of a large amount nutrition salt, and the primary productivity of lakes increases with the increase of nutrient salt concentration, which can be confirmed by the correlation between P/Ti and TOC.

The comprehensive research of paleoclimate, sources of OM andlake water environment indicated that there are significant differences in OM enrichment patterns in K_1jf^3 oil shale of different qualities (Fig.1). In summary, warm and humidpaleoclimate, algal blooming and anoxic conditions are the main causes for K_1jf^3 OM enrichment.

Key words: oil shale, paleoclimate, sources of OM, lake water environment, OM enrichment model, Beipiao Basin

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