ENRICHMENT MECHANISM OF ORGANIC MATTER IN SOURCE ROCKS OF THE 2ND MEMBER OF LIUSHAGANG FORMATION IN BEIBUWAN BASIN

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Introduction

The Beibuwan Basin, located in the Beibu Gulf of the South China Sea, is a Cenozoic extensional sedimentary basin (Zhang et al., 2013). The 2nd member of the Eocene Liushagang Formation is the main source rock consisting of oil shales, mudstone and dark shales. This suite of source rocks has high organic matter abundance and good organic matter type (Fu et al., 2017), but the paleoenvironment, mechanism of the enrichment of organic matter and development model of source rock remain unclear (Huang et al., 2012). It is of great significance to define the enrichment mechanism of organic matter and control factors of this suite of source rocks, and to establish the development model of oil shale in the freshwater lake basin, which is also of guiding value to deepen the oil and gas exploration in the study area.

In this work, the enrichment mechanism of organic matter and development model of source rock were studied by comprehensively applying seismic, drilling, logging and geochemical data, adopting geological, geochemical and geophysical research ideas. The data of conventional geochemistry, biomarker, organic maceral and palynology were analysed comprehensively. Based on the distribution characteristics of some nutrition elements(such as P, Fe and Mo) and geochemical parameters(such as 4-methyl sterance index, gammacerane index, S^{2-}, Sr/Cu, Sr/Ca, V/(V+Ni), δCe, $(La/Yb)_N$, V_{S-MnO} (Sugisaki et al,1984)), combined with the La/Yb-$\sum$REE chart (Allegre C J et al,1978), discrimination function chart of major elements and rare earth element partition curve chart, the geochemical characteristics and distribution features of oil shale, mudstone and dark shale of the 2nd member of Liushagang Formation were summarized. Meanwhile, the paleoenvironment of oil shale, mudstone and dark shale were reconstructed, source composition of organic matter was determined. Furthermore, the controlling effects of the provenance properties, paleoproductivity of lake, redox conditions and sedimentation rate on the accumulation of organic matter in oil shale and mudstone shale were analysed. Finally, the eutrophication mechanism of freshwater lake basin water was discussed, and the development model of oil shale in the study area was established.

Results

The results show that the paleoclimate of the 2nd member of the Liushagang Formation is warm and humid with moderate weathering, and the paleoenvironment is a weakly reduced freshwater lake. Under the paleoenvironment of weak oxidation and weak reduction, the reducibility of environment during the formation of oil shale is relatively strong. The phytoplankton and higher plants could contribute to organic matter in the mudstones and shales, but algae are the main sources of organic matter, and their content is higher in oil shales than in mudstones and shale. Algal blooming and subsequently microbially reworking would enhance the anoxic environment and promote the accumulation of organic matter in the middle-deep lake. The development model of oil shale in the 2nd member of the Liushagang Formation in the study area belongs to the phosphorus-controlled algal eutrophication mode of freshwater lakes (Figure 1). The microscopic mechanism has been

described in Algeo (2007), Bostrom (1988) and Wang (2015). Source rocks are mainly distributed in the middle-deep lacustrine facies, which is located in the upper middle part of the lacustrine transgressive system tracts or the lower middle part of the high stand system tracts. In addition, the mineral composition of parent rocks in the source areas is the main factor controlling the formation and distribution of oil shale, mudstone and shale. Both sedimentation rate and redox conditions play key roles during the formation of oil shale.
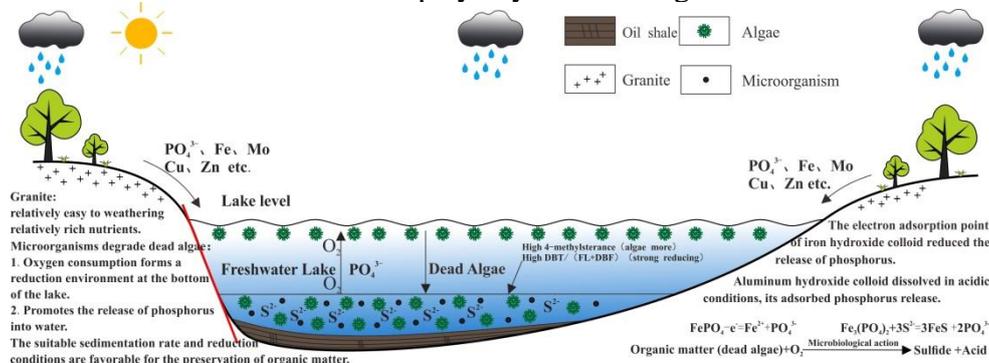

Figure 1 *The source rock development model of the 2nd member of Liushagang Formation in Beibuwan basin*

Conclusions

The development model of oil shale in the 2nd member of the Liushagang Formation in the study area belongs to the phosphorus-controlled algal eutrophication mode of freshwater lakes.

In warm and humid climate, nutrient elements mainly including P, Fe, Mo from provenance, providing nutrition for algae blooming. Algal blooming and subsequently microbially reworking enhance the anoxic environment and promote the accumulation of organic matter in the middle-deep lake.

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