CONTROLS ON THE EARLY CAMBRIAN WELL-DEVELOPED HYDROCARBON SOURCE ROCKS IN CRATONIC BASINS, CHINA

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Introduction

The early Cambrian is well known for rapid increases in life diversities (Landing et al., 2013; Steiner et al., 2007) and extensive accumulation of fine sediments, which is favourable for development of hydrocarbon source rocks (Zhu et al., 2018). Exploration practices have proved that the early Cambrian strata are one of the most important contributors to the discoveries of giant oil and gas fields in China (Zhu et al., 2018; Zou et al., 2014). Numerous studies have been carried out on this strata mainly related to life evolution (Chen et al., 2015; Lenton et al., 2014), sedimentary facies (Yang et al., 2016), redox conditions (Feng et al., 2014; Guilbaud et al., 2018), and source rock characteristics (Lin et al., 2016; Wang et al., 2015; Xu et al., 2018). Most of the source rocks exhibit high TOC (up to 20%) (Zhu et al., 2016). However, controls on the well-developed source rocks are still not clear. Here, we focus on one drill core X1 from Tarim basin and one section (Youyang) from South China, integrating with eight correlative sections to explore the possible controls. Geochemical profiles were generated by using Fe speciation, trace element analysis, petrology observations and organic geochemical measurements.

Results

Ratios of highly reactive iron (FeHR) and total iron (FeT) as well as those of iron in pyrite (Fepy) and FeHR are used to determine paleoredox conditions. The results show that samples from drill core X1 generally exhibited high FeHR/FeT (0.52-1.0, mean 0.88) and high Fepy/FeHR (0.48-0.91, mean 0.79), dominantly indicating euxinic conditions. Whereas, other sections were characterized by moderate-high FeHR/FeT (0.3-1.0) and low-moderate Fepy/FeHR (0-0.81), mainly suggesting ferruginous bottomwaters. In the plot of Fepy/FeHR vs TOC, higher TOC values could be observed for samples forming under euxinic conditions. In addition, high FeHR/FeT and Fepy/FeHR occurred when TOC achieved a great increase either in euxinic or ferruginous conditions. This occurs probably due to the reactions between organic matter and highly reactive iron to form pyrite.

Conclusions

Organic matter tends to be better preserved under anoxic conditions. This study further proves that euxinic conditions are more favourable for well-developed hydrocarbon source rocks with higher TOC. Some certain relationships of TOC with FeHR/FeT and Fepy/FeHR may exist when it reaches a peak. Thus, much work should be conducted on the geochemical reactions in water column that organic matter gets involved in to explore a possible explanation.

References

oxygenation coincided with the Cambrian radiation of animals. Nat. Commun. 6. https://doi.org/10.1038/ncomms8142


