

CHARACTERIZATION OF SEAWATER CONDITIONS FAVORABLE FOR MICROBIAL HYDROCARBON SOURCE-RESERVOIR SYSTEMS IN THE ANCIENT PRECAMBRIAN

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PROJECT OBJECTIVES

- Examine the organic features related to microbial activities and assess the potential of hydrocarbon source rocks in the Ediacaran Doushantuo Formation.
- Analysis of the microbialite types, microbial relics, and reservoir porosity within the microbialite system in the Ediacaran Dengying Formation.
- Explore the Precambrian oceanic conditions and the controls operating on the development of microbe-related source rocks and microbialite reservoirs.
- Establish a model for microbial source-reservoir assemblage systems in the Precambrian.

BACKGROUNDS AND PROJECT RATIONALE

Several commercial Precambrian petroleum systems have been discovered worldwide. Various types of microorganisms have been identified in Precambrian successions contributing to the development of high-quality hydrocarbon source rocks and microbialites with high reservoir porosity (Nutman et al., 2016). However, there are still some key issues which need to be thoroughly explored. For example, what is the role of microbes and which oceanic conditions lead to the development of organic-rich hydrocarbon source rocks and microbialite reservoirs?

Fortunately, widespread black shale source rocks in the Ediacaran Doushantuo Formation, and the directly overlying Dengying Formation microbialite reservoirs in the Sichuan Basin (China), provide the ideal material to address these key issues (Fig.1). The Doushantuo Formation sediments were deposited in shallow to deep water environments, and black shales are distributed within the second and fourth members. The Dengying Formation was deposited in a shallow platform and consists mainly of “algal dolomite” with abundant dissolution pores, especially in the second member (Liu et al., 2016; Zhu et al., 2020).

WORKPLAN

To achieve the project objectives, some future work will be arranged as follows. Black shales from several representative outcrops of the Doushantuo Formation will be investigated and sampled in detail, to measure their TOC, TS, Ro, carbon isotope values, and elemental composition. Palynomorphs in shales will be identified on acidified thin sections. Microbialite samples will be polished and thin sectioned, to identify their petrological, mineralogical and morphological features. SEM-EDS analysis will be conducted to study the potential influence of microbes and associated organic exudates i.e. extracellular polymeric substances (EPS) in these formations. Microbial identification will be based on morphological traits (i.e. size, cell shape,

surface structure), whereas EPS detection will use morphological attributes based on those established in the literature. Crystal dolomite characterization will use SEM-EDS analysis. Porosity and permeability, and micro CT analysis for the Dengying Formation microbialites will be conducted to clarify the features of the reservoir spaces. All acquired data will be used to illustrate the hydrocarbon potential, microbial types, reservoir porosity and Precambrian oceanic geochemistry. Finally, we will propose a model for the microbial source-reservoir system.

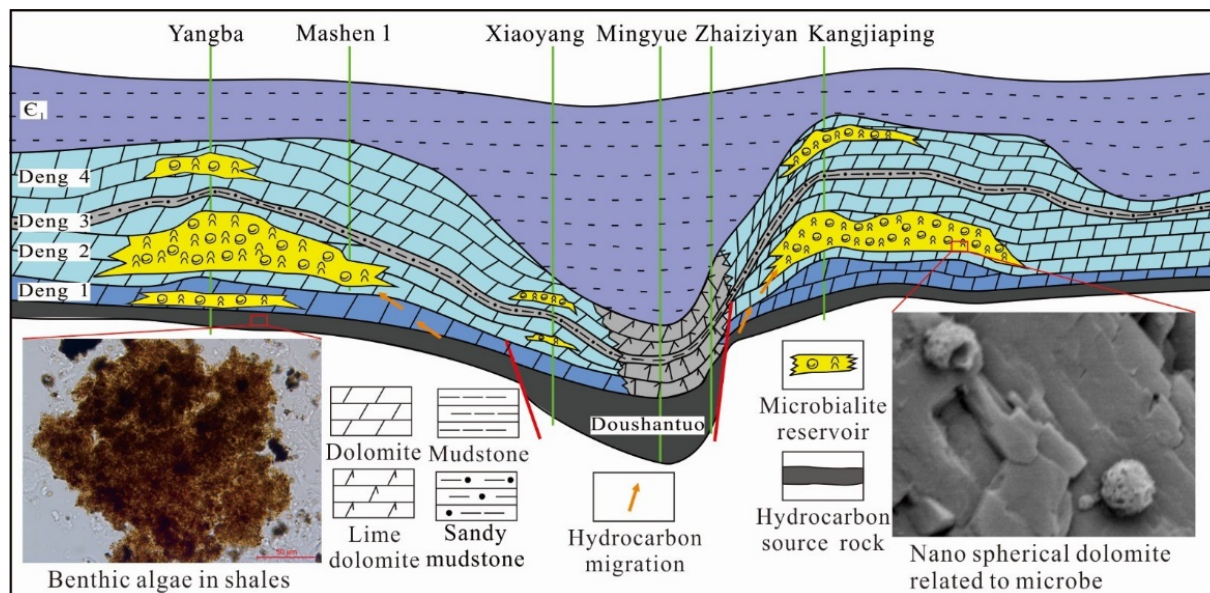


Figure 1: Models of assemblages of source rocks and microbialite reservoirs in Sichuan Basin

SIGNIFICANCE

This study focuses on the development mechanism of both the high-quality hydrocarbon source rocks and microbialite reservoirs in the Sichuan Basin, China. It provides an opportunity to establish the significance of microbes and oceanic conditions on the formation of Precambrian source rocks and microbialite reservoirs.

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