

Fluid migration paths in the marine strata of typical structures in the western Hubei–eastern Chongqing area, China

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Abstract: The western Hubei–eastern Chongqing area is an important prospective zone for oil and gas exploration in the central Yangtze area. Three representative structures, the Xinchang structure, Longjuba gas-bearing structure and the Jiannan gas field, were selected to analyze biomarker parameters in marine strata and to examine various types of natural gas and hydrocarbon sources. Fluid inclusions; carbon, oxygen, and strontium isotopic characteristics; organic geochemical analysis and simulation of hydrocarbon generation and expulsion history of source rocks were used for tracing fluid migration paths in marine strata of the study area. The Carboniferous–Triassic reservoirs in three typical structures all experienced at least two stages of fluid accumulation. All marine strata above the early Permian were shown to have fluids originating in the Permian rocks, which differed from the late stage fluids. The fluids accumulated in the late Permian reservoirs of the Xinchang structure were Cambrian fluids, while those in the late Carboniferous reservoirs were sourced from a combination of Silurian and Cambrian fluids. A long-distance and large-scale cross-formational flow of fluids destroyed the preservation conditions of earlier accumulated hydrocarbons. A short-distance cross-formational accumulation of Silurian fluids was shown in the late Permian reservoirs of the Longjuba structure with favorable hydrocarbon preservation conditions. The fluid accumulation in the Carboniferous reservoirs of the Jiannan structure mainly originated from neighboring Silurian strata with a small amount from the Cambrian strata. As a result, the Jiannan structure was determined to have the best preservation conditions of the three. Comparative analysis of fluid migration paths in the three structures revealed that the zone with a weaker late tectonism and no superimposition and modification of the Upper and Lower Paleozoic fluids or the Upper Paleozoic zone with the fluid charging from the Lower Paleozoic in the western Hubei–eastern Chongqing area are important target areas for future exploration.

Key words: Western Hubei–eastern Chongqing area, marine strata, geochemical tracer, fluid migration path

1 Introduction

The marine carbonate areas of the superimposed basins in the south of China have become important targets for exploration for oil and gas in China. However, as they have a deep burial depth and have experienced multiple cycles of structural movements and intense post-reconstructions, the geological conditions of these areas are especially complicated. The most influential movements are the

Caledonian, Dongwu, Indo-Sinian, Yanshan and Himalayan movements. The multi-phase tectonic activities have to a certain degree reformed and damaged the early excellent preservation condition. It is safe to say that the preservation condition has become a key factor restricting the exploration for oil and gas in these marine carbonate areas in the south of China. Scholars have studied the preservation condition from such perspectives as caprock physical properties, hydrodynamic environment, sealing ability of faults and tectonic movements. It is not possible for us to evaluate the static preservation condition of the complicated areas that have gone through multi-phase tectonic activities from only the perspective of general parameters of caprock physical

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