Basic Characteristics and Exploration Prospect of the Upper Triassic Xujiahe Formation Continental Shale Gas in Sichuan Basin of China

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Abstract

Very little attention were paid for the continental shale sequence compared to marine shale of the Sichuan Basin, although the continental shale owns good conditions for the shale gas accumulation. The further research of shale gas accumulation conditions is meaningful to realize the exploration and development prospects effectively, and to expand the field of exploration and development. Based on the research of the development characteristics, organic type of shale grade of maturity, abundance of organic matter, rock and ore characteristics, physical properties of reservoir, type of pore, and preservative conditions of the continental shale of the 5th sector of the Xujiahe Formation of Upper Triassic in Western Sichuan Depression, oil-bearing property and resource potential are comprehensive studied. The research shows that the thickness of shallow lake facies black mud shale in the 5th sector of the Xujiahe Formation is about 250 to 300 m, and the average of TOC is more than 2% in the mature to high mature stage. The micro-fractures, nano-micron level pores, clay mineral intergranular micro pores and slightly soluble holes are developed in shale, and the quantity of brittle minerals such as quartz, feldspar, carbonates is more than 60%. In spite of multiphase tectonic evolution, the shale’s preservation conditions of shale are excellent. The shale shows very well oil-bearing property. Natural gas was generally released while drilling, and the real quantity of shale gas of the in-situ sample ranges from 0.42 to 6.27 cubic meters per ton, with an average of 1.37 cubic meters per ton, and to absorbed gas mainly, which shows the better characteristics of gas content. The Xujiahe Formation shale has high gas resource potential and high abundance of gas resources. The quantity of the shale gas resource with depth less than 3500m is 0.01 Tcf, gas-bearing abundance is from 10.06×10^8 to 13.15×10^8 cubic meters per square kilometer. The quantity of brittle mineral of the continental shale reservoir in the Xujiahe Formation (quartz and carbonate) is high, which predicts that fracturing is easier to form network fractures, to achieve volume transformation and showing a good development prospects.

Introduction

According to incomplete statistics, shale gas resources in the world are 1.61 Tcf, which are mainly distributed in North America, Central Asia, China, the Middle East, North Africa, Latin America and the former Soviet Union and other regions. Shale gas resources ranges from 0.31 to 0.59 Tcf in China, in which the Paleozoic marine shale gas resources ranges from 0.26 to 0.52 Tcf, accounting for 88% of the total shale gas resources; the rest is ranges from 0.04 to 0.07 Tcf in Mesozoic and Cenozoic marine shale plays (Dong & Zou, et al., 2011). It should be noted that the total shale gas resources of the Xujiahe Formation of Upper Triassic ranges from 0.03 to 0.12 Tcf in Western Sichuan Depression, in which the amount is approximately 0.02 Tcf of the 5th sector of the Xujiahe Formation.

Geological and geochemical characteristics of 5th sector of Xujiahe Formation shale plays

Geological setting

The Sichuan basin, covering an area of 230,000 km^2 and with the shape of an irregular rhombus, is a multiple-cycle sedimentary basin in southwest China. Tectonic evolution of the basin can be divided into an earlier cratonic