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塔里木盆地塔中地区上奥陶统油气相态及其控制因素

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Controlling Factors and Phase State of Hydrocarbons in the Upper Ordovician of the Tazhong Area, Tarim Basin

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摘要/Abstract

摘要 :

在塔中地区上奥陶统已发现7个油气藏, 油气相态分布复杂。结合油气藏形成与分布的地质和地球化学条件, 综合分析了塔中地区油气相态的分布特征和主控因素。结果表明: 塔中地区上奥陶统油气藏由西向东, 从未饱和凝析气藏过渡为饱和凝析气藏|由北向南, 从凝析气藏过渡为未饱和油藏。原油规则甾烷既有呈 $C_{27} \leq C_{28} 29$ 的“反L型”的中—下寒武统烃源岩特征, 又有呈 $C_{27} > C_{28} 29$ “V”字型中—上奥陶统烃源岩特征, 表明主要来自中—下寒武统和中—上奥陶统烃源岩的混源。天然气干燥系数和甲烷碳同位素表明目前正处于高成熟—过成熟阶段, 与中—上奥陶统烃源岩处于成熟阶段不匹配, 表明主要来自中—下寒武统。由于天然气甲烷碳同位素值普遍偏低, $Ln(C_1/C_2)$ 与 $Ln(C_2/C_3)$ 两者大都呈正相关关系, 天然气可能是以原油裂解气为主。油气相态分布主要受控于温度、压力、多期成藏和多期改造。早期温压较低, 又经历了2次构造抬升, 使得早期的油气藏遭到破坏, 临界温度和压力发生改变, 形成未饱和油藏。晚期地层埋深持续增大, 形成高温高压, 同时原油裂解成气对早期油藏气侵, 形成未饱和凝析气藏。中—下寒武统优质储盖组合可能是塔中地区未来寻找天然气的重要领域。

关键词: 塔里木盆地, 塔中地区, 上奥陶统, 油气相态, 主控因素

Abstract:

There have been seven hydrocarbon reservoirs discovered so far in the Upper Ordovician in Tazhong area, of which the hydrocarbon phase distribution is complicated. The distribution features and controlling factors of the hydrocarbon phase in the Tazhong area were investigated based on the geological and geochemical conditions for formulation and distribution of hydrocarbon reservoirs. The results indicated that hydrocarbon reservoir types in the Upper Ordovician of Tazhong area, from west to east, varied from unsaturated to saturated condensate gas reservoirs|and from north to south, changed from condensate gas reservoir to unsaturated oil reservoirs. The regular sterane of the crude oil is of both the “reverse-L type” $C_{27} \leq C_{28} 29$ which means from Lower-Middle Cambrian and the V-type regular sterane $C_{27} > C_{28} 29$ which is from Middle-Upper Ordovician source rocks, so that the crude oil mainly came from the mixture of the Lower-Middle Cambrian and Middle-Upper Ordovician source rocks, while the drying coefficients and carbon isotopes suggested that the natural gas had entered the high to overmature stage of evolution, failing to match the mature stage of the Middle-Upper Ordovician source rock, showing that the natural gas mainly from the cracking gas of Lower-Middle Cambrian crude oil. The carbon isotopes of natural gas are mainly light, and the relationship between $Ln(C_1/C_2)$ and $Ln(C_2/C_3)$ exhibits a positive correlation, thus, the gas was considered to be crude oil cracking gas. The hydrocarbon phase distribution was mainly controlled by temperature, pressure, multiple periods of hydrocarbon accumulation and alteration. The temperature and pressure of the hydrocarbon reservoirs were low in early stage, then they underwent two periods of tectonic uplifts, which altered the critical temperature (T_c) and the critical condensate temperature (T_m) of the early reservoirs, forming unsaturated oil reservoirs. With the increase of burial depth in late stage, the temperature and pressure of reservoirs became high due to the oil-cracking gas flushing of the early oil, forming unsaturated condensate-gas reservoirs. The Lower-Middle Cambrian reservoir-cap assemblage of high quality may be an important target for the future exploration of natural gas in Tazhong area.

Key words: Tarim Basin, Tazhong area, Upper Ordovician, Hydrocarbon phase, Controlling factor

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