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滇东北龙马溪组页岩气地质条件及有利区优选

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Geological Conditions Evaluation and Favorable Areas Selection of the Shale Gas from Longmaxi Formation in the Northeast of Yunnan

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摘要/Abstract

摘要：

通过对滇东北龙马溪组野外剖面实测与样品测试分析,测定样品有机质丰度及成熟度,以X-射线衍射、高压压汞法、气体吸附法及扫描电镜观察等分析页岩储层特征,结合等温吸附实验模拟,综合分析优选有利区。研究表明:①滇东北龙马溪组黑色页岩自南东往北西方向厚度逐渐增大,均分布于其下段,平均厚度大于30m;以盐津县、大关县为中心,地层埋深向外逐渐增大。②平面上,泥页岩TOC值由南往北增大,在盐津西北、威信以北地区TOC值普遍大于2%;垂向上,TOC值在龙马溪组下段平均值大于2%,中上段TOC值均小于1%;实测镜质体反射率平均为3.6%,属于过成熟阶段。③龙马溪组页岩脆性矿物含量较高,属于易压裂改造类型;但与北美主要含气页岩相比,黏土矿物含量较高,脆性矿物(石英等)及碳酸盐矿物(方解石等)相对较低。④压汞实验表明孔隙主要为过渡孔及微孔,从底到顶孔隙开放性逐渐变差;液氮吸附实验表明过渡孔及微孔中小于20nm孔径的孔隙发育较好,且多为开放孔,主要为两端均开口的圆筒孔、圆锥孔、平行板状孔,含有一定量的细颈瓶孔;测定孔隙比表面积为6.479~17.329m²/g,平均为11.425m²/g,总体积为0.006~0.016cm³/g,平均孔径分布范围为3.256~4.367nm。⑤等温吸附实验表明研究区龙马溪组理论最大吸附气含量平均可达3.21cm³/g。在主要参数综合评价基础上,共优选出盐津县—绥江县、大关县北东地区和威信县西南地区3个有利区。

关键词: 页岩气, 滇东北, 龙马溪组, 有利区优选

Abstract:

According to measured profiles and lab tests in the Longmaxi Formation of the northeast of Yunnan, TOC and maturity of the samples were determined. And also, the shale gas reservoirs were investigated by XRD, high pressure mercury intrusion, gas absorption and scanning electron microscope. Besides the above methods, isothermal absorption is also used to evaluate the favorable area in the study area. The results show that: (1) the black shales are distributed in the lower segment of Longmaxi Formation, and the average thickness is more than 30 m and it gradually increases from southeast to northwest in the study area. With Yanjin and Daguan counties as the center, the burial depth of strata increases outward. (2) Regionally, TOC of shale increases from south to north, and it is more than 2% in the northwest of Yanjin and the north of Weixin. Vertically, TOC of shale is more than 2% in lower segment of Longmaxi Formation, but less than 1% in the upper segment of Longmaxi Formation. The measured average vitrinite reflectance of shales is 3.6%, showing that the shales are at the over-mature stage. (3) The shales have more brittle minerals in the study area, so the reservoirs are easy to be artificially fractured. Compared with the major gas shales in the north American, clay mineral contents are higher but brittle minerals (quartz, et al.) and carbonate minerals (calcite, et al.) are less in the study area. (4) Mercury injection experiments show that the pores are mainly transition pores and micro pores, but the pore opening degree decreases from the bottom to top in the Longmaxi Formation. Liquid nitrogen adsorption experiments indicate that pores with diameters less than 20nm are better developed in the transition pores and micro pores. Moreover, the two ends of pores are open, with the shapes of cylinders, cones, parallel plates, and a certain amount of flask pores. Measured pore specific surface area is 6.479-17.329cm²/g, with the mean of 11.425cm²/g. The pore volume is 0.006-0.016cm³/g. The pore average size is 3.256-4.367nm. (5) Isothermal adsorption experiments show that maximum absorbed gas content of the shales in Longmaxi Formation can attain 3.21cm³/g. Comprehensively, this paper has selected three favorable areas for shale gas, including the area between Yanjin and Suijiang county, the northeast of Daguan and the southwest of Weixin.

Key words: Shale gas, Northeast of Yunnan, Longmaxi Formation, Favorable area

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