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川南地区二叠系龙潭组页岩微观孔隙特征及其影响因素

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Microscopic Pore Characteristics and Its Influence Factors of the Permian Longtan Formation Shales in the Southern Sichuan Basin

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PDF (PC)

205

摘要/Abstract

摘要 :

为了评价海陆过渡相煤系页岩气储层性质,采用扫描电镜、高压压汞、低温液氮和CO₂吸附等实验方法,对川南地区二叠系龙潭组页岩微观孔隙的发育情况、结构特征进行研究,并分析龙潭组页岩孔隙发育的主要影响因素。结果表明:川南地区龙潭组页岩储集空间多样,常见粒间孔、溶蚀孔和有机质孔,孔隙形态以圆形、椭圆形、三角形、不规则状为主,这些微观孔隙为页岩气赋存提供储集空间。龙潭组页岩纳米级孔隙以微孔和介孔为主,占孔隙总体积的56.2%,占总比表面积的80%以上,是页岩气赋存的主要载体;孔隙与比表面积呈正相关性,其中介孔(BJH)孔容、微孔(DFT)孔容与比表面积线性关系拟合较好;页岩孔隙结构类型主要以平板狭缝型、柱形和混合型为主,孔径主要分布于0.2~1nm、3~30nm之间,平均为4.66nm。龙潭组页岩气储层孔隙发育受页岩的有机碳含量和成熟度影响较大,孔隙度和孔容随有机碳含量增大而增大,并与成熟度有密切关系;黏土矿物一定程度上利于储层孔隙发育,与页岩总孔容呈正相关性,脆性矿物则相反。

关键词: 页岩气储层, 龙潭组页岩, 微观孔隙, 孔隙结构, 气体吸附, 川南地区

Abstract:

In order to evaluate the marine-terrestrial shale gas reservoir in coal measures,the morphologic development characteristics and structure of microscopic pores in shale samples from the Permian Longtan Formation in the southern Sichuan Basin were studied,and their major influencing factors of shale pores are analyzed in this paper,by using scanning electron microscope(SEM),high-pressure mercury injection,low-temperature liquid nitrogen absorption and carbon dioxide absorption.The results show that there are many kinds of reservoir spaces,such as intergranular pores,dissolution pores and organic pores.The main pores are in circular,oval,triangular,and irregular shapes.These microscopic pores provide reservoir space for shale gas.The nano-scale pores in the Longtan Formation shale samples are dominated by micropores and mesopores.Both micropores and mesopores provide with 56.2% volume and over 80% specific surface area of total pores,and they are favorable for shale gas accumulation.There is a positive correlation between pore volume and specific surface area,and the relation between BJH volume,DFT volume and specific surface area is better.The pore structure is mainly with plate slit type,cylindricity,and mixed types.The pore aperture is mainly distributed in 0.4-1nm,3-30nm,and averaged at 4.66nm.All the organic carbon content,maturity(R_o) of organic matter and clay minerals are certain favorable for the development of reservoir pores,while the content of brittle minerals has the opposite relation to it.

Key words: Shale gas reservoir, Longtan Formation shale, Microscopic pore, Pore structure, Gas adsorption, Southern Sichuan Basin

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