

含气页岩破坏模式及力学特性的试验研究

李庆辉^{1, 2}, 陈 勉¹, 金 衍¹, WANG F P^{2*}

(1. 中国石油大学 石油工程系, 北京 102249; 2. 德克萨斯州立大学 经济地质局, 奥斯汀 美国 78758)

EXPERIMENTAL RESEARCH ON FAILURE MODES AND MECHANICAL BEHAVIORS OF GAS-BEARING SHALE

LI Qinghui^{1, 2}, CHEN Mian¹, JIN Yan¹, WANG F P^{2*}

(1. Department of Petroleum Engineering, China University of Petroleum, Beijing 102249, China;

2. Bureau of Economic Geology, University of Texas, Austin, Texas 78758, USA)

摘要

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摘要 采用MTS815试验机对取自北美Barnett, Haynesville, Eagle Ford和中国南方下志留统龙马溪组含气页岩进行三轴压缩试验, 获得不同应力条件下含气页岩的破坏模式和力学行为, 并对比分析中美含气页岩力学特性上的差异。破坏模式上, 低围压测试时含气页岩破坏模式以劈裂式、双剪切破坏为主, 高围压测试时以单剪切破坏为主。页岩种类、天然埋深、取芯角度和测试围压与其力学特性关系明显; 矿物组成中脆性矿物含量越高, 脆性特征越显著, 碎裂越完全。页岩极限承载力与围压大小关系显著, 围压增加, 极限承载力升高, 弹性模量总体趋势为缓慢增加, 围压超过30 MPa后弹性模量迅速增加, 页岩的峰值强度与围压大致呈线性关系。Barnett页岩的强度高于Haynesville页岩, 低于Eagle Ford页岩; 中国南方页岩与北美页岩相比强度和弹性模量更高, 泊松比更低, 脆性特征大致相当。

关键词: 岩石力学 含气页岩 围压 破坏模式 力学特性

Abstract: Testing system MTS 815 is used to carry out triaxial compression tests for specimens from Barnett, Haynesville, Eagle Ford in North American, and Longmaxi shale in South China. Their failure modes and mechanical behaviors under different confining pressures are obtained correspondingly. The similarities and differences between them are analyzed in detail. Splitting failure and splitting-shear mixed failure modes are the main failure modes for shale samples under low confining pressures, while shear failure modes predominate under higher pressures. The types of shale, burial depth, coring direction and confining pressures are all factors affecting the mechanical behavior of specimens. More quartz and carbonate contained specimen tends to be more brittle. In addition, the peak strength and Young's modulus of shale are proportional with confining pressure, especially when the confining pressure is higher than 30 MPa. The peak strength of Barnett shale is higher than Haynesville, but lower than Eagle Ford. Shale samples from South China, compared with that from North America, have higher strength and Young's modulus, while lower Poisson's ratio. The brittleness characteristics of shale samples from China is similar to that from America.

Keywords: rock mechanics gas shale confining pressure failure modes mechanical behaviors

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