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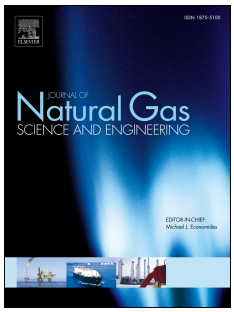

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An Experimental Investigation of Geomechanical Properties of Deep Tight Gas Reservoirs

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Abstract

An ultra-deep well (-3700m–7,000m) has high formation temperature (100–180 °C) and interlaced distributed lithology in longitude which has significant influence on wellbore stability and hydraulic fracture propagation. At present, few findings are available for a systematic understanding of different lithologies' deformation properties and fracture-cave structures under high-temperature. In this paper, a series of rock mechanical tests are conducted to study the rock mechanical properties of different lithologies under different temperatures. The results show that the influences of temperature on strength and failure mode for different lithologies are not the same. Under high temperature, the strength of fine sandstone and argillaceous fine sandstone increases slightly while the strength of medium sandstone and mudstone decreases seriously. As to failure mode, mudstone suffers from tensile failure and sand stones suffer from shear failure under the experiment condition in this study. For carbonate without crack, strength decreases as temperature increases when the temperature is higher than 80 °C; for carbonate with macrocrack developed, if the rock failure zone is parallel to the crack trend, the fracture strength will rapidly decline as the temperature increases. However, if the rock failure zone is vertical to the crack trend, the influence of temperature will be small. For shale, the strength and elasticity modulus are lower and the Poisson's ratio is higher under the condition of high temperature and low confining pressure. As to failure mode, shale suffers from tensile failure at 25°C, and suffers from shear failure or tensile-shear combined mode at 110°C. Based on the experiment results, a modified Duncan model for mudstone considering temperature influence is established, which could be used in the study of wellbore stability and hydraulic fracturing.

Keywords: ultra-deep well; rock mechanic parameters; high temperature; failure mode; modified Duncan model.

1. Introduction