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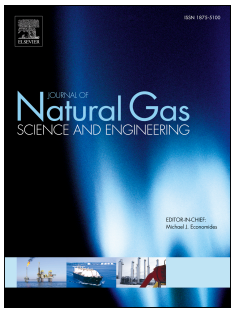

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Experimental investigation of *in situ* stress relaxation on deformation behavior and permeability variation of coalbed methane reservoirs during primary depletion

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Abstract

Dynamic evolution of coal deformation and permeability, induced by changes in *in situ* stresses with continued depletion in coalbed methane (CBM) reservoirs, has been extensively investigated both experimentally and theoretically. However, the impact of stress-/strain-controlled mechanics on permeability variation is somewhat unclear. To examine this behavior, gas flow experiments were conducted under best replicated *in situ* conditions. Considering that coal anisotropy may lead to changes in deviator stress and coal failure behavior during primary depletion, core flooding experiments were carried out to investigate the anisotropic behavior of coal. Using the experimental results, Mohr's circle of strain was first employed to facilitate the process of analyzing the dynamic deformation behavior of coal. Next, a strain-based failure criterion was developed to analyze the failure tendency of CBM reservoirs in order to explain the sudden increase in permeability observed during experimental work. The results show that the abrupt increase in permeability can be attributed to shear failure of coal due to increased deviator stress resulting from *in situ* stress redistribution after significant depletion. This study sheds light on the influence of stress relaxation on coal deformation behavior, failure tendency and permeability evolution, with practical implication for gas flow modeling of CBM reservoirs.