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Compartmentalization Analysis of Joint and Cleat Systems Associated with Coalbed Methane Reservoirs in the Black Warrior Basin: A Discrete Network Approach

Landowner concerns related to coalbed methane operations in the Black Warrior basin of Alabama include contamination of shallow sources of domestic groundwater by hydraulic fracturing and drawdown of shallow groundwater supplies by withdrawal of water from deep coal zones. Although no claim of contamination or drawdown has been substantiated, new regulations intended to address these concerns have placed a hardship on gas producers. To help determine if coalbed methane operations can affect shallow aquifers, we are developing discrete network compartmentalization models of joint and cleat systems in the Black Warrior basin using FracMan software.

Discrete fracture networks are three-dimensional stochastic models of fracture architecture that incorporate statistical scaling rules derived from analysis of fracture length, height, spacing, orientation, and kinematic aperture. Once statistical properties of fracture systems are derived, compartmentalization models can be developed based on adjacency analysis of transmissive fractures. Basic data on joint and cleat systems in coalbed methane reservoirs of the Black Warrior basin were derived from core and outcrop. The fracture systems are mainly stratabound, thus hydrologic connections between beds are mainly near the tip regions of the fractures. Kinematic aperture in coal, sandstone, and shale obeys exponential distributions. These distributions dictate that flow is concentrated in relatively few fractures and that connectivity among beds is limited. Accordingly, compartmentalization analysis of discrete network models indicates that multiple no-flow boundaries exist between reservoir zones and shallow aquifers, and that shallow supplies of domestic groundwater are protected from coalbed methane operations.