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Richard H. Groshong[1], Jack C. Pashin[2], Michael Cox[3], Guohai Jin[4], Marcella McIntyre[1] (1) University of Alabama, Tuscaloosa, AL (2) Geological Survey of Alabama, Tuscaloosa, (3) Science Applications International, Anniston, (4) Geological Survey of Alabama, Tuscaloosa, AL

Structural Controls on Fracture Permeability Distribution Indicated by Coalbed Methane and Water Production in the Black Warrior Basin, Alabama

Production of both water and gas from coalbed methane reservoirs in the Black Warrior basin depends on flow conduits provided by natural fractures. Deerlick Creek Field contains extensional folds and faults, and heterogeneous fluid production is related to the map-scale geologic structure. In this field, an exceptional gas-producing well is typically an exceptional water producer, but an exceptional water producer is not necessarily an exceptional gas producer. Abundant well control allows the field to be accurately mapped in three dimensions. Six normal faults divide the area into a horst, five half grabens and one full graben. The faults themselves are zones of very low water and gas production and segment the reservoir into blocks having significantly different productivity. The two most productive fault blocks are half grabens in the eastern part of the study area. The three other half grabens have low productivity, presumably because they are west of the thermogenic gas window. The horst and full graben have limited productivity even though the coal is thermally mature. This suggests that moderate deformation (half grabens) may enhance fracture transmissivity relative to areas of no deformation (the horst), and that excessive deformation (the full graben) reduces transmissivity. Extreme variation of well performance within the most productive areas suggests that heterogeneous fracturing makes the productivity of individual wells difficult to predict. Discrete network analysis of joint systems in these reservoirs suggests that this heterogeneity is the product of bed-delimited fracture systems in which fracture apertures obey exponential distributions.