

Hydrodynamic Control of Coalbed Methane Reservoir Performance in the Black Warrior Basin, Jack C. Pashin, Geological Survey of Alabama, P.O. Box 869999, Tuscaloosa, AL 35486-6999, jpashin@gsa.state.al.us

The Black Warrior Basin of Alabama hosts a prolific coalbed methane play in the Pottsville Formation (Pennsylvanian), with 4,180 wells producing 3.4 Bcm of gas in 2004. Gas is produced from five to 25 bituminous coal seams at depths between 150 and 1,200 m. Reservoir coal beds are exposed in a steep fold limb that marks the southeast basin margin. A broad range of geologic, hydrologic, and production data indicate that this folded basin margin is a site of meteoric recharge that dominates basin hydrodynamics and influences reservoir performance. Fresh-water plumes containing bicarbonate waters with low TDS extend from the recharge area into the interior of the basin. Northwest of the plumes, coal beds contain mainly chloride waters with moderate to high TDS. Carbon isotopic data indicate that fresh water facilitates bacterial methanogenesis and high gas content, and production operations have been most successful where TDS content is less than 10,000 mg/L.

The recharge system apparently controls the pressure regime and the production characteristics of the reservoirs. Initial reservoir pressure is typically normal near recharge, and underpressured distal to recharge. Water production is characteristically high proximal to recharge and minimal distal to recharge. Gas production throughout the basin is highly variable, reflecting significant reservoir heterogeneity, but a correlation exists between original reservoir pressure and production-decline characteristics. In normally pressured, water-wet reservoirs, production can increase for up to 4 years before exponential decline is established. In drier, underpressured reservoirs, peak production rates are typically achieved within the first year of production. Accordingly, low water production rate and short time to peak gas production favor reservoirs that contain fresh water and are distal to recharge areas.