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Coalbed Methane in the Fruitland Formation, San Juan Basin, Western USA: A Giant, Unconventional Gas Play

In 1998, coalbed methane production in the U.S. was 1.2 Tcf or 6.3% of the gas produced in the Lower 48 states. That same year, coalbed methane reserves were 12.2 Tcf, or 7.4% of the USA dry gas reserves. The San Juan Basin of Colorado and New Mexico is the leading producer of coalbed gas in the world. Original coalbed gas in-place was approximately 50 Tcf in the Fruitland Formation (Upper Cretaceous) in the San Juan Basin. In 1996, the San Juan Basin produced approximately 800 Bcf of coalbed methane; cumulative production through 1998 was approximately 6.2 Tcf.

The San Juan Basin can be divided into 3 regions with markedly different coalbed gas production behavior that results from contrasting geologic and hydrologic settings. In the north part of the basin (Area 1), individual Fruitland coal beds are as much as 35 ft thick, and total coal thickness is as great as 100 ft. Coals are thermally mature for gas generation ($R_o \geq 0.78\%$), and the formation is overpressured. Methane makes up more than 97% of the hydrocarbon content of coalbed gas from this area, and carbon dioxide comprises 3 to 10% of the coalbed gas. Commonly, coalbed wells in Area 1 produce 100 to 350 Mcf/d gas during their best year and 100 to 300 (bbls/d) water on initial completion. Fracture stimulation is the most effective completion method in Area 1.

The coalbed gas "fairway" (Area 2) is a northwestward-trending area located along the southwest margin of Area 1. It is characterized by thick, thermally mature, gas-saturated (in some areas) coals. The area is overpressured, and there is potential for upward flow. Methane comprises more than 97% of total hydrocarbons in fairway coalbed gas; carbon dioxide comprises 6 to 13% of the gas. Coalbed gas wells in Area 2 commonly produce between 1 and 15 MMcf/d gas during their best year and 50 and 400 bbls/d water on initial completion. An open-hole cavity completion is commonly used in Area 2.

Area 3 is in the west-central part of the San Juan Basin. Generally, individual coal beds are less than 20 ft thick, and total coal thickness is 50 ft or less. Coal beds are underpressured. The coal is thermally immature ($R_o \leq 0.50\%$). Methane commonly comprises 94 to 97% of total hydrocarbons, and carbon dioxide makes up less than 1.5% of coalbed gas from this area. Coalbed wells produce 30 to 500 Mcf/d (commonly 150 to 250 Mcf/d) gas during their best year and little or no water on initial completion. Fracture stimulation is the most effective completion method in Area 3