Testimony
NMOCC Case No. 12888
Application of Fruitland Coalbed Methane Study Committee
San Juan, Rio Arriba, McKinley, and Sandoval Counties, New Mexico

May 23, 2003

Prepared for:

Mr. J. Scott Hall
Miller, Stratvert & Torgerson, P.A.
150 Washington Avenue, Suite 300
Santa Fe, NM 87501

Prepared by:

James O. Murphy
Staff Geologist
ConocoPhillips Company
600 N. Dairy Ashford
Houston, TX 77252-2197
Phone 832-486-2361

TESTIMONY

My name is James O. Murphy. I reside in Houston, TX. I am Staff geologist employed by ConocoPhillips, one of the applicants in these proceedings.

I am a petroleum geologist and stratigrapher by education, background, and experience. I have not testified or been qualified as an expert or not had my credentials accepted by the New Mexico Oil Conservation Division.

A brief summary of my education, credentials, and experience is presented below
I have the following degree:
B.A. in Geology from the Hartwick College (1977 with honors)

From 1979-1980, I was a wellsite geologist with Continental Laboratories working the Anadarko basin of Oklahoma, the Texas panhandle and SW Kansas.

Since 1980 I have been employed by Conoco as a geologist. Work assignments include 5 years in Oklahoma City, followed by 5 years working the Gulf of Mexico, both shallow and Deep-water regions. This was followed by 3 years working the North Slope of Alaska both as a geologist and as an Exploration Supervisor.

In 1993 I was transferred to Midland Texas and this began my involvement with the San Juan Basin. Since 1993 I have worked the San Juan Basin both as a geologist and as a supervisor except for an 18-month period when I was working the Val Verde Basin of West Texas. My responsibilities in the San Juan Basin have included the development of both conventional Pictured Cliffs, Mesa Verde and Dakota sandstone reservoirs, in New Mexico, as well as the development of the Fruitland coal in both New Mexico and Colorado.

I am familiar with the application filed in this case and with the lands and wells that are the subject of this proceeding. My testimony is based on sufficient facts and data and is the product of reliable principles and methods which I have applied reliably. My opinions and conclusions are based on facts, data, and methods of analysis reasonable relied on by experts in the fields of petroleum geology and stratigraphy.

SUMMARY OF INVESTIGATIONS

The focus of my investigations and testimony in this case has been to address the following points, and will be based on published reports and data as well as internal work within the ConocoPhillips organization.

1. To better understand the distribution of the Fruitland Coal seams in the High Rate fairway portion of the San Juan Basin: (both HPA and LPA Areas)

2. To better understand the controls on the production of Coal Bed Gas out of the Fruitland Coal seams in the High Rate Fairway portion of the San Juan Basin

3. To determine if infill wells drilled into the Fruitland Coal will recover additional reserves that would otherwise not be recovered.

4. The focus will be on local changes as apposed to regional variations in the coal and production. By local I am referring to changes from one drill location to its immediate offsets, and not changes that occur from township to township.

SUMMARY OF CONCLUSIONS

From my investigation, I have reached the following conclusion:

Do to the stratigraphic complexity and heterogeneity of reservoir properties infill wells targeting the Fruitland Coal seams will increase ultimate recovery from presently producing coal seams, recover additional gas from untapped coal seams, and as a result prevent waste.

This conclusion is supported as follows:

1. The Fruitland formation is a multi-layer, stratigraphicly complex formation representing many different depositional environments.

2. The geologic characteristics of the Fruitland Coal packages vary both laterally within an individual seam and vertically between different seams. These different characteristics are the result of depositional, and post depositional processes.

3. Because of the different geologic history that the individual coal seams have gone through the resulting reservoir characteristics vary from coal to coal.

4. Gas production from coal seams is controlled by the characteristics of the individual coal seams.

A more comprehensive discussion of these points follows:

Coal is the product of both biological and geological processes: biological in that it is formed from the preserved remains of growing plants, and geological in that where it accumulates and what form it exist in today is controlled by sedimentological, tectonic, and geothermal processes. The plants that make up the coals can be of many types and can be deposited in different peat forming environments, some of these environments include: rheotrophic (stream fed) swamps containing herbaceous and woody plants; swamp forests, where trees are the major component; marshes where the dominate plants are grasses, reeds or sedges; ombrotrophic (raised) bogs with woody and/or herbaceous plants; bog forests, raised bogs made up of mainly trees. As well as having different plants in these different environments, the sedimentary processes can also vary greatly from one of these environments to the other. It is these sedimentary processes and variations in plant type that lead to variations in coal seam distribution and coal characteristics that we see in the sub surface today in the San Juan Basin.

The Fruitland Coal seams of the San Juan Basin of New Mexico and Colorado where deposited on the western flank of the Late Cretaceous Western Interior Seaway. This was a shallow inland sea that stretched from present day Texas to the North Slope of Alaska. During this time there were a series of transressive-regressive depositional cycles, as the relative sea level rose and fell. These depositional cycles are marked by the deposition of the Gallup, Point Lookout. Cliff House, and Pictured Cliffs sandstone deposits. The one that we are interested in here is the last of these regressive cycles, as the shallow seas receded from San Juan Basin for the final time. During this regression the Lewis Shale was deposited in a marine environment followed in a landward direction by the littoral Pictured Cliffs Sandstone, then the paralic Fruitland Formation, and then the alluvial Kirtland Shale. It was during this time that the Fruitland coals were deposited in an environment in a lot of ways very similar to the present Gulf Coast of Texas. There were many different sub-environments, bays, beaches, river channels, deltas, tidal inlets, and peat mires. Most of the fossils identified in the Fruitland Formation are of a fresh water origin but some brackish-water fossils have been identified.

Fassett has shown that the Fruitland coal seams form a seaward stepping en echelon pattern, with each younger stratigraphically higher package extending further basin ward to the northeast as the older, lower seams pinch out into the littoral sands of the Pictured Cliffs. Because of this; the "upper" coal package in one well may correlate with the "middle" coal package in another well a few miles to the northeast, and the "basal" coal package in another well even further to the northeast. Individual coal beds of the Fruitland commonly lack lateral continuity and are frequently disrupted, being either totally absent or drastically thinned or changed within the distance of the well spacing in the basin, (either 320, 160 acre spacing or less). Some of the processes that can lead to such drastic changes are erosion by fluvial, or tidal channels, rapid pinch outs into fluvial margin deposits, shale outs into lacustrine, or lagoonal mudstones, thinning over paleotopographic highs, or splitting by flood deposits or cravasse splays. These processes that can eliminate or change the distribution of the coal seams and can also effect the composition of the coal and thus the primary characteristics of the coal. By changing the environment of deposition the type of plants that exist at a specific location can change, or the amount of impurities deposited with the organic material can change. The thickest and cleanest (low ash content) coals were deposited in ombrotrophic bogs forests of rheotrophic swamp forests well away from influxes of fluvial or overbank deposition. These coals tend to be more continuous. Portions of the coal swamps that bordered fluvial distribution received influxes of sediment-laden floodwaters or channel sands causing the coals to be discontinuous, and more sediment rich. From this discussion one can envision that the Fruitland coal deposits contain numerous lateral discontinuities, and lateral variability in coal quality. Given this highly heterogeneous formation our confidence in predicting the potential or offset locations for coal quantity and quality is rather low. And in some cases wells drilled within a few hundred feet from existing wells are hard to correlate.

The three primary characteristics of coals are: **rank**, the maturity of the coal; **grade**, the amount of inorganic impurities or mineral matter in the coal, and, **type** the kind of plant remains that that make up the coal. These characteristics determine the physical and chemical make up of all coals and have been use to categories coals. The changes that we see in grade and type can be very localized because they are closely related to variations in depositional environment. On the other hand the rank of the coal, due to its tie to burial history and geothermal gradients, tends to vary more on a regional basis. Because of this fact I will not discuss the characteristics of rank in very much detail in this preceding.

The rank of the coal is very important in understanding the gas content and cleat development of the coals. As the coals become more mature the gas content increases and the coals develop an internal fracture system called cleating. The macro porous cleat system in the Fruitland coals in the San Juan Basin is the number one control on permeability. If the coals are not mature enough, or are too mature the macro porous cleat system is not developed and the coals tend to have lower permeability. The characteristics of grade and type have an effect on the cleat development during the maturation process and thus an effect on the permeability of the coals.

Coal Grade: Coal is defined as a rock containing 50% or more by weight or 70% or more by volume of carbonaceous matter. The grade of a coal is a measure of the non-carbonaceous impurities that make up the remainder of the coal. Sand, silts and clay usually make up the largest percentage of this constituate. These impurities are usually introduce to the coal forming environment when a clastic rich system of either a stream channel, crevasse splay or flood event migrates into the peat bog. The commonly use measure of this is referred to as the ash content of the coal. For the Fruitland coals ash content ranges from 5 to 50 percent, with concentrations greater then 50% being carbonaceous shales. The ash content in the coal can have a number of effects on the physical properties of the coal. The presence of ash in the coal can increase the strength of the coal, and make the coal less brittle. This can have a negative effect on the creation of the cleats during the maturation process, and lead to the development of permeability barriers or baffles, that can affect the drainage of the gas within the coals.

Coal Type: The coal type refers to the organic fraction of the coal. The organic fraction can be very heterogeneous containing many different components. Various classifications have been used in typing coals, from easily observed macroscopic characteristics such as vitrain for glassy, clarain for bright, durain for hard, or fusain for charcoal. Petrographic maceral analysis is another very useful technique in typing coals. In this technique the altered but recognizable plant material is identified. Three maceral groups have been classified they are vitrinites, liptinites, and inertinites. These macerals reflect the sort of plant material from which the coal was formed and the kind of alteration that the plant material was subjected to in the depositional environment. Vitinites are made up of the woody tissues of plants or cell wall material. They are the most common constituents of North American coals with the percentages varying from 50 to 90 percent. Vitrinite maceral coals are usually the bright coal lithotypes. The vitrinite rich, bright, blocky coals usually make the best gas reservoirs because they tend to be more brittle and have better developed cleating. Liptinite macerals form from the remains of the outer layers of leaves, needles, shoots, stalks, seed and spore coatings, pollen and resinous secretions. Liptinites are not as abundant as vitinites comprising usually 10 percent or less. The parafinitic oils that are produced at a few locations from the Fruitland coals are thought to be sourced from these lipitnitic coals. The depositional environment that produce these type of coals appear to be very localized. The ConocoPhillips 31-6 Unit # 205 well encountered this high parafinitic hydrocarbon to a degree that it hindered the gas production. A replacement well the 205R was drilled about 1000 feet to the southwest and encountered no mobile paraffin. These coals tend to be less brittle then the vitinitic coals and exhibit a lower degree of cleating. Like the ash content this may be another factor in the permeability heterogeneity that is observed in the basin. Inertinites like vitrinites are formed from woody tissues, the difference being that they have been highly altered through oxidation. They usually appear to be composed of discrete particles and tend to be friable and the cleating that does develop is irregular and not well developed. As a result their cleat permeability is low.