

# Geometry and Depositional Environment of Fruitland Formation Coal Beds, San Juan Basin, New Mexico and Colorado: Anatomy of a Giant Coal-Bed Methane Deposit

James E. Fassett<sup>1</sup>

## ABSTRACT

Coal-bed methane resources in Fruitland Formation coal beds, San Juan Basin, New Mexico and Colorado, have recently been estimated to exceed 50 trillion cubic feet of gas. This enormous resource is only beginning to be tapped in the northern part of the basin, principally on the Southern Ute Indian Reservation in southwest Colorado. In order to develop exploration plans for the production of this resource in the most efficient and orderly manner, the detailed geometry of individual Fruitland coal beds must be carefully mapped. Previously published studies relate environments of deposition of the Fruitland and associated rocks to Fruitland coal-bed geometry throughout the San Juan Basin and provide guidelines that should make such coal-bed mapping easier and more accurate. The principal guidelines are: 1) Coal beds can only be correlated by using the Huerfanito Bentonite Bed of the Lewis Shale as a datum. 2) Depositional strike of Fruitland coals trended northwest. 3) Fruitland coals occur in an en echelon arrangement and rise 1,200 feet stratigraphically from southwest to northeast across the basin. 4) Coals generally thicken and terminate abruptly northeastward. 5) Coals generally thin and split southwestward. 6) Along depositional strike, coals may terminate abruptly against or be cut out by stream-channel deposits.

## INTRODUCTION

The San Juan Basin of northwest New Mexico and southwest Colorado (fig. 1) contains large tonnages of coal in several Upper Cretaceous rock units. One of these units, the Fruitland Formation, has been described in detail in a paper by Fassett and Hinds (1971). That study showed that the distribution of the thickest total coal in the Fruitland seemed to coincide with the locations of large vertical buildups of the underlying regressive-marine Pictured Cliffs Sandstone. Because of this relationship, it was possible to develop a model describing how the distribution of coal in the Fruitland Formation was closely tied to the depositional history of the Pictured Cliffs Sandstone.

In this report I present a summary of the Fruitland coal depositional model of Fassett and Hinds (1971) and discuss the basinwide distribution and geometry of the Fruitland coal beds to illustrate some of the problems in coal-bed correlation and present apparent physical constraints on the movement of coal-bed methane through Fruitland coal beds and associated rocks throughout geologic time. Most of the data, all of the illustrations, and some of the text in this report are from Fassett and Hinds, 1971 and more recently, Fassett, 1986. (This report is a slightly revised version of a paper by Fassett published in 1987.)

<sup>1</sup> U.S. Geological Survey  
Box 25046, MS 939, DFC  
Lakewood, Colorado 80225

## GENERAL GEOLOGY

The central part of the structural San Juan Basin is outlined in figure 1 by the outcrop of the Fruitland Formation. The basin outline is roughly circular in shape, except for the linear north-trending east side. The basin structure is asymmetric (fig. 2) with its northwest-trending axis located near, and parallel to, the northeast rim of the basin. Dips around the northwest, north, and east parts of the basin are 20-40 degrees, whereas dips on the west and south sides are quite gentle and average less than a degree. The diameter of the basin is about 100 mi and its surface area is about 7,500 mi<sup>2</sup>.

Upper Cretaceous rocks have produced most of the oil and gas in the San Juan Basin; they range from 0 to 6,000 feet thick and consist of cyclically interbedded marine and non-marine rocks. These rocks represent a remarkably complete record of a series of transgressions and regressions of the western shoreline of the Western Interior Upper Cretaceous seaway into and out of the San Juan Basin area (the location of the basin relative to this seaway is shown on fig. 3). The Fruitland Formation and its coal beds are intimately associated with the last regression of the Western Interior seaway from the San Juan Basin area.

## GAS AND OIL RESOURCES

The San Juan Basin is a vast storehouse of gas, oil, and coal. In the conterminous United States the San Juan Basin gas field is second in size only to the Hugoton field of Oklahoma, Texas, and Kansas. Total cumulative gas production in the basin (through 1982 for the New Mexico part and through

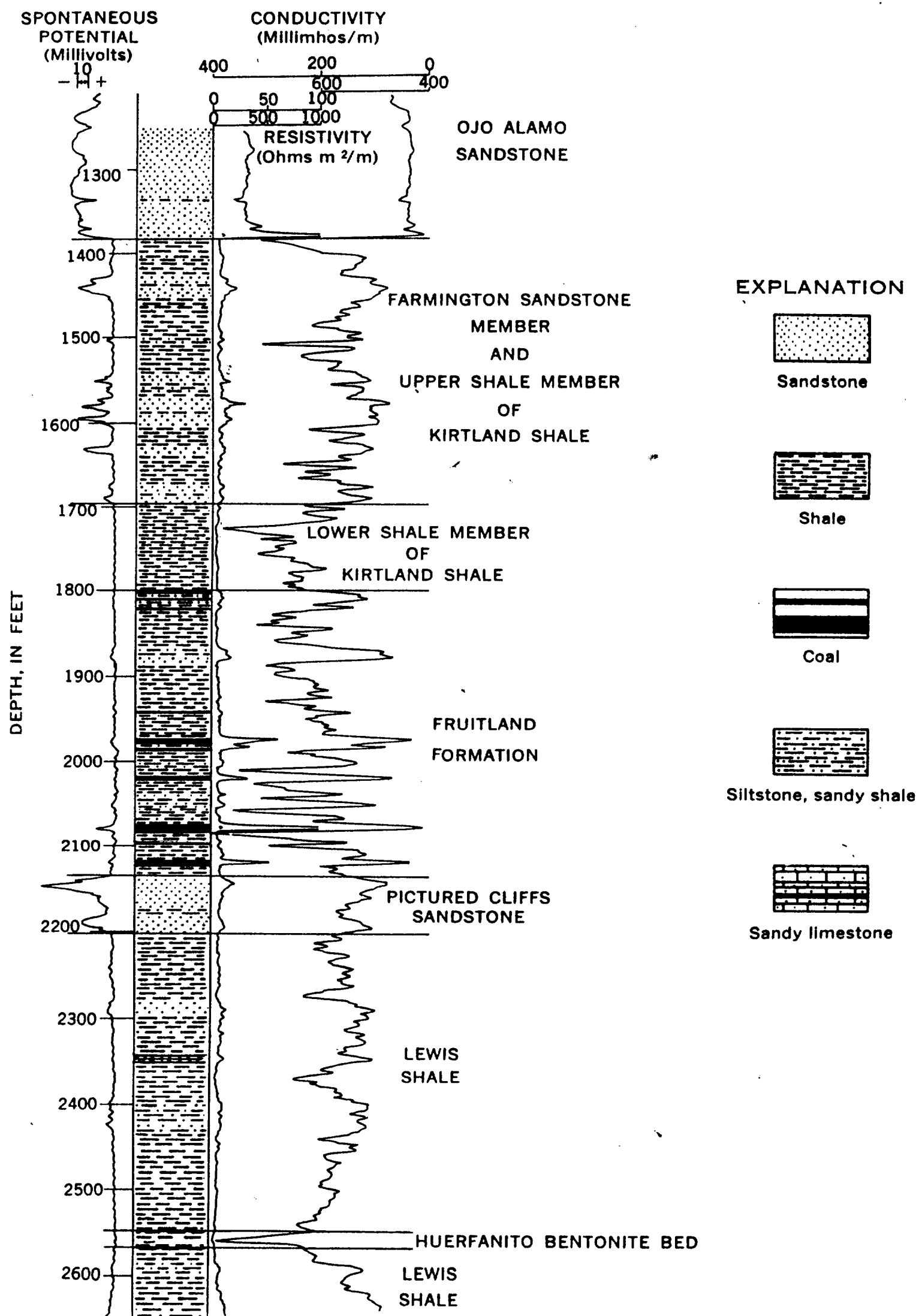


Figure 4. Induction-electric log and lithologic column of the type well of the Huerfanito Bentonite Bed of the Lewis Shale showing the interval from below the Huerfanito through the lower part of the Ojo Alamo Sandstone. Lithologies are based on an interpretation of the three geophysical logs shown.

# Environment of Fruitland Formation Coal Beds

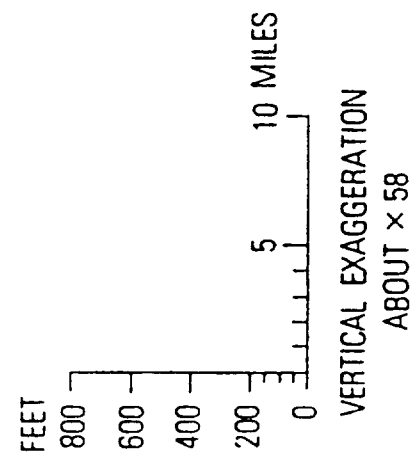
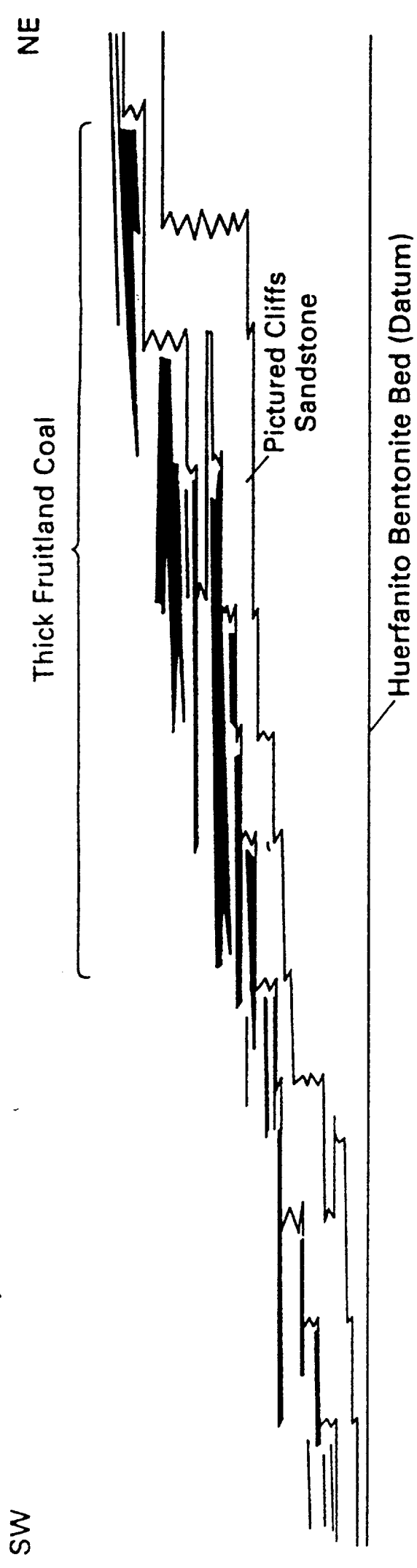


Figure 10. Northeast-trending stratigraphic cross section showing Fruitland Formation coal beds and underlying Pictured Cliffs Sandstone. This cross section is modified from section B-B' of figure 8; coal bed thicknesses are from plate 3 of Fassett and Hinds (1971).