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ABSTRACT: GEOLOGY AND FUEL RESOURCES OF THE FRUITLAND FORMATION AND KIRTLAND SHALE OF THE SAN JUAN BASIN, NEW MEXICO AND COLORADO*

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EXPLANATION

This abstract summarizes U.S. Geological Survey Professional Paper 676, which is a companion volume for this field conference. The report, published in 1971, describes the stratigraphy of the Cretaceous Pictured Cliffs Sandstone, Fruitland Formation and Kirtland Shale, and the Tertiary Ojo Alamo Sandstone in great detail throughout the subsurface and surface of the San Juan Basin. It also deals with the Cretaceous-Tertiary Animas Formation (including the McDermott Member), and the Tertiary Nacimiento Formation and San Jose Formation in a less detailed manner. The fuel resources of the Fruitland Formation, principally coal, are discussed at length.

ABSTRACT

The San Juan Basin is an asymmetric structural basin in northwestern New Mexico and southwestern Colorado containing sedimentary rocks that range from Cambrian to Holocene in age and are as much as 15,000 feet thick. Upper Cretaceous rocks, which are more than 6,000 feet thick, are composed of intertonguing marine and nonmarine sedimentary rocks deposited during three basin-wide cycles of transgression and regression of an epicontinental sea. The final regression of the sea is represented by the marine Pictured Cliffs Sandstone. Subsurface studies of this unit, based primarily on well-log interpretation, and surface evidence indicate that the Pictured Cliffs regression was interrupted frequently by relatively minor transgressive episodes that resulted in vertical buildups and intertonguing of the Pictured Cliffs Sandstone with the overlying Fruitland Formation. The strand lines of the Pictured Cliffs sea had northwest alinements, and the Pictured Cliffs Sandstone and the overlying Fruitland Formation and Kirtland Shale are younger in the northeastern part of the basin than in the southwestern part. Concomitant with the Pictured Cliffs regression, an area southeast of the basin was uplifted, resulting in either lack of deposition or possible erosion of the Pictured Cliffs; there the Fruitland Formation now rests on the Lewis Shale.

After deposition of the Fruitland and Kirtland, the Upper Cretaceous McDermott Member of the Animas Formation was deposited in the northwestern part of the basin area. Next, the basin area was tilted toward the northwest, and as much as 2,100 feet of rocks was eroded in the east. Following this erosion cycle, the fluvial Ojo Alamo Sandstone of Paleocene age was deposited. The source of the Ojo Alamo was primarily from the west, as indicated by a decrease in pebble size in the Ojo Alamo conglomerates toward the east, although renewed uplift to the east may have furnished some Ojo Alamo sediment. In the northeastern part of the basin, the Ojo Alamo rests on Lewis Shale. After deposition of the Ojo Alamo, the Paleocene Nacimiento Formation and upper shale member of the Animas Formation were deposited, followed by deposition of the Eocene San Jose Formation. These units seemingly rest unconformably on older rocks near the edge of the basin and rest conformably on older rocks in the central part of the basin.

Fuel resources of the Fruitland Formation and the Kirtland Shale include uranium, oil, gas, and coal. The uranium occurs in channel sandstone in the Fruitland Formation. Oil and gas occur mostly in small scattered stratigraphic traps. The thickest coal beds occur in the lower part of the Fruitland Formation. Deposition of the coal was controlled by the position and the relative stability of the strand lines of the Pictured Cliffs sea. The thickest coal occurs adjacent to and southwest of major stratigraphic rises of the Pictured Cliffs Sandstone. The coal occurs in elongate tabular bodies whose long axes trend northwest parallel to the strand lines. The coal beds intertongue with and pinch out into marine rocks to the northeast and grade southwestward into flood-plain deposits.

The wells selected for detailed study of coal beds are generally about 6 miles apart. Because of stratigraphic complexities, this spacing did not permit reliable correlation of individual coal beds, although many of the beds are continuous for more than 10 miles and a coal zone generally overlies the Pictured Cliffs Sandstone.

Analyses of Fruitland coal samples from rotary-drill cuttings show that the highest quality coal on an as-received basis underlies the northwestern part of the San Juan Basin. As-received Btu values in this area range from about 12,000 to more than 13,000 compared with values elsewhere of about 9,000-12,000. The coal from the washed drill cutting is low in moisture content, ranging generally between 2-6 percent. The ash content of the coal is unusually high and erratic, ranging from 10 to more than 30 percent. The lowest ash contents are in the west-central part of the basin. The moisture and ash-free Btu values and fixed-carbon ratios of the samples show a well-defined zonation across the basin paralleling the trends of deposition and the basin axis.

The statistical method of analysis used in this report indicates that the Fruitland Formation in the San Juan contains approximately 200 billion tons of coal in beds more than 2 feet thick at depths of as much as 4,500 feet.

*Reprinted from U.S. Geological Survey Professional Paper 676.

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