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Edward C. Beaumont and John W. Shomaker
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UPPER CRETACEOUS COAL IN THE CUBA-LA VENTANA-TORREON AREA, EASTERN SAN JUAN BASIN, NEW MEXICO

by
EDWARD C. BEAUMONT and JOHN W. SHOMAKER
Consulting Geologists
Albuquerque, New Mexico

INTRODUCTION

The area that will be considered in this paper extends from the Nacimiento fault on the east to the western boundary of R. 5 W., and from the southern boundary of T. 18 N. to the vicinity of Cuba (Fig. 1). Generally speaking, it is the triangle formed by Cuba, La Ventana and Torreon Trading Post. Coal production was active in this vicinity during the 1920's and 30's, and there was some minor activity until the 1960's. No coal is being mined at present. Major resources, consisting almost entirely of coal beyond economic stripping depths, exist in the area. Only a tiny fraction of this coal resource was removed during the days of active mining.

Most of the information in this report is taken from unpublished work done for the New Mexico Bureau of Mines and Mineral Resources with support from the U.S. Bureau of Mines (Shomaker, 1971), and from published sources.

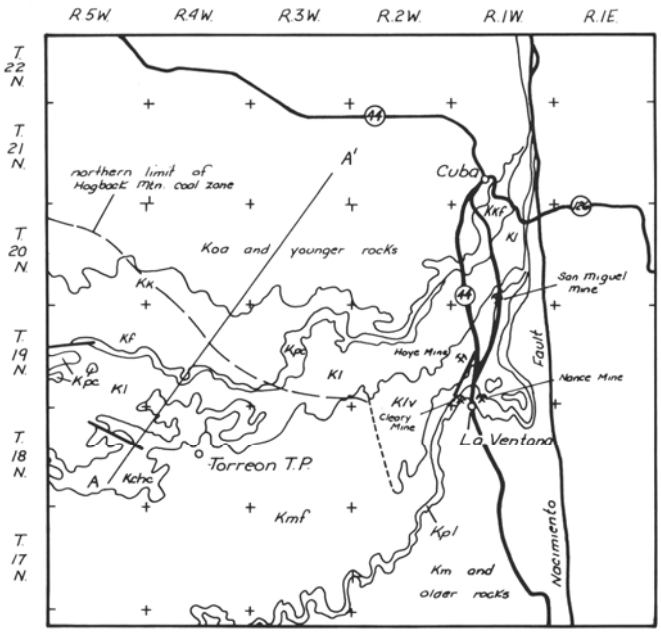

Figure 1. Generalized geologic map of Cuba-La Ventana-Torreon area. Km, Mancos Shale; Kpl, Point Lookout Sandstone; Kmf, Menefee Formation; Klv, La Ventana Tongue of Cliff House Sandstone; Kchc, "Chacra Tongue" of Cliff House Sandstone; Kl, Lewis Shale; Kpc, Pictured Cliffs Sandstone; Kf, Fruitland Formation; Kk, Kirtland Shale; Koa, Ojo Alamo Sandstone.

GEOLOGIC SETTING

Structure

The Cuba-La Ventana-Torreon area lies along the east edge of the San Juan Basin, close to the abrupt eastern boundary formed by the Nacimiento uplift. Within the area, the prevailing regional strike of about N. 70° W. gives way rather abruptly to the northeast-southwest and north-south structural trends imposed by the Nacimiento uplift. In a large part of the San Juan Basin the structural strike coincides fairly closely with the depositional strike; in the Cuba-La Ventana-Torreon area, however, the structural strike becomes nearly normal to the depositional strike. Thus an opportunity is afforded to see the transgressive-regressive stratigraphic relationships almost "edge-on." Near the western edge of the area the structural trend is almost east-west, and near Cuba it is almost north-south.

At the western edge of the area, dips are on the order of 1° to 2°, as is typical of large areas in the south-central part of the San Juan Basin. The strata steepen gradually and irregularly eastward to the vicinity of La Ventana where dips between 4° and 10° are common. North of La Ventana dips steepen still more until in the vicinity of Cuba the coal-bearing units are nearly vertical or are overturned locally.

Stratigraphy

The coal-bearing rocks of the Cuba-La Ventana-Torreon area are within the Menefee and the Fruitland Formations, both of Late Cretaceous age. Beginning with the Point Lookout Sandstone at the base (see Fig. 2), the succession includes the Menefee Formation, the Cliff House Sandstone (and two transgressive buildups associated with it), the Lewis Shale, the Pictured Cliffs Sandstone and the Fruitland Formation. The cross-section in Figure 2 illustrates the complex relationships of the Menefee, Cliff House and Lewis Shale sequence. The orientation of the cross-section is approximately normal to the depositional strike. It was constructed mainly from oil and gas test data. At the northeast end of the section, the Menefee Formation is approximately 570 feet thick. Overlying it is a sandstone about 40 feet thick which is correlative with the Cliff House Sandstone as generally recognized in the central part of the basin. Above the Cliff House is a sequence of marine Lewis Shale about 1,400 feet thick, and above the Lewis there is about 85 feet of Pictured Cliffs Sandstone. The Fruitland Formation and the overlying Pictured Cliffs are not shown in the section.

About 6 miles southwest from the northeast end of the cross-section, the Menefee is about 750 feet thick, the Cliff House is about 60 feet thick, and there is a sequence of sandy

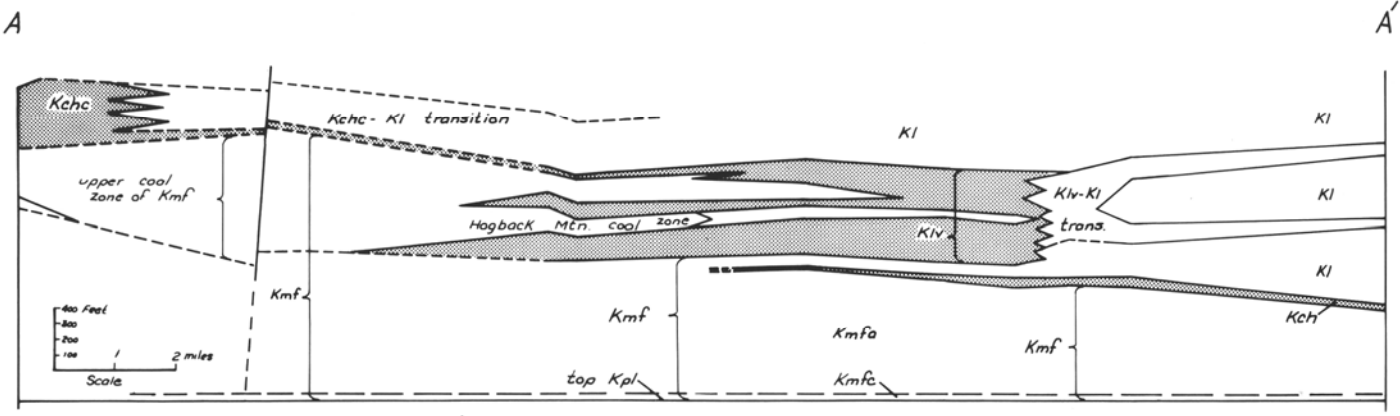

Figure 2. Diagrammatic cross-section A-A' (see Fig. 1 for line of section). Kpl, Point Lookout Sandstone; Kmfc, Cleary Coal Member of Menefee Formation; Kmfa, Allison Member of Menefee Formation; Kmf, Menefee Formation; Kch, Cliff House Sandstone; Kl, Lewis Shale; Klv, La Ventana Tongue of Cliff House Sandstone; Kchc, "Chacra Tongue" of Cliff House Sandstone.

shale about 80 feet thick overlying the Cliff House which has been correlated with the lower part of the Lewis. Above this is the main body of the La Ventana Tongue buildup. At this position the La Ventana, which is considered a tongue of the Cliff House, is about 610 feet thick. Thin tongues of the marine Lewis from the seaward side, and a tongue of continental and paludal Menefee Formation from the landward side, can be detected in the La Ventana sequence in the electric logs. The main body of the Lewis overlies the La Ventana, and it and the Pictured Cliffs and the Fruitland sequence are similar to the equivalent rocks of the northeast end of the section.

At about the middle of the section, the Menefee is approximately 900 feet thick, and the Cliff House, as it has been correlated from the northeast corner of the section, is no longer recognizable. The thin Lewis equivalent which lies between the Cliff House and the La Ventana further north also is not recognizable, so at this position the La Ventana (about 600 feet thick) overlies the Menefee directly. Here it contains two tongues of Menefee, both coal-bearing, the lower about 100 feet thick being correlated with the Hogback Mountain coal zone, and the upper about 170 feet thick. About 600 feet of Lewis, somewhat over 100 feet of Pictured Cliffs, and the Fruitland Formation lie above the La Ventana. At a position about 5 miles from the southwest end of the cross-section, the Menefee Formation is about 1,700 feet thick, and the upper 750 feet are equivalent to the La Ventana further north. A sandstone only about 50 feet thick overlies the Menefee and may be equivalent to the uppermost La Ventana or may be stratigraphically somewhat higher. Above this sandstone is a sequence about 275 feet thick composed of thin alternating sandstones and shales which represents the transition between the Lewis to the northeast, i.e. seaward, and the equivalent "Chacra Tongue" of the Cliff House landward. At the southwest end of the cross-section, the Menefee is about 1,660 feet thick and the "Chacra Tongue" of the Cliff House Sandstone is something over 400 feet thick. At this point the base of the "Chacra Tongue" is approximately 1,000 feet stratigraphically higher than the base of the Cliff House Sandstone at the northeast end of the section.

The Fruitland Formation, according to its definition as the coal-bearing portion of the Fruitland Formation-Kirtland Shale sequence, ceases to exist in the southeastern part of T. 20 N., R. 2 W., and it decreases steadily in thickness from the west edge of the area considered in this report to that point.

The two massive build-ups of sand represented by the La Ventana Tongue and the "Chacra Tongue" separated laterally by very thin sand sections is, in the writers' opinions, representative of a relatively long period of shoreline stability terminated abruptly by a rapid shoreline shift and then reestablishment of the stable conditions. The landward (southeast) direction of the rapid transgression is taken to indicate comparatively sudden subsidence—perhaps the results of a catastrophic event.

Direct superposition of the marine Lewis Shale on coal-bearing nonmarine strata of the Menefee such as is seen in the vicinity of Newcomb on the west side of the basin is indicative of very rapid transgression. Also in this same area, the nonmarine sequence slightly further landward is complicated by a multitude of intraformational disconformitics. The writers interpret this to be a further sign of instability (Shomaker, Beaumont, and Kottlowski, 1971, p. 26). A similar phenomenon is noted in the area of this study by Dane (1936, p. 96). He reports irregularities in the bedding of the upper part of the Allison, but whether or not the Newcomb area phenomenon and the observations by Dane represent the same type of disturbance is not known at this time.

The massiveness of the La Ventana Tongue and the "Chacra Tongue" signifies a close balance between subsidence and sediment supply. The secondary regressive phases represented by the Hogback Mountain coal zone indicate temporary imbalance, but all in all the balance was maintained for a relatively long period. The "Chacra Tongue" accumulation may in effect represent a continuation of this balanced condition but with the locale having been shifted quite suddenly a few miles southeastward by the aforementioned catastrophic event. The somewhat jerky manner in which this last transgressive phase in the Cretaceous proceeded may be a precursor of the profound changes which were about to cause the sea to finally withdraw from the region.

It was not unexpected that Shomaker's (1971) study of the Hogback Mountain coal zone and related coal-bearing strata in the Upper Allison on the shoreward side of the La Ventana build-up should reveal a considerable amount of coal in a thick sequence. The presence of the thick La Ventana representing the near-shore and beach depositional environment is a clue to

the presumed presence of the paludal environment of corresponding thickness on the shoreward side. The relative thinness of the individual coal beds can be interpreted as indications of minor oscillations that temporarily disrupted deposition.

Were the nonmarine beds equivalent to the "Chacra Tongue" not to have been removed by erosion, it is likely significant coal measures would be present to the southeast. Although obviously speculative, it is possible that had those strata been preserved, they would have contained some of the most significant coal beds in the entire Cretaceous of the region inasmuch as they represented paludal deposition in that final inertial period marking the major depositional change from transgressive to regressive.

MENEFEE FORMATION COAL

The "upper coal zone" of the Menefee Formation, which includes the Hogback Mountain coal zone (see Fig. 2), crops out just southwest of Torreon Trading Post. This coal zone, representing a band of paludal environment landward from the La Ventana Tongue buildup, extends for over 90 miles in a virtually straight line from Torreon Trading Post on the southeast to Hogback Mountain (in T. 28 N., R. 16 W.) to the northwest. It contains a great deal of coal in irregular lenses and in at least one place interpretation of well logs indicates there may be over 150 feet of coal in one section. In the Cuba-La Ventana-Torreon area the upper coal zone contains as much as 15 feet of coal distributed in a number of beds within a total of about 780 feet of section. This massive buildup of coal occurs in the southern half of T. 19 N., R. 5 W. and the northern part of T. 18 N., R. 5 W. It is at its thickest in the northeast corner of T. 18 N., R.5 W. Coal resources which have been estimated from oil and gas test data in this area are as follows: In the shallowest overburden category (in which the depth to the first minable coal bed is less than 500 feet) T. 18 N., R. 5 W. is estimated to contain 1,225 million tons of coal. T. 19 N., R. 5 W. is estimated to contain 775 million tons. In the next deeper overburden category (in which the depth to the first minable coal bed ranges from 500 to 1,000 feet) T. 18 N., R. 5 W. is not estimated to contain coal. T. 19 N., R. 4 W. is estimated to contain 163 million tons, and T. 19 N., R. 5 W. is estimated to contain 420 million tons. T. 20 N., R. 5 W. is estimated to contain about 3 million tons. In the third overburden category (in which the depth to the first minable coal bed is over 1,000 feet) T. 19 N., R. 4 W. is estimated to contain about 53 million tons. T. 19 N., R. 5 W. is estimated to contain about 88 million tons. T. 20 N., R. 4 W. is estimated to contain about 8 million tons, and T. 20 N., R. 5 W. is estimated to contain about 285 million tons. The total resource within the upper coal zone of the Menefee Formation within the Cuba-La Ventana-Torreon area is estimated to be on the order of 3 billion tons. It is important to note that these resource estimates were based on very sparse drill hole data and that the determination of coal tops and thicknesses is based on electric logs which were not intended for coal exploration.

There is no direct evidence as to the quality of the coal that makes up this resource, but it can be anticipated that the quality is similar to that of the other Menefee Formation coals which have been mined nearby. These coals are of high volatile bituminous C rank with as-received heating values something above 10,000 Btu per pound, ash between 5 and 10 percent, sulfur generally on the order of 1 percent, and moisture content between 15 and 20 percent.

The economic potential of the coals of the upper coal zone and the Hogback Mountain coal zone is limited by several factors. First, essentially none of it is strippable; much of it is too deep even for today's underground mining technology. Second, the coal occurs in irregular lenses, and thicknesses of individual beds probably vary greatly over short distances. Third, these beds typically have very irregular lower contacts which make conventional underground mining difficult. On the other hand, the large thicknesses of coal, the lenticular nature of the beds, and the low permeability of confining beds may make these coals suitable for in situ gasification or the application of a solvent mining process.

A second important coal zone in the Menefee Formation lies just below the La Ventana Tongue of the Cliff House Sandstone and just below the Cliff House itself beyond the northern extremity of the La Ventana Tongue. This zone is called the "Upper Allison" zone because of its stratigraphic position (see Dane, 1936) even though the Allison was defined in the vicinity of Gallup as a Barren Member. The Upper Allison zone ordinarily contains one or two coal beds of very irregular thickness ranging up to a rarely-reached 10 feet. The total resource available in the Upper Allison zone has never been determined, but based on an average thickness of about 5 feet in the Cuba-La Ventana-Torreon area it would contain on the order of 2 billion tons. Virtually none of this would be strippable.

The third important coal zone in the Menefee Formation is the Cleary Member which lies at the base of the formation and generally contains 2 beds of commercial potential in the vicinity of La Ventana. North of La Ventana to a point about half way between La Ventana and Cuba, there is commonly one bed, and north of that point the Cleary contains little coal of minable thickness. Near La Ventana the thickness of coal beds in the Cleary is extremely irregular ranging up to something over 6 feet, but generally much less. An average thickness would probably be more on the order of 2 feet. The total resource available in the Cleary Member in the Cuba-La Ventana-Torreon area if restricted to beds of minable thickness would be far less than one billion tons. A reserve of some 15 million tons of strippable coal has been very tentatively estimated for the Cleary Member (Shomaker, Beaumont and Kottlowski, 1971). All of this lies in T. 17 N. Because of the thinness and irregularity of the beds it is really doubtful if any of this is ever going to be economically minable.

Coal was produced from both the Upper Allison zone and the Cleary Member during the 1920's and the early 1930's. The principal mines were the Cleary mine of the San Juan Coke & Coal Company in the W1/2 of section 31, the Nance Mine of the White Ash Coal Mining Company in the E1/2 of section 32, T. 19 N., R. 1 W. and the Hoye Mine in the NE¼ of section 19, T. 19 N., R. 1 W.

These three mines were served by rail. The railroad reached the La Ventana area from a connection at San Ysidro with a lumber railroad (the Santa Fe Northwestern) which was organized to serve the forests of the Jemez Mountains from a connection with the Santa Fe Railway at Bernalillo. The coal railroad from San Ysidro to the La Ventana coal fields was plagued with problems. It was organized in 1923 as the Cuba Extension Railroad, reorganized not long after as the Santa Fe Northern Railroad and reorganized again in 1928 as the Santa

Fe, San Juan, and Northern Railroad. A poor coal market and washouts along the line during 1930 thru 1932 essentially killed the business, and the rails were removed in 1940 and 1941.

The San Miguel mine in the NE'/ of section 33, T. 20 N., R. 1 W. began operation in a seam of the Upper Allison zone in 1917. It produced coal irregularly into the 1960's, and the leases are still current. The only coal lease of significant size in the Menefee Formation within the Cuba-La Ventana-Torreon area is that of Consiolidation Coal Company. It applies to 7,097 acres, mostly underlain by the Upper Allison zone in the northwestern part of T. 19 N., R. 1 W., the northeastern part of T. 19 N., R. 2 W., the southwestern part of T. 20 N., R. 1 W., and the southeastern corner of T. 20 N., R. 2 W. Almost none of the coal within this lease appears to be strippable.

FRUITLAND FORMATION COAL

Most of the geologic information in the following section is taken from Fassett and Hinds (1971). The aggregate thickness of coal in the Fruitland Formation decreases from west to east across the Cuba-La Ventana-Torreon area, and east of R. 2 W. there is no coal in the Fruitland Formation-Kirtland Shale sequence. Aggregate thickness of coal beds reaches something more than 14 feet at one point near the western edge of the area but is less than 10 feet east of the eastern edge of R. 5 W. The thickest bed reported in the Fruitland within the area in any surface exposure or from well control is 9 feet thick. Very little information is available as to quality of the Fruitland coal in this area. One sample from a small prospect pit, which probably represents weathered coal, indicated an as-received heating value of 9,450 Btu/lb, sulfur content of 0.6%, ash content of 27.4%, and moisture of 5.8%. Other samples which are available from the Cuba-La Ventana-Torreon area are weathered coal from surface outcrops.

Because of the scarcity of data as to the thickness and distribution of the Fruitland Formation coal beds in this area, no attempt has been made at a reliable estimate at the size of the source. A guess based on the few coal bed thickness measurements that are available is somewhere between 1 and 2 billion tons. A small part of this at the western end of the area would be within strippable depths.

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