

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Text to accompany:
OPEN-FILE REPORT 79-629

1985

FEDERAL COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS
OF THE MESA CORTADA 7 1/2-MINUTE QUADRANGLE,
McKINLEY COUNTY, NEW MEXICO

[Report includes 13 plates]

Prepared by Berge Exploration, Inc.

This report was prepared under contract to the U.S. Geological Survey, and has not been edited for conformity with Geological Survey editorial standards or stratigraphic nomenclature. Opinions expressed herein do not necessarily represent those of the Geological Survey.

MESA CORTADA
CONTENTS

	Page
Introduction	1
Purpose	1
Location	4
Accessibility	4
Physiography	4
Climate	5
Land status	5
General geology	6
Previous work	6
Stratigraphy	6
Depositional environments	9
Structure	10
Coal geology	10
Menefee Cleary No. 2 coal bed	13
Menefee Cleary No. 1 coal bed	13
Coal resources	14
Coal development potential	15
Development potential for surface mining methods	17
Development potential for subsurface mining methods and in situ gasification	17
Selected references	23
Glossary	24

ILLUSTRATIONS

Plates 1-11. Coal resource occurrence maps:

1. Coal data map.
2. Boundary and coal data map.
3. Coal data sheet.
4. Isopach map of the Menefee Cleary No. 2 coal bed.
5. Structure contour map of the Menefee Cleary No. 2 coal bed.
6. Isopach map of overburden of the Menefee Cleary No. 2 coal bed.
7. Isopach map of the Menefee Cleary No. 1 coal bed.
8. Structure contour map of the Menefee Cleary No. 1 coal bed.
9. Isopach map of overburden of the Menefee Cleary No. 1 coal bed.
10. Areal distribution and identified resources of the Menefee Cleary No. 2 coal bed.
11. Areal distribution and identified resources of the Menefee Cleary No. 1 coal bed.

Plates 12-13. Coal development potential maps:

12. Coal development potential for surface mining methods.
13. Coal development potential for subsurface mining methods.

	Page
Figure 1. Location of project area	2
2. Index to USGS 7 1/2-minute quadrangles and coal resource occurrence/coal development potential maps in the southern San Juan Basin area, New Mexico	3

TABLES

Table 1. Analyses of coal samples from the Allison Member of the Menefee Formation	12
2. Reserve base data (in short tons) for surface mining methods for Federal coal lands in the Mesa Cortada quadrangle	19
3. Reserve base data (in short tons) for subsurface mining methods for Federal coal lands in the Mesa Cortada quadrangle	20
4. Reserves and planimetered acreage, by section, for Federal coal lands in the Mesa Cortada quadrangle with surface mining potential.....	21
5. Reserves and planimetered acreage, by section, for Federal coal lands in the Mesa Cortada quadrangle with subsurface mining potential.....	22

INTRODUCTION

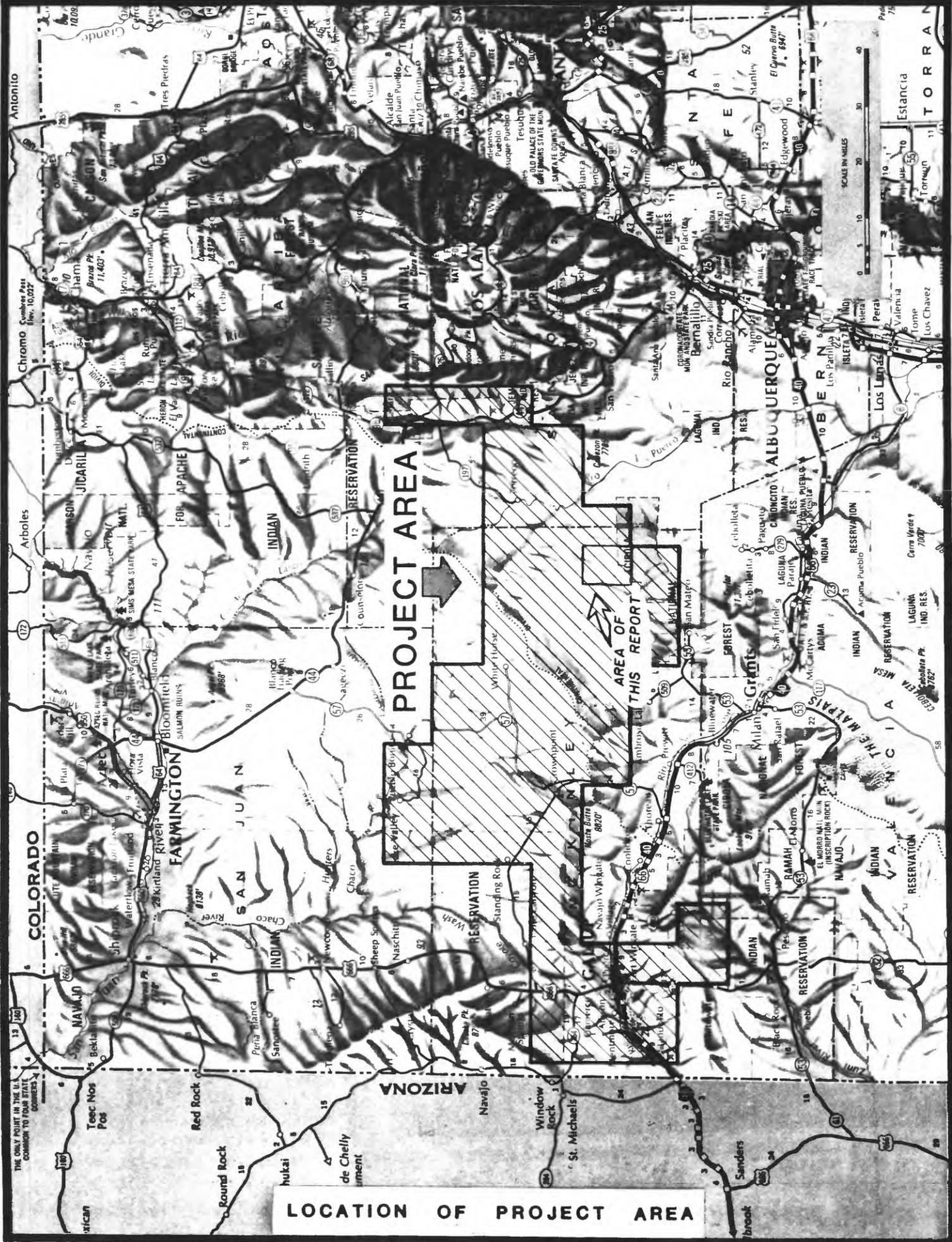
Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the Mesa Cortada 7½ minute quadrangle, McKinley County, New Mexico. These maps and report are part of an evaluation of fifty-six 7½ minute quadrangles in northwestern New Mexico which were completed under U. S. Geological Survey Contract No. 14-08-0001-17459 (see figs. 1 and 2).

The purpose of this Coal Resource Occurrence-Coal Development Potential program, which was conceived by Congress as part of its Federal Coal Leasing Amendments Act of 1976, is to obtain coal resource information and to determine the geographical extent of Federal coal deposits. In addition, the program is intended to provide information on the amount of coal recoverable by various mining methods and to serve as a guide for land-use planning.

The U. S. Geological Survey initiated the program by identifying areas underlain by coal resources. These areas were designated Known Recoverable Coal Resource Areas based on the presence of minable coal thicknesses, adequate areal extent of these coal deposits, and the potential for developing commercial quantities of coal at minable depths.

This report is limited to coal resources which are 3,000 ft (914 m) or less below ground surface. Published and unpublished public information was used as the data base for this study. No new drilling or field mapping was performed as part of this study, nor were any confidential data used.

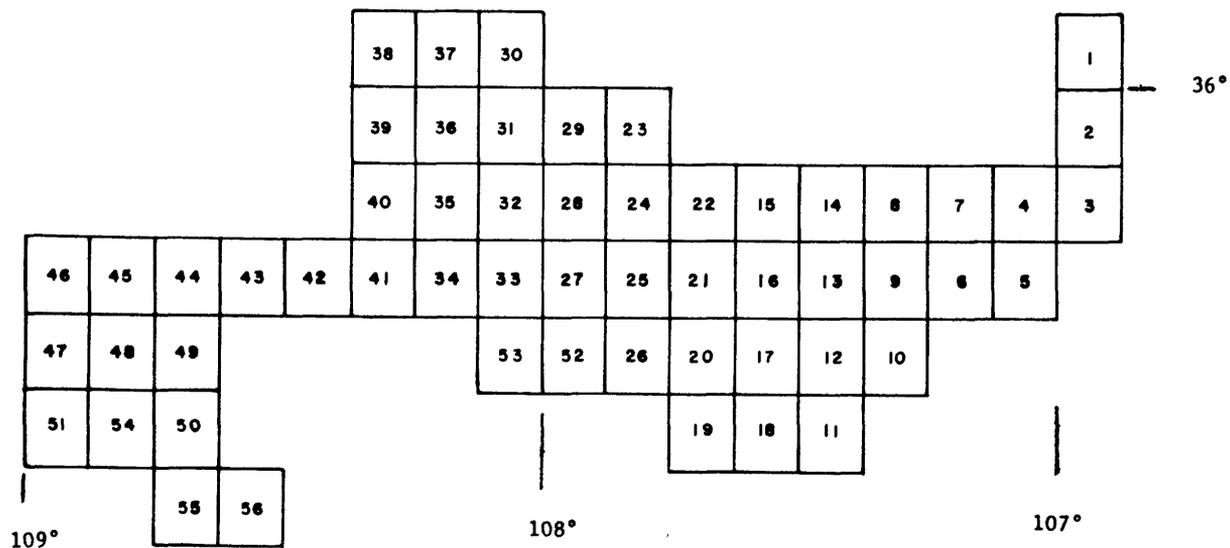


LOCATION OF PROJECT AREA

FIGURE 1

FIGURE 2.--Index to USGS 7 1/2-minute quadrangles and coal resource occurrence/
coal development potential maps for the southern San Juan Basin area, New Mexico

Map No.	Quadrangle	Open-file report	Map No.	Quadrangle	Open-file report
1	Cuba	79- 623	31	Nose Rock	79- 641
2	San Pablo	79- 624	32	Becenti Lake	79-1124
3	La Ventana	79-1038	33	Heart Rock	79- 642
4	Headcut Reservoir	79-1043	34	Crownpoint	79-1125
5	San Luis	79-1044	35	Antelope Lookout Mesa	79-1376
6	Arroyo Empedrado	79-1045	36	Milk Lake	79-1377
7	Wolf Stand	79-1046	37	La Vida Mission	79-1378
8	Tinian	79- 625	38	The Pillar 3 SE	79-1379
9	Canada Calladita	79- 626	39	Red Lake Well	79-1380
10	Cerro Parido	79- 627	40	Standing Rock	79-1381
11	El Dado Mesa	79- 628	41	Dalton Pass	80- 026
12	Mesa Cortada	79- 629	42	Oak Spring	80- 027
13	Mesita del Gavilan	79- 630	43	Hard Ground Flats	80- 028
14	Rincon Marquez	79- 631	44	Big Rock Hill	80- 029
15	Whitehorse Rincon	79- 632	45	Twin Lakes	80- 030
16	Mesita Americana	79- 633	46	Tse Bonita School	80- 031
17	El Dado	79- 634	47	Samson Lake	80- 032
18	Cerro Alesna	79- 635	48	Gallup West	80- 033
19	San Lucas Dam	79- 636	49	Gallup East	80- 034
20	Piedra de la Aguila	79-1039	50	Bread Springs	80- 035
21	Hospah	79- 637	51	Manuelito	80- 036
22	Whitehorse	79-1040	52	Borrogo Pass	80- 037
23	Seven Lakes NE	79- 638	53	Casamero Lake	80- 038
24	Kin Nahzin Ruins	79- 639	54	Twin Buttes	80- 039
25	Orphan Annie Rock	79-1041	55	Pinehaven	80- 040
26	Mesa de los Toros	79-1122	56	Upper Nutria	80- 041
27	Laguna Castillo	79- 640			
28	Seven Lakes	79-1042			
29	Seven Lakes NW	79-1123			
30	Kin Klizhin Ruins	79-1047			



Location

The Mesa Cortada 7½ minute quadrangle includes acreage in Tps. 15 and 16 N., Rs. 5 and 6 W., of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

No paved roads pass through the Mesa Cortada quadrangle. Unimproved dirt roads traverse most parts of the area. The Atchison, Topeka, and Santa Fe Railroad line passes about 32 mi (51 km) south of the quadrangle (see fig. 1).

Physiography

The Mesa Cortada quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). Mountains, eroded mesas, and flatlands dissected by arroyos are the prominent topographic features in the quadrangle. Elevations in the area range from 6,320 ft (1,926 m) in the north central part of the quadrangle to 8,578 ft (2,615 m) at Cerro Colorado peak in the southeastern part of the quadrangle.

Drainage is provided by several intermittent arroyos, including Chico Arroyo, San Miguel Creek, Arroyo Chavez, and Arroyo Seccion. There are no perennial streams in the quadrangle.

Climate

The climate of this area is semiarid to arid. The following temperature and precipitation data were reported by the National Oceanic and Atmospheric Administration for the San Mateo Station. The Mesa Cortada quadrangle is about 13 mi (21 km) NNE. of the San Mateo Station. Average total annual precipitation for ten of the previous fifteen years is 8.37 in. (21.26 cm). Intense thunderstorms in July, August, and September account for the majority of precipitation. The area is susceptible to flash flooding associated with these thunderstorms. Mean annual temperature for four of the previous fifteen years is 48.8⁰ F (9.3⁰ C). The average daily temperatures in January and July are 28.3⁰ F (-2.1⁰ C) and 69.0⁰ F (20.6⁰ C), respectively.

Land status

The Federal Government holds coal rights to about 35 percent of the Mesa Cortada quadrangle. For the specific coal ownership boundaries, see plate 2. It is not within the scope of this report to provide detailed land-surface ownership. About 9,600 acres (3,885 ha) in the northwestern and southwestern parts of the quadrangle are within the Hospah Known Recoverable Coal Resource Area. Approximately 7,100 acres (2,873 ha) in the northeastern portion of the area are within the La Ventana Known Recoverable Coal Resource Area. The Felipe Tafoya and Ignacio Chavez Land Grants occupy the central portion of the quadrangle. As of October 26, 1978, there were no Federal coal leases, coal preference right lease applications or coal exploration licenses within the Mesa Cortada quadrangle.

GENERAL GEOLOGY

Previous work

Early reports on the area include that of Gardner (1910) who reported several outcrop measurements in the area. Hunt (1936) reported coal outcrop measurements of the Gibson Coal Member of the Crevasse Canyon Formation and Menefee Formation. Shomaker, Beaumont, and Kottowski (1971) noted the possibility of strippable coal reserves within the quadrangle, but faulting would complicate mining feasibility. Tabet and Frost (1979) mapped the surface geology including coal outcrops and conducted exploration drilling in the northeastern part of the quadrangle. Their study was completed after the compilation of these maps and should be consulted for additional coal data in this area.

Stratigraphy

Within the San Juan Basin, the shoreline positions of the Cretaceous seaways changed innumerable times. The overall regional alignment of the shorelines trended N. 60° W.-S. 60° E. (Sears, Hunt, and Hendricks, 1941). The transgressive and regressive shoreline migrations are evidenced by the intertonguing relationships of continental and marine facies. Rates of trough (geosynclinal) subsidence and the availability of sediment supplies are the major factors that controlled the transgressive-regressive shoreline sequences.

Exposed rock units in the Mesa Cortada quadrangle include some of the sedimentary units of Upper Cretaceous age. Tertiary basalts cover the surface in portions of the Cibola National Forest in the southeastern part of the quadrangle. There is Quaternary alluvium along drainages in the area.

The Dalton Sandstone Member of the Crevasse Canyon Formation represents nearshore or littoral deposits which formed during a shoreline regression of the Cretaceous seaways. Yellowish-gray, very fine-grained quartzose sandstone comprises the lithologies of the Dalton Sandstone Member. Local thickness of the Dalton Sandstone Member is 25 to 60 ft (8 to 18 m). Because the Dalton Sandstone Member is not present in quadrangles to the north, the unit pinches out in the Mesa Cortada quadrangle.

The Gibson Coal Member of the Crevasse Canyon Formation overlies the Dalton Sandstone Member and represents the continental deposits which formed inland from the beach area during deposition of the Dalton Sandstone Member. Medium gray carbonaceous siltstone with interbedded gray to tan sandstones, and coal beds comprise the lithologies of the Gibson Coal Member, which averages 220 ft (67 m) thick locally. Increased rates of trough subsidence resulted in the gradual reversal from regressive to transgressive depositional conditions.

During the transgressive sequence, the Hosta Tongue of the Point Lookout Sandstone and the Satan Tongue of the Mancos Shale were deposited. The Hosta Tongue overlies the Gibson Coal Member, and is composed of light gray to reddish-brown, fine- to medium-grained sandstone with interbedded shales, and averages 270 ft (82 m) thick locally. The Satan Tongue

overlies the Hosta Tongue and formed from the marine sands, silts, and muds as the advancing seaways deepened, and is composed of light to dark gray silty shale with interbedded tan to buff sandstone. Thickness of the unit averages 245 ft (75 m) in this area.

The Point Lookout Sandstone overlies the Satan Tongue, and represents nearshore or littoral deposits which formed during the most extensive northeastward retreat prior to the final withdrawal of the Cretaceous seaways in the San Juan Basin (Sears, Hunt, and Hendricks, 1941). Lithology of the Point Lookout Sandstone is identical to the Hosta Tongue, and averages 170 ft (52 m) thick locally. The continental sediments deposited inland from the beach area during deposition of the Point Lookout Sandstone compose the overlying Menefee Formation.

The Menefee Formation consists of dark gray to brown carbonaceous to noncarbonaceous shales, light gray, medium-grained sandstones, and coal beds, and is divisible into the basal Cleary Coal Member and upper Allison Member. A massive channel sandstone sequence defines the boundary between the two members. The Cleary Coal Member contains the most important coal beds in this quadrangle, and has been extensively eroded from the San Miguel Creek Dome. Where the full section is present, the Cleary Coal Member averages 400 ft (122 m) thick locally. The Allison Member crops out in the northeastern part of the quadrangle, and erosion has reduced its thickness to about 150 ft (46 m) in this quadrangle. The Dilco Coal Member of the Crevasse Canyon Formation and the Dakota Sandstone which contain coals in areas nearby were not mapped in the Mesa Cortada quadrangle because of insufficient data.

Depositional environments

The Cretaceous System sedimentary units in the quadrangle represent transgressive and regressive depositional conditions. There were innumerable minor cycles of widely varying duration and extent within the major sedimentary sequences. The paucity of data in this quadrangle and the intended scope of this report permit only general interpretations of the depositional environments.

The Cretaceous coal deposits of the San Juan Basin are products of former coastal swamps and marshes. These swamps and marshes were supported by heavy precipitation and a climate conducive to rapid vegetal growth in moderately fresh water. Due to relatively low sulfur contents of the San Juan Basin coals, Shomaker and Whyte (1977) suggest the coals formed in fresh water environments.

Most of the coal-bearing units were deposited in coastal plain environments. The majority of the peat deposits formed in a transition zone between lower and upper deltaic sediments during periods of relative shoreline stability. Coals also formed in lake margin swamps inland from the coastal area. Shoreline oscillations and the subsequent influx of continental or marine debris upon the peat accumulations produced the vertical buildup or "stacking" of peat deposits. This sediment debris represents variable ash contents, rock partings, and splits within the coal seams.

The peat accumulated in lenses or pods which were generally parallel to the ancient shorelines. The coals in the lower portions of the coal-bearing units represent regressive depositional conditions (Sears, Hunt, and Hendricks, 1941). The coals in the upper portions of these units are relatively sporadic in occurrence.

Structure

The Mesa Cortada quadrangle is in the Chaco Slope structural division in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). The uplifted and eroded San Miguel Creek Dome is a prominent structural feature in the western part of this quadrangle. Hunt (1936) mapped several faults which are associated with the dome. The rock units dip $3\frac{1}{2}^{\circ}$ E. on the eastern flank of the San Miguel Creek Dome, and 1° to 2° NE. to SE. in other mapped areas.

COAL GEOLOGY

In this quadrangle, the authors identified two coal beds and three coal zones in well logs from Tabet and Frost's (1979) coal test holes and Hunt's (1936) surface mapping. These coals occur in the Gibson Coal Member of the Crevasse Canyon Formation and Cleary Coal and Allison Members of the Menefee Formation. These beds and zone coals are here informally called the Crevasse Canyon Gibson coal zone, Menefee Cleary No. 1 and No. 2 coal beds, Menefee Cleary coal zone, and Menefee Allison coal zone.

Stratigraphically, the Crevasse Canyon Gibson coal zone contains the lowest coal identified in the Mesa Cortada quadrangle. The zone was mapped at outcrop and is represented by a 1.2 ft (0.4 m) bed which occurs about 272 ft (83 m) below the Point Lookout Sandstone. The zone coals may be correlated for limited distances in portions of the area but lack sufficient continuity with poorly defined stratigraphic position and cannot be designated as persistent coal beds.

The Menefee Cleary No. 1 coal bed is the first persistent Cleary Coal Member bed which occurs about 7 ft (2 m) above the Point Lookout Sandstone in this quadrangle. The Menefee Cleary No. 2 coal bed is the second persistent Cleary Coal Member bed and is 20 ft (6 m) above the Point Lookout Sandstone in this area. Both coal beds were mapped at outcrop and only one coal measurement is available, and consequently their areal extent is unknown in this area.

The single outcrop trace that Hunt (1936) mapped represents a zone of several coal beds. Measured section #2 (plate 3) contains two separate coal beds which the authors correlated to be the Menefee Cleary No. 1 and No. 2 beds. The beds were mapped as separate outcrop traces. The coal beds were inferred a reasonable distance north of measured section #2 (plates 1 and 3) and are shown to terminate in an area where data is insufficient for further projection. Because of the paucity of Menefee Cleary No. 1 and No. 2 coal data, the authors interpreted Hunt's outcrop trace north of a projected sec. 16, T. 15 N., R. 6 W. in the Ignacio Chavez Land Grant to be the stratigraphically higher Menefee Cleary coal zone. Thicknesses of the Menefee Cleary zone is unknown. The Menefee Allison coal zone was identified in two coal test holes by Tabet and Frost (1979).

There are no published coal quality analyses of Menefee Formation coals from the Mesa Cortada quadrangle. Analyses of three Allison Member coal core samples (from one drill hole) taken about 13 mi (21 km) NNW. of the quadrangle have been reported by Shomaker and Whyte (1977) and are shown in table 1. The Allison Member beds analyzed are probably similar in quality to the Cleary Coal Member beds in this quadrangle. Rank of the Cleary Coal Member seams is probably high volatile C bituminous in this area.

Table 1. - Analyses of coal samples from the Allison Member of the Menefee Formation.

(Core test hole from NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ of sec. 11, T. 18 N., R. 5 W.)

[Form of analyses: A, as received; B, moisture free; C, moisture and ash free]
 from Shomaker and Whyte, 1977

Sample	Form of Analysis	Proximate analysis (percent)					Heating Value (Btu/lb)
		Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	
1	A	12.0	34.1	39.9	14.0	0.3	10,410
	B	-----	38.7	45.4	15.9	0.4	11,830
	C	-----	46.1	53.9	-----	0.5	14,070
2	A	13.0	34.7	33.8	18.5	0.3	9,550
	B	-----	39.8	39.0	21.2	0.4	10,980
	C	-----	50.6	49.4	-----	0.5	13,940
3	A	11.0	34.4	35.1	19.5	0.4	9,800
	B	-----	38.7	39.4	21.9	0.5	11,020
	C	-----	49.5	50.5	-----	0.6	14,100

Remarks:

A moist, mineral-matter-free (MMMF) calculation, using the Parr formula (American Society for Testing and Materials, 1973) yields heating values of 12,270 Btu/lb (28,540 kJ/kg; sample 1), 11,940 Btu/lb (27,772 kJ/kg; sample 2) and 12,432 Btu/lb (28,917 kJ/kg; sample 3). No agglomerating characteristics are available for these analyses.

Menefee Cleary No. 2 coal bed

The Menefee Cleary No. 2 coal bed crops out in the southwestern corner of the Mesa Cortada quadrangle. A fault displaces the bed a short distance in sec. 20, T. 15 N., R. 5 W. Measured section #2 (plate 3) indicates 7.2 ft (2.2 m) of coal with a 5.5 (1.7 m) rock parting. Menefee Cleary No. 2 bed data from the northern adjacent Mesita del Gavilan quadrangle were used to infer the presence of the coal bed in the northern part of Mesa Cortada. The configuration of the isopach, structure, and overburden contours are generalized due to limited data. Because of insufficient data in the central part of the quadrangle, existence and character of the coal bed are unknown.

Menefee Cleary No. 1 coal bed

The Menefee Cleary No. 1 coal bed crops out in the southwestern part of the Mesa Cortada quadrangle. A fault mapped by Hunt (1936) displaces the coal bed a short distance north of sec. 20, T. 15 N., R. 5 W. The bed is 6.1 ft (1.9 m) thick with 0.6 ft (0.2 m) of rock parting. Existence and character of the bed are unknown in the south central part of the quadrangle because of insufficient data.

COAL RESOURCES

The U. S. Geological Survey requested resource evaluations of the Menefee Cleary No. 1 and 2 coal beds, where the beds are 3.0 ft (0.9 m) or more thick. The evaluation is restricted to Federal coal lands.

The following procedures were prescribed by the U. S. Geological Survey for the calculation of reserve base. Criteria established in U. S. Geological Survey Bulletin 1450-B were used to areally divide the bed into measured, indicated, and inferred reserve base categories. Reserve base was calculated for each category, by section, using data from the isopach and overburden maps (plates 4, 6, 7, and 9). The acreage in each category (measured by planimeter) multiplied by the average coal bed thickness and a bituminous coal conversion factor (1,800 tons of coal per acre-ft) yields the reserve base for that category. Coal beds with a 3.0 ft (0.9 m) minimum thickness are included in reserve base and reserve data rather than the 28 in. (71 cm) minimum thickness prescribed in U. S. Geological Survey Bulletin 1450-B. Reserve figures are derived from reserve base totals by applying recovery factors of 85 percent and 50 percent for coal beds 0 to 200 ft (0 to 61 m) and 200 to 3,000 ft (61 to 914 m) deep, respectively. All reserve base and reserve values are rounded to the nearest 10,000 short tons (9,072 t).

Total reserve base data for the Menefee Cleary No. 1 and No. 2 coal beds, which include all reserve data in the various categories are shown by section on plate 2. Reserve base and reserve data in the various categories are shown on plates 10 and 11.

COAL DEVELOPMENT POTENTIAL

The factors used to determine the development potential are the presence of a potentially coal-bearing formation, and the thickness and overburden of correlative coal beds. The U. S. Geological Survey supplied the criteria to evaluate the coal development potential for Federal lands in this quadrangle. These criteria are based on current industry practice, U. S. Geological Survey Bulletin 1450-B, and anticipated technological advances. All available data were utilized for the surface and subsurface development potential evaluations.

Any area underlain by a potentially coal-bearing formation with 200 ft (61 m) or less of overburden has potential for surface mining. The U. S. Geological Survey designated the 200 ft (61 m) maximum depth as the stripping limit. Areas where a potentially coal-bearing formation is overlain by more than 200 ft (61 m) of overburden have no potential for surface mining. Areas with no correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) in thickness and overlain by 200 ft (61 m) or less of overburden have unknown surface mining potential. Areas which have a correlative coal bed 3.0 ft (0.9 m) or more thick with surface mining potential are assigned a high, moderate or low development potential based on the mining ratio (cubic yards of overburden per short ton of recoverable coal). The formula used to calculate mining ratios is:

$$MR = \frac{t_o (C)}{t_c (Rf)}$$

Where MR = Mining ratio

t_o = Thickness of overburden in feet

t_c = Thickness of coal in feet

Rf = Recovery factor

C = Volume-weight conversion factor

(.896 yd³/short ton for bituminous coal)

(.911 yd³/short ton for subbituminous coal)

High, moderate, and low development potential areas have respective surface mining ratio values of 0 to 10, 10 to 15, and greater than 15.

Any area underlain by a potentially coal-bearing formation with 200 to 3,000 ft (61 to 914 m) of overburden has potential for subsurface mining. Areas where a potentially coal-bearing formation is overlain by more than 3,000 ft (914 m) of overburden have no subsurface mining potential. Development potential for subsurface mining is unknown where a potentially coal-bearing formation within 200 to 3,000 ft (61 to 914 m) of the surface contains no identified correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) thick. High, moderate, and low development potential areas have respective overburden values of 200 to 1,000 ft (61 to 305 m), 1,000 to 2,000 ft (305 to 610 m), and 2,000 to 3,000 ft (610 to 914 m). The no and unknown boundaries for surface development potential (plate 12) are defined at the contact of the coal-bearing Menefee Formation with the noncoal-bearing Point Lookout Sandstone. This contact is approximated due to the inaccuracies of adjusting old geologic maps to modern topographic bases.

Boundaries of coal development potential areas coincide with the boundaries of the smallest legal land subdivision (40 acre lot). When a land subdivision contains areas with different development potentials, the potential shown on the map is that of the areally largest component area. When an area is underlain by more than one bed, the potential shown on the map is

that of the bed with the highest potential.

Reserve base (in short tons) in the various development potential categories for surface and subsurface mining methods are shown in tables 2 and 3, respectively.

The coal development potential maps are subject to revision. Map boundary lines and reserve base values are based on coal resource occurrence map isopachs, overburden isopachs, and coal bed correlations that are interpretive and subject to change as additional coal information becomes available.

Development potential for surface mining methods

The coal development potential for surface mining methods in the Mesa Cortada quadrangle is shown on plate 12. Based on coal development criteria, all Federal coal lands have high, moderate, low, unknown or no potential for surface mining methods. Refer to table 4 for reserves and planimetered acreage, by section, for Federal coal lands with surface mining potential.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the Mesa Cortada quadrangle is shown on plate 13. Based on coal development criteria, all Federal coal lands have subsurface mining potentials of high or unknown. Refer to table 5 for reserves and planimetered acreage, by section, for Federal coal lands with subsurface mining potential.

In situ gasification of coal has not been done on a commercial scale in the United States and criteria for rating the development potential of this method are unknown.

Table 2. - Reserve base data (in short tons) for surface mining methods for Federal coal lands in the Mesa Cortada quadrangle, McKinley County, New Mexico.

[Development potentials are based on mining ratios (cubic yards of overburden/ton of underlying coal). To convert short tons to metric tonnes, multiply by 0.9072; to convert mining ratios in yds³/ton coal to m³/t, multiply by 0.8421.

Coal Bed	High Development Potential (0-10 mining ratio)	Moderate Development Potential (10-15 mining ratio)	Low Development Potential (greater than 15 mining ratio)	Total
Menefee Cleary No. 1	470,000	70,000	190,000	730,000
Menefee Cleary No. 2	430,000	110,000	360,000	900,000
Total	900,000	180,000	550,000	1,630,000

Table 3. - Reserve base data (in short tons) for subsurface mining methods for Federal coal lands in the Mesa Cortada quadrangle, McKinley County, New Mexico.

[Development potentials are based on thickness of overburden. To convert short tons to metric tonnes, multiply by 0.9072].

Coal bed	High Development Potential (200' -1,000' overburden)	Moderate Development Potential (1,000' -2,000' overburden)	Low Development Potential (2,000' -3,000' overburden)	Total
Menefee Cleary No. 1	350,000	-----	-----	350,000
Menefee Cleary No. 2	1,350,000	-----	-----	1,350,000
Total	1,700,000	-----	-----	1,700,000

Table 4. - Reserves and planimetered acreage, by section, for Federal coal lands in the Mesa Cortada quadrangle with surface mining potential.

[To convert acres to hectares, divide acres by 2.471; to convert short tons to metric tonnes, multiply short tons by 0.9072].

Potential category	Coal bed	Sec. T. N. R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Cleary No. 2	20 15 6	44.7	370,000
	Menefee Cleary No. 1	16 15 6	5.0	40,000
		20	48.9	360,000
Moderate	Menefee Cleary No. 2	20 15 6	13.6	90,000
	Menefee Cleary No. 1	20 15 6	9.6	60,000
Low	Menefee Cleary No. 2	8 16 5	6.8	30,000
		17	12.3	60,000
		20 15 6	35.3	210,000
		22	4.1	20,000
	Menefee Cleary No. 1	22 15 6	6.8	30,000
	20	21.9	130,000	

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the Mesa Cortada quadrangle with subsurface mining potential.

[To convert acres to hectares, divide acres by 2.471; to convert short tons to metric tonnes, multiply short tons by 0.9072].

Potential category	Coal bed	Sec. T. N. R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Cleary No. 2	7 16 5	34.2	110,000
		8	10.9	40,000
		17	12.3	40,000
		18	54.6	170,000
		22 15 6	93.0	280,000
		28	15.0	40,000
		22 15 6	60.2	170,000
		20	1.1	less than 10,000
	Menefee Cleary No. 1			

SELECTED REFERENCES
(MESA CORTADA QUADRANGLE)

- American Society for Testing and Materials, 1973, Standard specification for classification of coals by rank, in American Society for Testing and Materials Standards for coal and coke: Designation D388-66, p. 54-57.
- Baltz, E. H., 1967, Stratigraphy and regional tectonic implications of part of Upper Cretaceous and Tertiary rocks, east-central San Juan Basin, New Mexico: U.S. Geological Survey Professional Paper 552, 101 p.
- Beaumont, E. C., and Shomaker, J. W., 1974, Upper Cretaceous coal in the Cuba-La Ventana-Torreon area, eastern San Juan Basin, in New Mexico Geological Society Silver Anniversary Guidebook, Ghost Ranch, central-northern New Mexico, 1974: p. 329-332.
- Gardner, J. H., 1910, The coal field between San Mateo and Cuba, New Mexico, in Coal fields in Colorado and New Mexico: U.S. Geological Survey Bulletin 381-C, p. 461-473.
- Hunt, C. B., 1936, The Mount Taylor coal field, part 2 of Geology and fuel resources of the southern part of the San Juan Basin, New Mexico: U.S. Geological Survey Bulletin 860-B, p. 31-80.
- Kelley, V. C., 1950, Regional structure of the San Juan Basin, in New Mexico Geological Society Guidebook of the San Juan Basin, New Mexico and Colorado, 1st Field Conference, 1950: p. 101-108.
- Keroher, G. C., and others, 1966, Lexicon of geologic names of the United States for 1936-60: U.S. Geological Survey Bulletin 1200, 4341 p.
- National Oceanic and Atmospheric Administration, 1964-78, Climatological data, New Mexico: National Climatic Center, Asheville, N. C., v. 68-82.
- Petroleum Information Well Log Library: Denver, Colo.
- Rocky Mountain Well Log Service, 1974, Catalog of electrical, radioactivity and hydrocarbon surveys: Electrical Log Services, 1974, 819 p.
- Sears, J. D., Hunt, C. B., and Hendricks, T. A., 1941, Transgressive and regressive Cretaceous deposits in southern San Juan Basin, New Mexico: U.S. Geological Survey Professional Paper 193-F, p. 101-121.
- Shomaker, J. W., Beaumont, E. C., and Kottowski, F. E., 1971, Strippable low-sulfur coal resources of the San Juan Basin in New Mexico and Colorado: New Mexico Bureau of Mines and Mineral Resources Memoir 25, 189 p.
- Shomaker, J. W., and Whyte, M. R., 1977, Geologic appraisal of deep coals, San Juan Basin, New Mexico: New Mexico Bureau of Mines and Mineral Resources Circular 155, 39 p.
- Tabet, D. E., and Frost, S. J., 1979, Environmental characteristics of Menefee coals in the Torreon Wash area, New Mexico: New Mexico Bureau of Mines and Mineral Resources Open File Report 102, 134 p.
- U.S. Bureau of Mines, 1936, Analyses of New Mexico coals: U.S. Bureau of Mines Technical Paper 569, 112 p.
- U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geological Survey Bulletin 1450-B, 7 p.
- U.S. Geological Survey, 1965, Mineral and water resources of New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 87, 437 p.

GLOSSARY

- coal bed--A stratified sequence of coal, composed of relatively homogeneous material, exhibiting some degree of lithologic unity and separated from the rocks above and below by physically rather well defined boundary planes.
- coal bed separation line--A line on a map plate separating areas where different coal beds or zones are mapped.
- coal bench--One of two or more divisions of a coal bed separated by rock.
- coal conversion factor--A factor used to convert acre-feet of coal into short tons of coal; bituminous coal is 1800 tons/acre-ft; subbituminous coal is 1770 tons/acre-ft.
- coal development potential--A subjective determination of the comparative potential of Federal coal lands for development of a commercially viable coal mining operation.
- coal exploration license--An area of Federal coal lands in which the licensee is granted the right, after outlining the area and the probable methods of exploration, to investigate the coal resources. An exploration license has a term not to exceed 2 years and does not confer rights to a lease.
- coal lease--An area of Federal coal lands in which the Federal Government has entered into a contractual agreement for development of the coal deposits.
- coal split--A coal bed resulting from the occurrence of a noncoal parting within the parent coal bed which divides the single coal bed into two or more coal beds.
- coal zone--A distinctive stratigraphic interval containing a sequence of alternating coal and noncoal layers in which the coal beds may so lack lateral persistence that correlating individual beds in the zone is not feasible.
- Federal coal land--Land for which the Federal Government holds title to the coal mineral rights, without regard to surface ownership.
- hypothetical resources--Undiscovered coal resources in beds that may reasonably be expected to exist in known mining districts under known geologic conditions. In general, hypothetical resources are in broad areas of coal fields where points of observation are absent and evidence is from distant outcrops, drill holes or wells. Exploration that confirms their presence and reveals quantity and quality will permit their reclassification as a Reserve or Identified Subeconomic Resource.
- identified resources--Specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements.
- indicated--Coal for which estimates for the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.
- inferred--Coal in unexplored extensions of demonstrated resources for which estimates of the quality and quantity are based on geologic evidence and projections.
- isopach--A line joining points of equal bed thickness.
- Known Recoverable Coal Resource Area (KRCRA)--Formerly called Known Coal Leasing Area (KCLA). Area in which the Federal coal land is classified (1) as subject to the coal leasing provisions of the Mineral Leasing Act of 1920, as amended, and (2) by virtue of the available data being sufficient to permit evaluation as to extent, location, and potential for developing commercial quantities of coal.
- measured--Coal for which estimates for rank, quality, and quantity can be computed, within a margin of error of less than 20 percent, from sample analyses and measurements from closely spaced and geologically well known sample sites.
- mining ratio--A numerical ratio equating the in-place volumes, in cubic yards, of rocks that must be removed in order to recover 1 short ton of coal by surface mining.
- overburden--A stratigraphic interval (composed of noncoal beds and coal beds) lying between the ground surface and the top of a coal bed. For coal zones, overburden is the stratigraphic interval lying between the ground surface and the structural datum used to map the zone.
- parting--A noncoal layer occurring along a bedding plane within a coal bed.
- Preference Right Lease Application (PRLA)--An area of Federal coal lands for which an application for a noncompetitive coal lease has been made as a result of exploration done under a coal prospecting permit. PRLA's are no longer obtainable.
- quality or grade--Refers to measurements such as heat value; fixed carbon; moisture; ash; sulfur; phosphorus; major, minor, and trace elements; coking properties; petrologic properties; and particular organic constituents.
- rank--The classification of coal relative to other coals, according to degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite (Classification of coals by rank, 1973, American Society for Testing and Materials, ASTM Designation D-388-66).
- recovery factor--The percentage of total tons of coal estimated to be recoverable from a given area in relation to the total tonnage estimated to be in the Reserve Base in the ground.
- reserve--That part of identified coal resource that can be economically mined at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified coal resource designated as the reserve base.
- reserve base--That part of identified coal resource from which Reserves are calculated.
- stripping limit--A vertical depth, in feet, measured from the surface, reflecting the probable maximum, practical depth to which surface mining may be technologically feasible in the foreseeable future. The rock interval, expressed in feet, above the stripping limit is the "strippable interval."
- structure contour--A line joining points of equal elevation on a stratum or bed.