UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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1985

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

[Report includes 5 plates (6 sheets)]

Prepared by Berge Exploration, Inc.

CASAMERO LAKE QUADRANGLE
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ILLUSTRATIONS

INTRODUCTION

Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the Casamero Lake 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 Published and unpublished public information was used as the data base for this study.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.

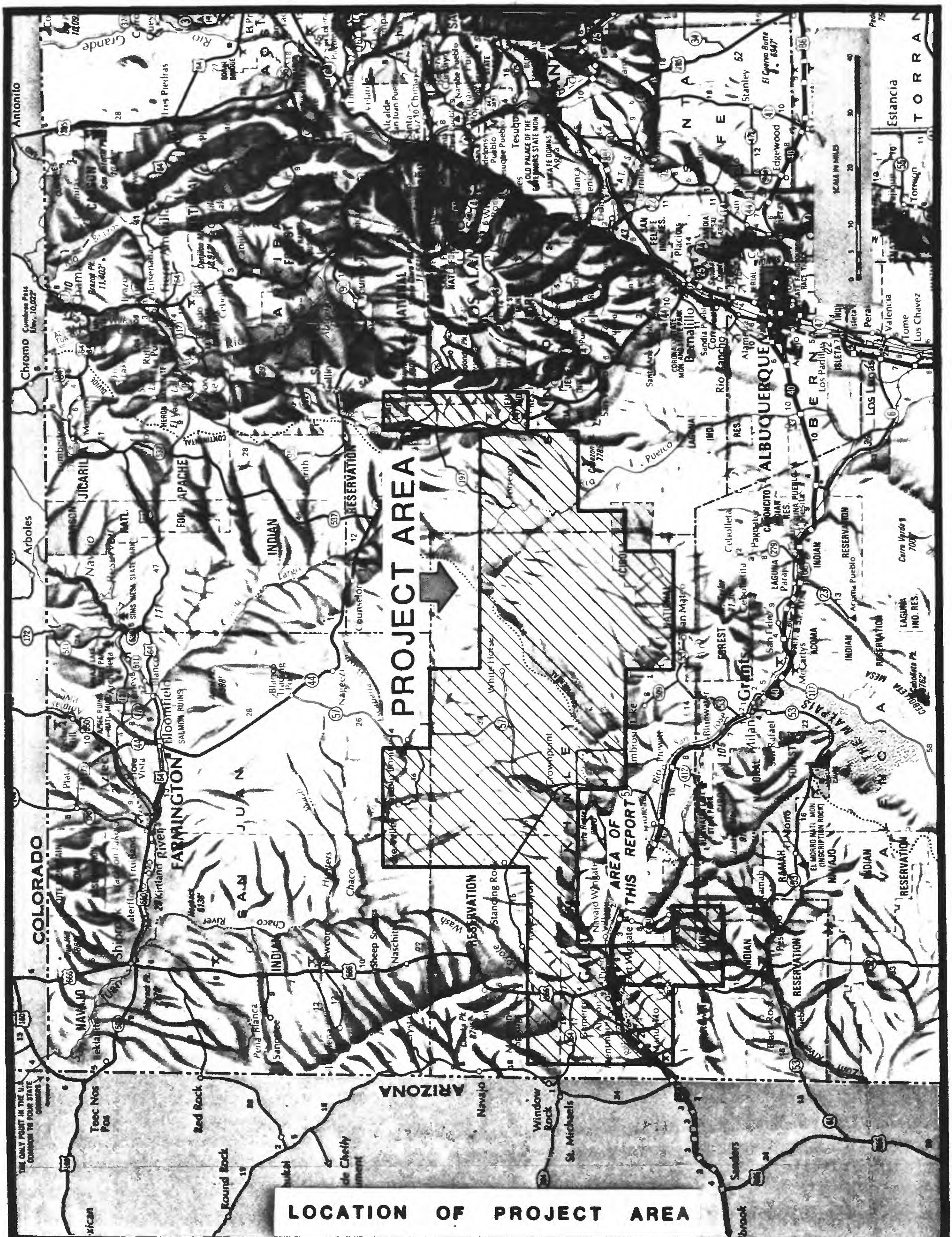
LOCATION OF PROJECT AREA
PROJECT AREA
AREA OF THIS REPORT
COLORADO
ARIZONA
FARMINGTON
ALBUQUERQUE
Grants
Bloomfield
Bernalillo
Estancia
Window Rock
Gallup

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
1	Cuba	79- 623
2	San Pablo	79- 624
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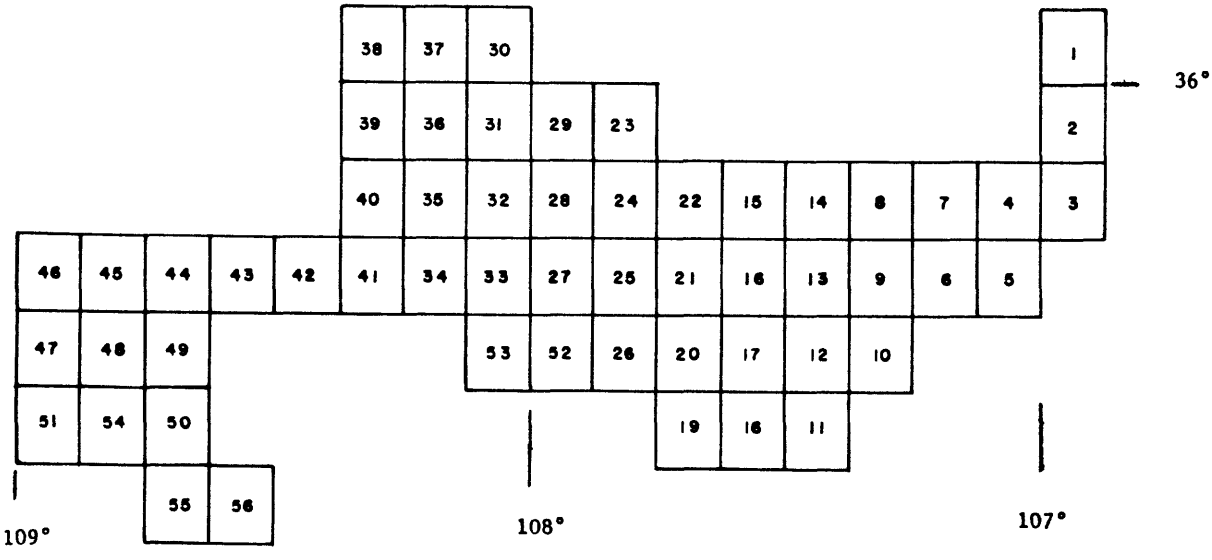
23	Seven Lakes NE	79- 638
24	Kin Nahzin Ruins	79- 639
25	Orphan Annie Rock	79-1041
26	Mesa de los Toros	79-1122
27	Laguna Castillo	79- 640
28	Seven Lakes	79-1042
29	Seven Lakes NW	79-1123
30	Kin Klizhin Ruins	79-1047
31	Nose Rock	79- 641
32	Becenti Lake	79-1124
33	Heart Rock	79- 642
34	Crownpoint	79-1125
35	Antelope Lookout Mesa	79-1376
36	Milk Lake	79-1377
37	La Vida Mission	79-1378
38	The Pillar 3 SE	79-1379
39	Red Lake Well	79-1380
40	Standing Rock	79-1381
41	Dalton Pass	80- 026
42	Oak Spring	80- 027
43	Hard Ground Flats	80- 028
44	Big Rock Hill	80- 029
45	Twin Lakes	80- 030
46	Tse Bonita School	80- 031
47	Samson Lake	80- 032
48	Gallup West	80- 033
49	Gallup East	80- 034
50	Bread Springs	80- 035
51	Manuelito	80- 036
52	Borrego Pass	80- 037
53	Casamero Lake	80- 038
54	Twin Buttes	80- 039
55	Pinehaven	80- 040
56	Upper Nutria	80- 041



Location

The Casamero Lake 7½ minute quadrangle includes acreage in Tps. 15 and 16 N., Rs. 11 and 12 W. of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

State Route 57 passes through the northwest corner and along the western quadrangle boundary, and provides access to the towns of Crownpoint, 5 mi (8 km) northwest, and to Thoreau, 14 mi (23 km) southwest of the quadrangle. Several light-duty maintained and unimproved dirt roads traverse most parts of the area. The Atchison, Topeka, and Santa Fe Railroad line passes about 7 mi (11 km) south of the quadrangle.

Physiography

The Casamero Lake quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). The topography of the quadrangle is characterized by eroded mesas, alluvial valley floors, and flatlands. The Continental Divide passes through the northern part of the quadrangle.

No perennial streams are present in the quadrangle. Local drainage is provided by several intermittent arroyos. Elevations within the quadrangle range from less than 6,920 ft (2,109 m) along the northern quadrangle boundary to over 8,180 ft (2,493 m) at Big Point in the central eastern part of the area.

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 Thoreau 5ENE Station. The Casamero Lake quadrangle is about 5 mi (8 km) NE of the Thoreau 5ENE Station. Average total annual precipitation for thirteen of the previous fifteen years is 10.84 in. (27.53 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 thirteen of the previous fifteen years is 49.4°F (9.7°C). The average daily temperatures in January and July are 30.8°F (-0.7°C) and 70.9°F (21.6°C), respectively.

Land status

The Federal Government holds coal rights to approximately 34 percent of the Casamero Lake 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 12,120 acres (4,905 ha) in the northern part of the quadrangle are within the Crownpoint Known Recoverable Coal Resource Area. As of October 26, 1978, there were no Federal coal leases, coal preference right lease applications or coal exploration licenses within the Casamero Lake quadrangle.

GENERAL GEOLOGY

Previous Work

Early reports in this area include that of Gardner (1909) who conducted reconaissance mapping and measured coal thicknesses in sec. 11, T. 15 N., R. 12 W., and sec. 29, T. 16 N., R. 11 W. Sears (1934) mapped coal bed outcrops and measured coal sections in the Gibson and Dilco Coal Members of the Crevasse Canyon Formation. Shomaker, Beaumont, and Kottlowski (1971) noted coal outcrops of the Gibson and Dilco Coal Members in the area and measured a 4.5 ft (1.4 m) thick Gibson Coal Member bed. They mentioned that the coals were generally thin and noncorrelative, and did not report any reserve estimates for the 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 Casamero Lake quadrangle include some of the sedimentary units of Upper Cretaceous age. Quaternary deposits include alluvium and terrace gravels along drainages in the area.

The "main body" of the Mancos Shale is, stratigraphically, the lowest Upper Cretaceous rock unit exposed in the quadrangle and represents transgressive marine deposits. Light to dark gray, silty shales with interbedded brown,

calcareous sandstones comprise the lithologies of the Mancos Shale. Thickness of the unit ranges from 600 to 700 ft (183 to 213 m) locally.

A major northeastward regression of the Cretaceous seaways resulted in deposition of the Gallup Sandstone in a nearshore or littoral environment. The Gallup Sandstone is composed of pink to gray, fine-to very coarse-grained, massive sandstone, interbedded gray shales, and coal beds. Thickness of the unit ranges from 150 to 180 ft (46 to 55 m) in the area. The Dilco Coal Member of the Crevasse Canyon Formation overlies the Gallup Sandstone and represents the continetal deposits which formed inland from the beach area during the deposition of the Gallup Sandstone. Medium to dark gray siltstone, interbedded medium-grained, tan sandstones, and coal beds comprise the lithologies of the Dilco Coal Member, which ranges from 100 to 150 ft (30 to 46 m) thick in the area.

Increased rates of trough subsidence caused the regressive sequence to gradually slow, and finally stop. The seaways deepened and the shorelines advanced southwestward during the succeeding transgressive phase. The Mulatto Tongue of the Mancos Shale overlies the Dilco Coal Member and is composed of light gray to tan, silty shale with interbedded reddish-tan, very fine-grained sandstone. Thickness of the unit averages 240 ft (73 m) in this area. A transitional contact of the Mulatto Tongue with the overlying Dalton Sandstone Member of the Crevasse Canyon Formation indicates the gradual reversal from transgressive to regressive depositional conditions.

The Dalton Sandstone Member is composed of yellowish-gray, very fine-grained, quartzose sandstone which formed in a nearshore environment, and ranges from 80 to 120 ft (24 to 37 m) thick locally. 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. Medium gray, carbonaceous

siltstone, interbedded gray to tan sandstone, and coal beds comprise the lithologies of the Gibson Coal Member, which ranges from 200 to 310 ft (61 to 94 m) thick locally.

Increased rates of trough subsidence resulted in the gradual reversal from regressive to transgressive depositional conditions, and the Hosta Tongue of the Point Lookout Sandstone was deposited during the advancing shoreline sequence. 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 ranges from 40 to 95 ft (12 to 29 m) thick locally.

As the transgression proceeded and the Cretaceous seaways deepened, the Satan Tongue of the Mancos Shale was deposited over the Hosta Tongue. The Satan Tongue is composed of light to dark gray, silty shale with interbedded tan to buff sandstone, and ranges from 20 to 80 ft (6 to 24 m) thick locally. The Satan Tongue pinches out within three miles south of the southern quadrangle boundary, and the Hosta Tongue and overlying Point Lookout Sandstone merge into an undivided sandstone unit. The Point Lookout Sandstone 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 similar to the Hosta Tongue. Thickness of the separate Point Lookout Sandstone ranges from 75 to 120 ft (23 to 37 m). Portions of the Menefee Formation may be present near the northern quadrangle boundary, although previous workers in the area did not map the Menefee Formation in this quadrangle.

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 the 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 is represented by 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 Casamero Lake quadrangle is in the Chaco Slope structural division in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). Sears (1934) mapped several low to moderate displacement faults in the area. Hackman and Olson (1977) mapped the Casamero fault which trends NE - SW in the southern part of the quadrangle. They also note the presence of the Bluewater fault zone in the western part of the area. The rock units dip from 2° to 5° NE to NW in most of the Casamero Lake quadrangle.

COAL GEOLOGY

In this quadrangle, the authors identified two coal beds and two coal zones in an oil and gas well log and Sears' (1934) surface mapping. These coal beds and coal zones are here informally called the Crevasse Canyon Dilco coal zone, Crevasse Canyon Gibson coal zone, and the Crevasse Canyon Gibson No. 3 and No. 3B coal beds.

The Crevasse Canyon Dilco coal zone contains, stratigraphically, the lowest identified coal beds in the Casamero Lake quadrangle. Up to three individual coal beds which range in thickness from 1.2 to 4.5 ft (0.4 to 1.4 m) occurring from 3 to 90 ft (1 to 27 m) above the top of the Gallup Sandstone comprise the Crevasse Canyon Dilco coal zone. These zone coals, as with all identified zone coals in this quadrangle, may be correlated for limited distances in portions of the area, but they lack sufficient continuity with poorly defined stratigraphic position and cannot be designated as persistent coal beds.

The Crevasse Canyon Gibson coal zone contains up to eighteen individual coal beds that occur from 0 to 308 ft (0 to 94 m) below the base of the Hosta

Tongue of the Point Lookout Sandstone. The Crevasse Canyon Gibson No. 3 coal bed ranges in thickness from 0.2 to 6.1 ft (0.1 to 1.9 m) and occurs from 40 to 72 ft (12 to 22 m) below the base of the Hosta Tongue. About 12 to 17 ft (4 to 5 m) below the Hosta Tongue, the Crevasse Canyon Gibson No. 3B coal bed ranges from 0.5 to 2.6 ft (0.2 to 0.8 m) in thickness.

Although the Crevasse Canyon Gibson No. 3 coal bed is 3.0 ft (0.9 m) or greater in thickness on Federal coal lands in the quadrangle, the U. S. Geological Survey did not request further Coal Resource Occurrence maps be constructed for this area.

COAL RESOURCES

The U. S. Geological Survey specified that coal beds 3.0 ft (0.9 m) or greater in thickness be 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. Because no coal beds or coal zones were specified for additional mapping, no reserve base or reserve data were computed for the Casamero Lake quadrangle.

COAL DEVELOPMENT POTENTIAL

The factors used to determine the development potential are the presence of a potentially coal-bearing formation, and 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 coal 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.

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.

The no and unknown development potential boundaries for surface mining methods (plate 4) are defined at the contacts of the coal-bearing Gibson Coal Member with the overlying noncoal-bearing Dalton Sandstone Member. Additional no and unknown potential boundaries are defined at the contact of the coal-bearing Dilco Coal Member and Gallup Sandstone with the overlying noncoal-bearing Mulatto Tongue of the Mancos Shale and underlying noncoal-bearing "main body" of the Mancos Shale.

The no and unknown development potential boundaries for subsurface mining methods (plate 5) are defined on the contacts of the coal-bearing Gallup Sandstone with the underlying noncoal-bearing "main body" of the Mancos Shale. These contacts for no and unknown development potential boundaries for surface and subsurface mining methods are 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 acres or 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. Where an area is underlain by more than one bed, the potential shown on the map is that of the bed with the highest potential.

The coal development potential of this quadrangle is subject to revision. As further coal information becomes available, it is possible that correlative coal beds with sufficient thickness may be identified. These coal data will likely define areas of Federal coal lands with development potentials other than no or unknown.

Development potential for surface mining methods

The coal development potential for surface mining methods in the Casamero Lake quadrangle is shown on plate 4. Based on coal development potential criteria, all Federal coal lands have no or unknown surface mining potentials.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the Casamero Lake quadrangle is shown on plate 5. Based on coal development criteria, all Federal coal lands have no or unknown development potential for subsurface mining methods.

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.

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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 forseeable 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.