UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Text to accompany:

OPEN-FILE REPORT 80-028

1985

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

[Report includes 4 plates]

Prepared by Berge Exploration, Inc.

CONTENTS (HARD GROUND FLATS QUADRANGLE)

ILLUSTRATIONS

INTRODUCTION

Purpose

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 Published and unpublished public information was used as the data base for this study.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

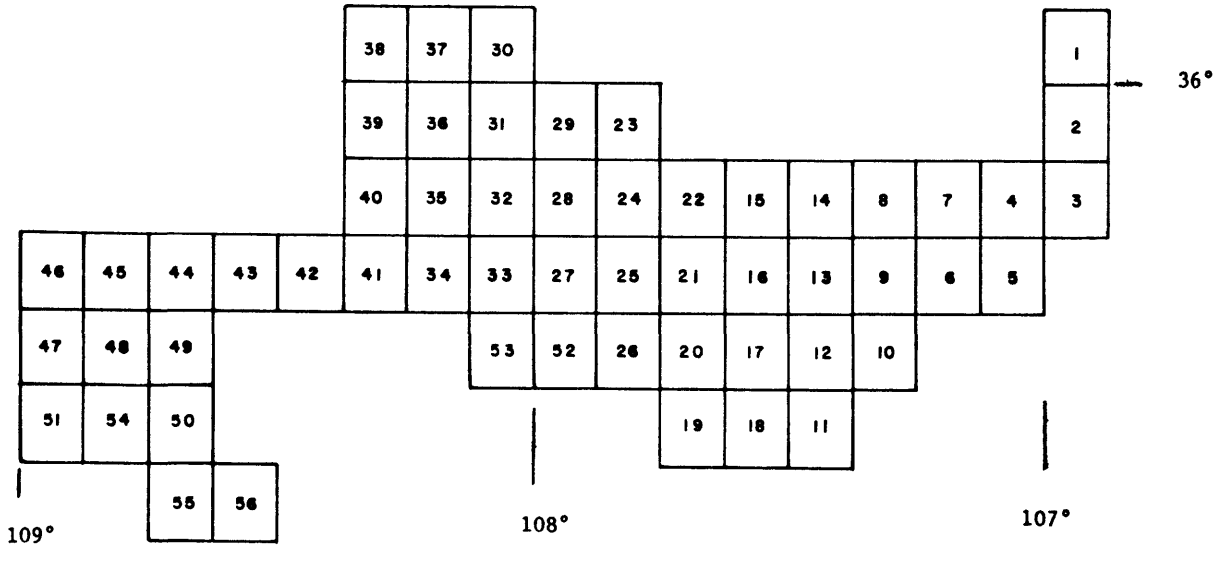
LOCATION OF PROJECT AREA
PROJECT AREA
AREA OF THIS REPORT
COLORADO
ARIZONA
FARMINGTON
ALBUQUERQUE
Grants

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
3	La Ventana	79-1038
4	Headcut Reservoir	79-1043
5	San Luis	79-1044
6	Arroyo Empedrado	79-1045
7	Wolf Stand	79-1046
8	Tinian	79- 625
9	Canada Calladita	79- 626
10	Cerro Parido	79- 627
11	El Dado Mesa	79- 628
12	Mesa Cortada	79- 629
13	Mesita del Gavilan	79- 630
14	Rincon Marquez	79- 631
15	Whitehorse Rincon	79- 632
16	Mesita Americana	79- 633
17	El Dado	79- 634
18	Cerro Alesna	79- 635
19	San Lucas Dam	79- 636
20	Piedra de la Aguila	79-1039
21	Hospah	79- 637
22	Whitehorse	79-1040
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

Map No.	Quadrangle	Open-file report
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 Hard Ground Flats 7½ minute quadrangle includes acreage in Tps. 16, 17, and 18 N., Rs. 16 and 17 W. of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

No paved roads pass through the Hard Ground Flats quadrangle. Unimproved dirt roads traverse most parts of the area. A secondary paved road passes about 2 mi (3 km) north of the quadrangle. The Atchison, Topeka, and Santa Fe Railroad line parallels Interstate Highway 40 about 4.5 mi (7.2 km) south of the quadrangle (see fig. 1).

Physiography

The Hard Ground Flats quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). The area is characterized by mesa-and-canyon topography.

No perennial streams are present in the quadrangle. Local drainage is provided by the Puerco River and several intermittent arroyos. Elevations within the quadrangle range from less than 6,240 ft (1,902 m) along Pumpkin Canyon in the northwest to 7,548 ft (2,301 m) on the mesa in the southwest.

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 Gallup 5E Station. The Hard Ground Flats quadrangle is about 7 mi (11 km) NE of the Gallup 5E Station. Average total annual precipitation for eleven of the previous fifteen years is 9.53 in. (24.41 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 seven of the previous fifteen years is 48.8° F (9.3° C). The average daily temperatures in January and July are 29.0° F (-1.7° C) and 71.3° F (21.8° C), respectively.

Land status

The Federal Government holds the coal mineral rights to approximately 9 percent of the Hard Ground Flats 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 3 acres (1 ha) along the western edge of the quadrangle are within the Gallup Known Recoverable Coal Resource Area. The Navajo Indians own the coal mineral rights to the northern three-fourths 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 Hard Ground Flats quadrangle.

GENERAL GEOLOGY

Previous work

Early reports on the area include reconnaissance mapping by Gardner (1909) who measured coals in sec. 35, T. 17 N., R. 16 W., in the southeastern part of the quadrangle. Sears (1934) mapped and measured coals within the Dilco and Gibson Coal Members of the Crevasse Canyon Formation, and Cleary Coal Member of the Menefee Formation in the Hard Ground Flats quadrangle. Shomaker, Beaumont, and Kottlowski (1971) reviewed the area and reported the presence of minable coals within the Gibson Coal Member. They note that the minable coals are in most areas overlain by 100 to 200 ft (30 to 61 m) of overburden and are not considered strippable. No reserves were estimated for the area. Kirk and Zech (1976) mapped the surface geology and compiled a structure contour map of the Hard Ground Flats quadrangle.

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^{o} W. - S. 60^{o} 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 Hard Ground Flats quadrangle include some

of the sedimentary units of Upper Cretaceous age. There is Quaternary alluvium along drainages in the area.

The "main body" of the Mancos Shale is stratigraphically the lowest exposed unit 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 is up to 660 ft (201 m) in surrounding areas, although only up to 340 ft (104 m) of the unit is exposed in the Hard Ground Flats quadrangle.

A major northeastward regression of the Cretaceous seaways followed, and resulted in deposition of the Gallup Sandstone in a beach or littoral environment. The Gallup Sandstone is composed of pink to gray, fine to medium-grained, massive sandstone with interbedded gray shales, and coal beds, which averages 160 ft (49 m) thick locally. The Dilco Coal Member of the Crevasse Canyon Formation overlies the Gallup Sandstone and represents the continental deposits which formed inland from the beach area during the deposition of the Gallup Sandstone. Medium to dark gray siltstone with interbedded medium-grained, tan sandstones, and coal beds comprise the lithologies of the Dilco Coal Member, which ranges from 140 to 200 ft (43 to 61 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 was deposited over 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 ranges from 0 to 100 ft (0 to 30 m) locally. The Mulatto Tongue pinches out in the south-

western part of the Hard Ground Flats quadrangle. In the area where the Mulatto Tongue is absent, the Dalton Sandstone Member of the Crevasse Canyon Formation directly overlies the Dilco Coal Member.

The Dalton Sandstone Member formed during a regression of the Cretaceous seaways, and is composed of yellowish-gray, very fine-grained, quartzose sandstone which formed in a nearshore environment. Thickness of the unit ranges from 60 to 120 ft (18 to 37 m) locally. Kirk and Zech (1976) note than the Dalton Sandstone Member is divided into upper and lower units, each of which interfinger locally with the Mulatto Tongue. Overlying the Dalton Sandstone Member, the Bartlett Barren Member represents flood plain deposits and consists of yellowish-brown to olive-gray siltstone with interbedded gray shales, white to brown locally calcareous sandstone, and local coal beds. Thickness of the unit ranges from 90 to 140 ft (27 to 43 m) locally.

The Gibson Coal Member of the Crevasse Canyon Formation overlies the Bartlett Barren Member, and is composed of medium gray, carbonaceous siltstone with interbedded gray to tan sandstones, and coal beds. Thickness of the Gibson Coal Member ranges from 190 to 300 ft (58 to 91 m) locally.

The Point Lookout Sandstone overlies the Gibson Coal Member 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). Light gray to reddish-brown, fine-to medium-grained sandstone with interbedded gray shale comprise the lithologies of the Point Lookout Sandstone, which ranges from 0 to 140 ft (0 to 43 m) thick locally. The Point Lookout Sandstone pinches out in the central western part of the Hard Ground Flats quadrangle,

and the overlying Cleary Coal Member of the Menefee Formation and Gibson Coal Member become an undifferentiated unit.

The Menefee Formation consists of dark gray to brown, carbonaceous to noncarbonaceous shales, light gray 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. Thickness of the Cleary Coal Member ranges from 175 to 225 ft (53 to 68 m) locally. Kirk and Zech (1976) note that the lower contact of the Cleary Coal Member with the Point Lookout Sandstone is distinct but interfingered, particularly near the depositional pinchout of the Point Lookout Sandstone. The Allison Member crops out in the high mesas in the central part of the quadrangle, where erosion has reduced the members thickness to about 225 ft (68 m) locally.

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 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 Hard Ground Flats quadrangle is in the Chaco Slope and Zuni Uplift structural divisions in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). The rock units dip from less than 1^{o} to 4^{o} NE to NW. Kirk and Zech (1976) mapped localized folding, faulting, and anticlinal and synclinal structural features in the quadrangle.

COAL GEOLOGY

In this quadrangle, the authors identified ten coal beds, three coal zones, and a local coal bed in oil and gas well logs, a coal test hole, and Sears' (1934) surface mapping. These coal beds and zones are here informally called the Crevasse Canyon Dilco No. 2, No. 3, and No. 4 coal beds, Crevasse Canyon Dilco coal zone, Crevasse Canyon Gibson No. 4, No. 6, No. 7, and No. 8 coal beds, Crevasse Canyon Gibson coal zone, Menefee Cleary No. 1, No. 2, and No. 2A coal beds, and the Menefee Cleary coal zone.

The Crevasse Canyon Dilco No. 2 coal bed is stratigraphically the lowest identified coal bed in the quadrangle. It occurs from 169 to 210 ft (52 to 64 m) below the Dalton Sandstone Member. The Crevasse Canyon Dilco No. 3 and No. 4 beds are 105 to 137 ft (32 to 42 m) and 55 to 76 ft (17 to 23 m), respectively, below the Dalton Sandstone Member. These beds are inferred to be continuous, although they may be several individual beds that are stratigraphically equivalent. The Crevasse Canyon Dilco coal zone contains one bed which occurs from 92 to 103 ft (28 to 31 m) below the Dalton Sandstone Member. 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.

About 200 ft below the base of the Point Lookout Sandstone, the Crevasse Canyon Gibson No. 4 coal bed contains from 11.0 to 12.0 ft (3.3 to 3.7 m) of coal. The Crevasse Canyon Gibson No. 6 and No. 7 coal beds occur from 48 to 86 ft (15 to 26 m) and 23 to 61 ft (7 to 19 m), respectively, below the Point Lookout Sandstone. The Crevasse Canyon Gibson No. 8 bed is

the uppermost Gibson Coal Member bed in this area, and occurs immediately below the base of the Point Lookout Sandstone. Other Gibson Coal Member beds include the Crevasse Canyon Gibson coal zone which contains up to ten individual beds that occur from 4 to 248 ft (1 to 76 m) below the Point Lookout Sandstone.

Stratigraphically, the Cleary Coal Member of the Menefee Formation contains the highest identified coal beds in the Hard Ground Flats quadrangle. The Menefee Cleary No. 1 coal bed ranges from 0 to 3 ft (0 to 0.9 m) above the Point Lookout Sandstone in this quadrangle, although it is known to occur up to 15 ft (5 m) above the Point Lookout Sandstone in nearby areas. The Menefee Cleary No. 2 and No. 2A coal beds occur from 20 to 23 ft (6 to 7 m) and 43 to 48 ft (13 to 15 m), respectively, above the Point Lookout Sandstone. Other Cleary Coal Member beds include the Menefee Cleary coal zone which contains up to five individual beds that are 10 to 96 ft (3 to 29 m) above the Point Lookout Sandstone.

COAL RESOURCES

No resource evaluations were made for any of the coal beds identified in the Hard Ground Flats quadrangle because all beds that were underlying Federal coal lands were less than 3.0 ft (0.9 m) thick. The U. S. Geological Survey specified that only 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.

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 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 underlain by a potentially coal-bearing formation within 200 ft (61 m) of the surface which contain no correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) thick 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 Gallup Sandstone and Dilco Coal Member of the Crevasse Canyon Formation with the underlying noncoal-bearing "main body" of the Mancos Shale and overlying noncoal-bearing Mulatto Tongue of the Mancos Shale and Dalton Sandstone Member of the Crevasse Canyon Formation. The contact of the coal-bearing Gibson Coal Member of the Crevasse Canyon Formation with the underlying Bartlett Barren Member of the Crevasse Canyon Formation and the overlying noncoal-bearing Point Lookout Sandstone also defines a no and unknown development potential boundary. These contacts are approximated due to the inaccuracies of adjusting old geologic maps to modern topographic bases.

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 thicknesses 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 Hard Ground Flats quadrangle is shown on plate 4. Based on coal development potential criteria, all Federal coal lands in the Hard Ground Flats quadrangle where data are sufficient to determine development potentials, have either no or unknown development potential for surface mining methods.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods was not mapped in the Hard Ground Flats quadrangle because based on coal development potential criteria, all Federal coal lands in the quadrangle have 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.

SELECTED REFERENCES
(HARD GROUND FLATS QUADRANGLE)

#43

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.

Chapman, Wood, and Griswold, Inc., 1977, Geologic map of the Grants uranium region: New Mexico Bureau of Mines and Mineral Resources Geologic Map 31.

Gardner, J. H., 1909, The coal field between Gallup and San Mateo, New Mexico, in Coal fields of Colorado, New Mexico, Utah, Oregon, and Virginia: U.S. Geological Survey Bulletin 341-C, p. 364-378.

Hackman, R. J., and Olson, A. B., 1977, Geology, structure, and uranium deposits of the Gallup 1°x2° quadrangle, New Mexico and Arizona: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-981, scale 1:250,000.

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.

Kirk, A. R., and Zech, R. S., 1976, Preliminary geologic and structure contour maps of the Hard Ground Flats quadrangle, New Mexico: U.S. Geological Survey Open-File Report 76-859.

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., 1934, The coal field from Gallup eastward toward Mount Taylor, part 1 of Geology and fuel resources of the southern part of the San Juan Basin, New Mexico: U.S. Geological Survey Bulletin 860-A, p. 1-30.

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 Kottlowski, 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.

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 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.