Information Series 25

Selected References on the Geology and Coal Resources of Central and Western Colorado Coal Fields and Regions

Written and Compiled by
Peter Rushworth,
Bruce S. Kelso,
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Denver, Colorado / 1988

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SELECTED REFERENCES ON THE GEOLOGY AND COAL RESOURCES OF CENTRAL AND WESTERN COLORADO COAL FIELDS AND REGIONS

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PREFACE

This bibliographic reference was compiled using two U.S. Geological Survey and three Colorado Geological Survey Open-File Reports. The purpose of this publication is to combine into one volume, the references on the geology of central and western Colorado coal fields and regions. Included in this publication are references for the Yampa and Danforth Hills Coal Fields, Sand Wash Basin, Uinta Coal Region and Piceance Creek Basin, San Juan River Coal Region, and North Park, Middle Park, and South Park Coal Fields.

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The Colorado Geological Survey gratefully acknowledges the cooperation of the U.S. Geological Survey. This publication results from the cooperative effort of Michael Brownfield and Edward Johnson of the U.S. Geological Survey and Bruce Kelso and Peter Rushworth (now with Colorado Mined Land Reclamation Division) of the Colorado Geological Survey. It combines and updates previous Open-File Reports from both agencies into a more meaningful and usable document.

NOTE

All efforts were made to assure the accuracy and completeness of these references, but if errors or ommissions are found, please inform the Colorado Geological Survey.

CONTENTS

SELECTED REFERENCES ON THE GEOLOGY OF THE DANFORTH HILLS COAL FIELD, EASTERN UINTA COAL REGION, MOFFAT AND RIO BLANCO COUNTIES, COLORADO

(Previously published as "Selected References on the Geology of the Danforth Hills Coal Field, Moffat and Rio Blanco Counties, Colorado", U.S. Geological Survey Open-File Report 87-768, 1984, revised 1986 for this publication.)

by
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U.S. Geological Survey

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INTRODUCTION

The selected references contained in this report cover most geologic subjects relevant to areas in or adjacent to the Danforth Hills coal field of northwest Colorado (fig. 1). Approximately 220 references are listed ranging from 1876 to 1984. While no such list should ever be considered complete, it is hoped that this report contains the basic sources of interest to those earth scientists studying the area. Most of the reference material can be found in larger public libraries and those of major colleges and universities.

PHYSIOGRAPHY

The Danforth Hills coal field is situated in northwest Colorado in Moffat and Rio Blanco Counties. The coal field lies north of the White River, west of the White River Plateau, south and west of the Axial Basin, and east of the valley of Strawberry Creek which flows southward along the northward extension of the Grand Hogback. The Flat Tops highlands of the White River Plateau to the southeast ranges in elevation from 8,500 to 12,000 ft.

The Danforth Hills area is characterized by northward-sloping ridges separated by steep canyons on the north and to the south and west by steeply dipping, long and narrow hogbacks. Elevations range from 6,200 to 8,700 ft. Northward drainage is to the Yampa River and southward drainage is to the White River.

REGIONAL STRATIGRAPHY

There are approximately 30 named stratigraphic formations or groups in the study region. Distribution of most of these formations is shown on various regional geologic maps, particularly those compiled by Tweto (1975, 1976), Miller (1977), and Rowley and others (1979).

Coal beds of economic interest are present only in strata of Late Cretaceous and Tertiary age. These will be more fully described in the following part of this report.

Formations of Late Mesozoic age (Cretaceous) are the oldest strata that contain coal beds of economic interest in northwestern Colorado. The Dakota, Mowry, Frontier, Niobrara, and Mancos Formations, which underlie the coal-bearing rocks, were deposited under marine and marginal-marine conditions. The coal-bearing Iles and Williams Fork Formations were deposited mostly in terrestrial environments that contained swamps where organic materials accumulated to form the present coal beds. Fluctuations of sea level occurred so that sediments of marine or near-marine origin are interbedded with the nonmarine coal-bearing beds. To the north and east of the Danforth Hills, the upper part of the coal-bearing Williams Fork Formation grades upward into and interfingers with the marine beds of the Lewis Shale. Ritzma (1955) provides a brief history of the end of the Cretaceous and early Cenozoic time in this region.

During earliest Tertiary time, in the Paleocene Epoch, swamps associated with fluvial conditions were present and the accumulated organic material became the coal beds of the Fort Union Formation. These coal beds are approximately the same age as the lignites of Montana, North and South Dakota, the Denver Basin, and some of the Powder River Basin coal beds.

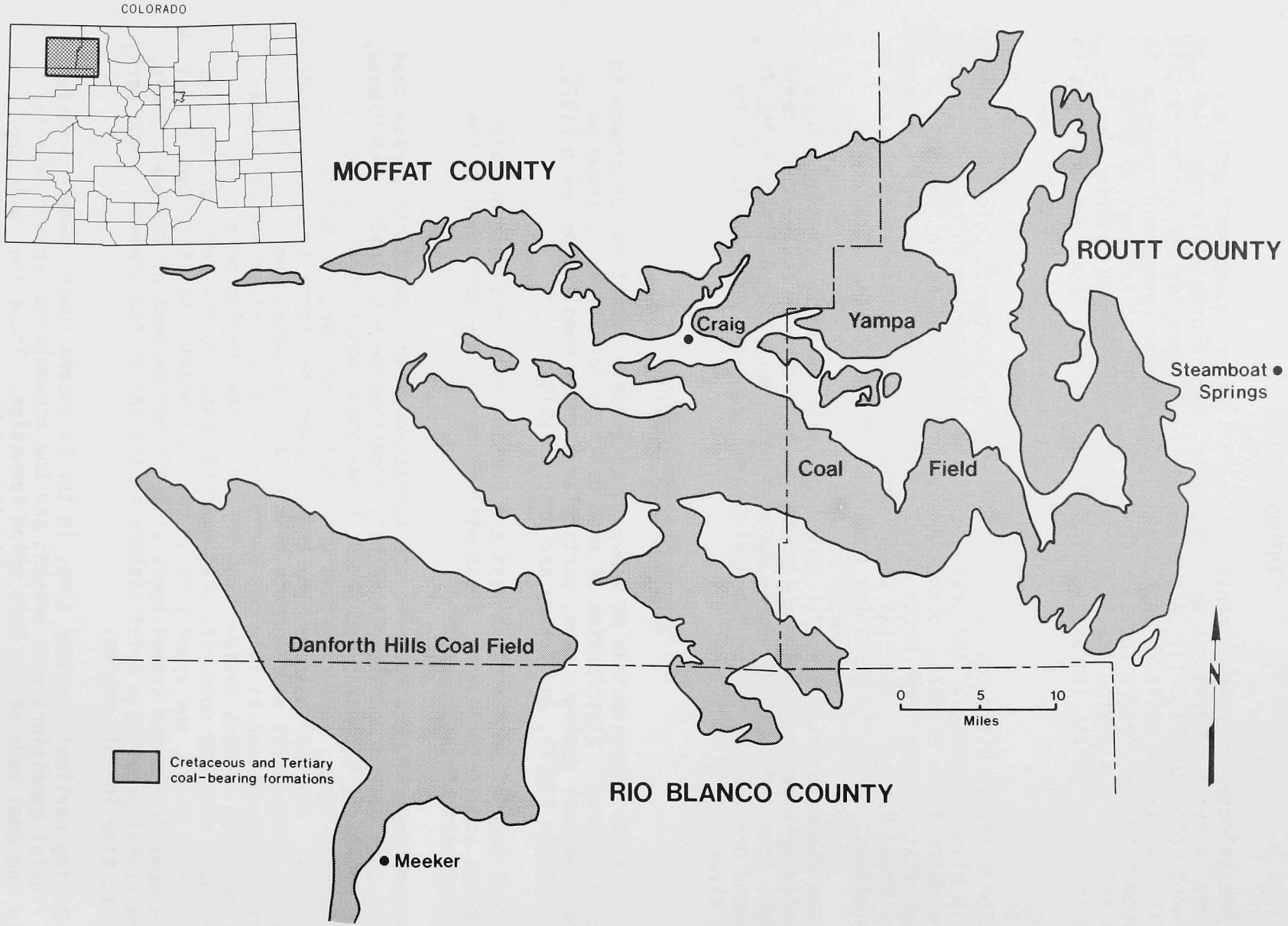

Figure 1. Location map showing the Danforth Hills Coal Field and adjacent coal field in northwestern Colorado (from Brownfield and Johnson, 1984).

COAL STRATIGRAPHY

Coal beds of economic interest in the Danforth Hills coal field occur in the Iles and Williams Fork Formations of the Mesaverde Group of Late Cretaceous age and the Fort Union Formation of Paleocene age. The stratigraphic sequence of these coal-bearing rocks is shown in figure 2.

The Mesaverde Group crops out throughout most of the Danforth Hills coal field. To the southwest, the Mesaverde plunges too deep to be of economic interest at the present time. This group of coal-bearing sediments in the Danforth Hills coal field has been described by several geologists. Among these are Hancock (1925) for the Axial area in the northeast portion of the field, and Hancock and Eby (1930) for the Meeker region. Gale (1907 and 1910) described the regional stratigraphic variations. The following descriptions of the Iles and Williams Fork Formations are modified from Hancock and Eby (1930).

The Iles Formation, which makes up the lower part of the Mesaverde Group, consists of a sequence of rocks 1,350-1,600 ft thick. The formation contains massive ledge-forming beds of sandstone interbedded with sandy shale and shale with minor coals occurring throughout. The uppermost ledge-forming sandstone in the Iles Formation is the Trout Creek Sandstone Member. This conspicuous white marine sandstone was named by Fenneman and Gale (1906) for its outcrop in Twentymile Park southwest of Steamboat Springs, Colo. The coal beds assigned to the lower coal group and Black Diamond coal group are in the Iles Formation. The lower coal group consists of thin coal beds from 100 to 250 ft above the base of the Iles and the Black Diamond coal group lies 150-350 ft below the Trout Creek Sandstone.

The Williams Fork Formation, which makes up the upper part of the Mesaverde Group, includes all beds between the top of the Trout Creek Sandstone Member of the Iles Formation and the base of the overlying unconformable Fort Union Formation. Its thickness ranges from 4,500 to 5,000 ft and the formation consists of thin to thick sandstone beds, sandy shale, shale, and coal. About 3,000 ft above the Trout Creek Sandstone is another white marine sandstone named the Lion Canyon Sandstone Member by Hancock and Eby (1930). The coal beds of the Fairfield, Goff, and Lion Canyon coal groups occur in the Williams Fork Formation. The Fairfield coal group contains numerous coal beds throughout an interval 1,300 ft thick above the Trout Creek Sandstone. The Goff coal group is an interval of 700 ft of coal-bearing sediments that directly underlie the Lion Canyon Sandstone. This coal group is separated from the Fairfield group by about 1,000 ft of Williams Fork sediments that are mostly barren of coal. The Lion Canyon coal group inlcudes all the coal bearing sediments above the Lion Canyon Sandstone and is about 1,000 ft thick.

Along the western margin of the Yampa coal field the thickness of the Williams Fork Formation is only about 2,000 ft compared to the 4,500-5,000 ft exposed along the southwest margin of the Danforth Hills. This great difference in thickness is due to regional facies changes within the Williams Fork, Lewis, and Lance Formations (fig. 2). The upper part of the Williams Fork in the Meeker area contains sediments equivalent in age to the Lewis and Lance Formations of the western Yampa coal field. The entire Mesaverde Group

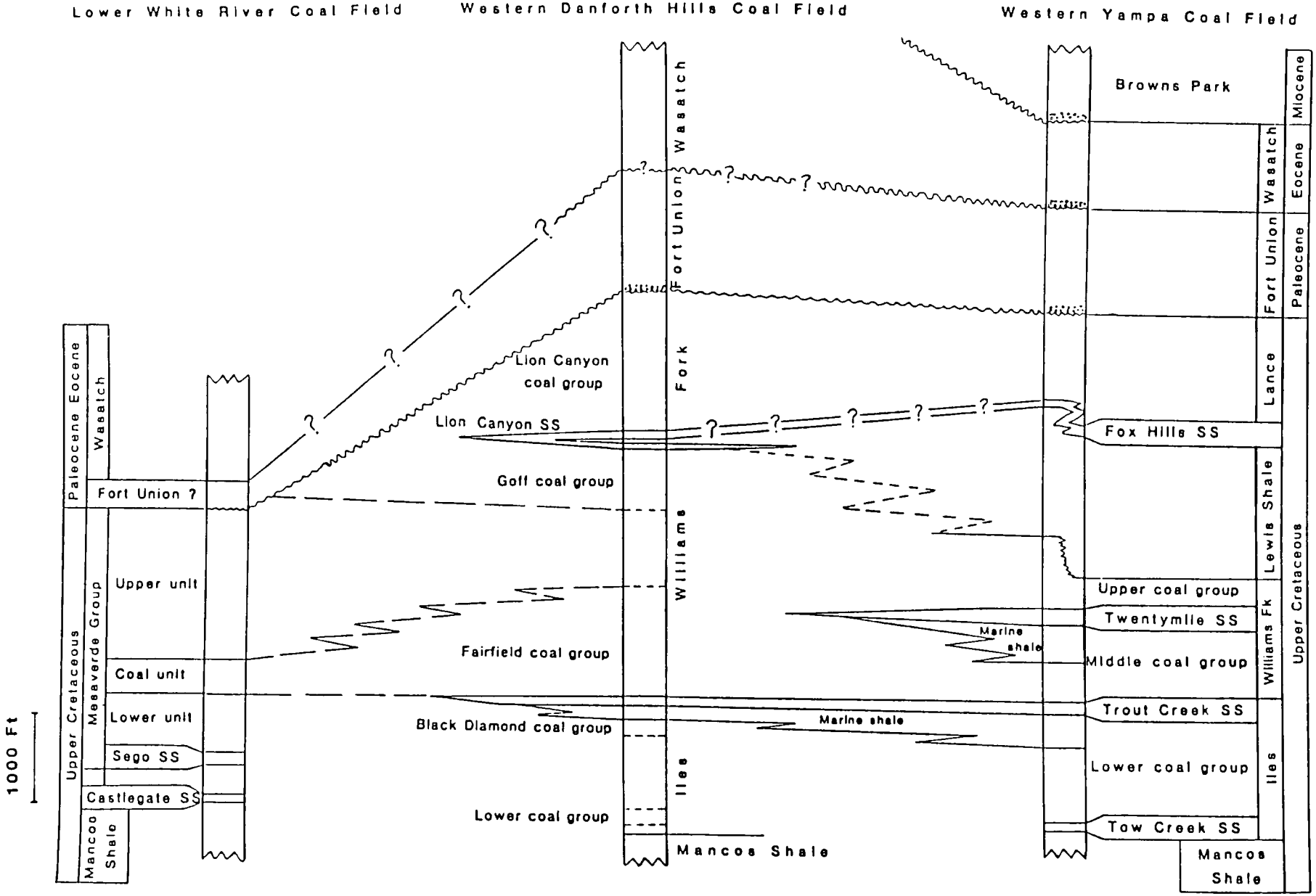

Figure 2. Generalized stratigraphic sections of the coal-bearing formations of northwestern Colorado (from Brownfield and Johnson, 1984).

thins to 2,400 ft about 50 miles west near the town of Rangley, Colo. This thinning is do in part to the truncating of the Cretaceous sedimentary rocks by the overlying Tertiary sedimentary units.

The coal-bearing Fort Union Formation unconformably overlies the Williams Fork Formation along the western margin of the Danforth Hills. The Fort Union consists of interbedded sandstone, shale, and coal. The lower sandstone member ranges in thickness from 1,200 to 1,400 ft (Pipiringos and Rosenlund, 1977) and is conglomeratic at the base. The Fort Union may exceed 2,000 ft in thickness if Paleocene shale beds included in the overlying Wasatch Formation by Pipiringos and Rosenlund (1977) are included in the Fort Union. Coal beds found within the Fort Union Formation are typically thin and lenticular.

COAL RESOURCES

The Danforth Hills coal field contains the major coal deposits on the northeast flank of the Piceance Creek Basin. In general, the individual coal beds within the coal groups are discontinuous and difficult to correlate laterally. The coal is mainly high-volatile C-bituminous in rank, though some of the upper coal beds in the northern part of the field may be subbituminous. The Iles and Williams Fork Formations, from which most future production will come, contain coals with Btu values ranging from 10,600 to 11,800 per pound on an as-received basis and with sulfur content ranging from 0.2 to 0.9 percent. In these same formations the range of percentage value of moisture is 9.4-14.8; volatile matter is 33.1-42.0; fixed carbon is 41.2-49.2; and ash is 2.2-9.5 (Hancock and Eby, 1930).

In Landis' (1959) report the reserves were estimated by bed, except in the northern part of the field where inferred coal reserves were estimated on a group basis, and in the part of the field west of long 108 W., where reserves were estimated on a coal zone basis by Spencer and Erwin (1953). A total of about 7,854 million tons of bituminous coal is estimated to have been originally present in 252 mi^2 of the field. An additional area of 18 mi^2 may contain minable reserves of coal with less than 3,000 ft of overburden.

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SELECTED REFERENCES ON THE GEOLOGY OF THE YAMPA COAL FIELD, SOUTHERN GREEN RIVER COAL REGION, MOFFAT, ROUTT AND RIO BLANCO COUNTIES, COLORADO

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INTRODUCTION

The selected references contained in this report cover most geologic subjects relevant to areas in or adjacent to the Yampa coal field of northwestern Colorado (fig. 1). Also included are listings for the southeastern part of the Sand Wash Basin which is known to contain coal at depths of less than 3,000 ft. Approximately 385 references are listed ranging from 1874 to 1984. While no such list should ever be considered complete, it is hoped that this work contains the basic sources necessary to those earth scientists studying the area. Most of the references can be found in larger public libraries and those of major colleges and universities.

PHYSIOGRAPHY

The Yampa coal field is an area characterized by rolling hills, broad river valleys, and low mountain ranges. Elevations within the coal field typically range between 6,000 and 8,000 ft. This area is partly bordered by higher, mountainous terrain where elevations locally exceed 12,000 ft. The coal field is drained by the Yampa River.

REGIONAL STRATIGRAPHY

There are approximately 30 named stratigraphic formations or groups in the general region of the Yampa coal field. Distribution of most of these units is shown on various regional geologic maps, particularly those complied by Miller (1975, 1977) and Tweto (1976).

Formations of late Mesozoic age (Cretaceous) are the oldest strata that contain coal beds of economic interest in northwestern Colorado (fig. 2). In ascending order, the Dakota Sandstone, Mowry Shale, Frontier Sandstone, Niobrara Formation, and Mancos Shale were deposited under marine or marginal-marine conditions and do not contain coal in this area.

The Iles and Williams Fork Formations, which comprise the Mesaverde Group, were deposited primarily in terrestrial environments which included swamps where the organic materials accumulated that later formed the present coal beds of these units. Fluctuations of sea level did occur so that some rocks of marine or marginal-marine origin are interbedded with the nonmarine coal-bearing rocks.

The Iles Formation, which is the lower part of the Mesaverde Group, consists of a sequence of rocks about 1,500 ft thick containing massive ledge-forming beds of sandstone interbedded with sandy shale, shale, and widely distributed coal. The coal beds in this formation are assigned to the lower coal group of the Mesaverde Group. The thicknesses of individual beds of sandstone vary greatly, but some sandstone units, or zones, persist throughout the area and deserve special mention as guides to correlation within the coal field. They are: (1) the Tow Creek Sandstone Member at the base in the eastern part of the coal field, (2) a double ledge-forming sandstone sequence about 400 ft above the base also located in the eastern part of the field, and (3) the Trout Creek Sandstone Member occurring throughout the coal field at the top of the formation.

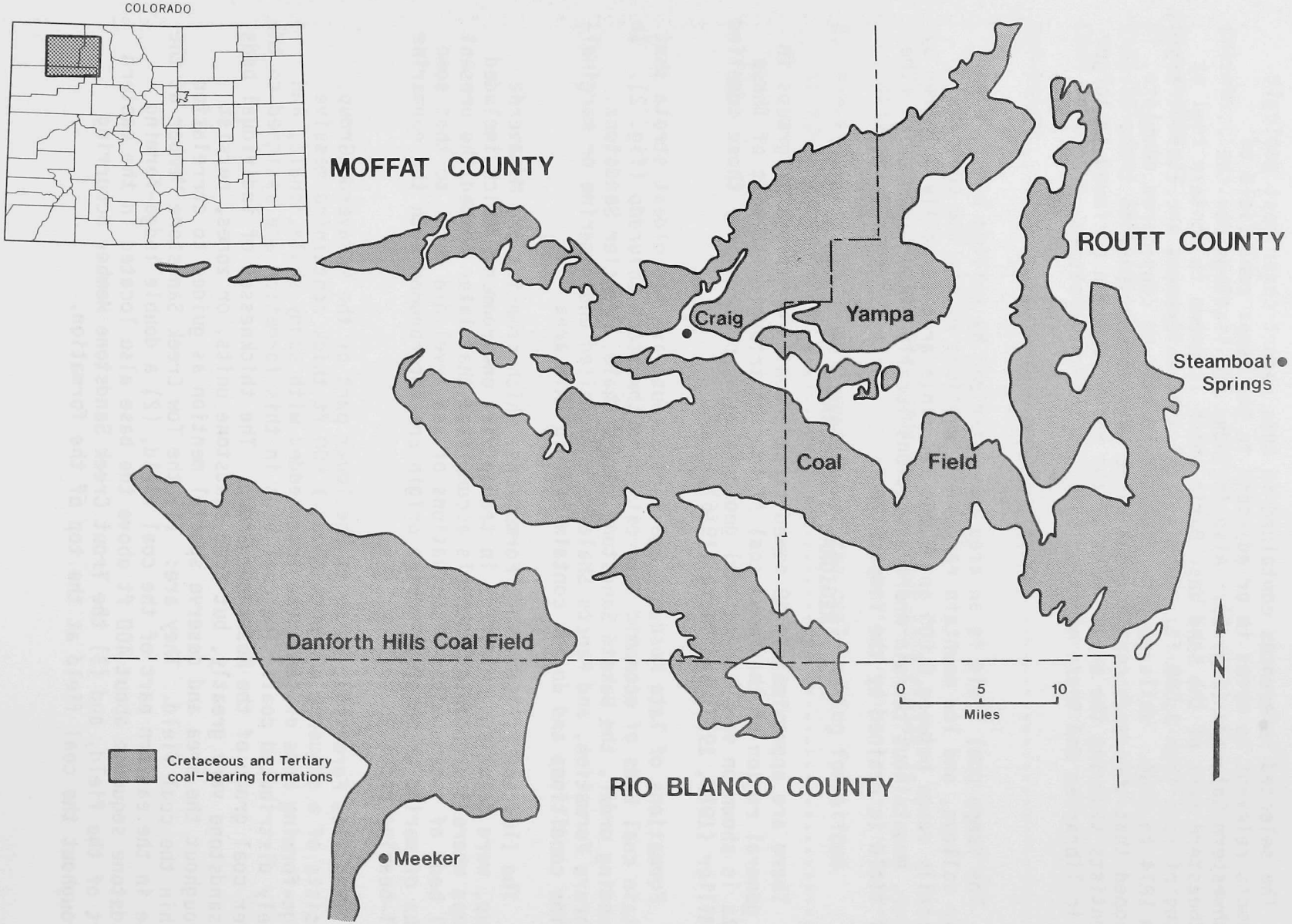

Figure 1. Location map showing the Yampa and adjacent coal field in northwestern Colorado (from Johnson and Brownfield, 1984).

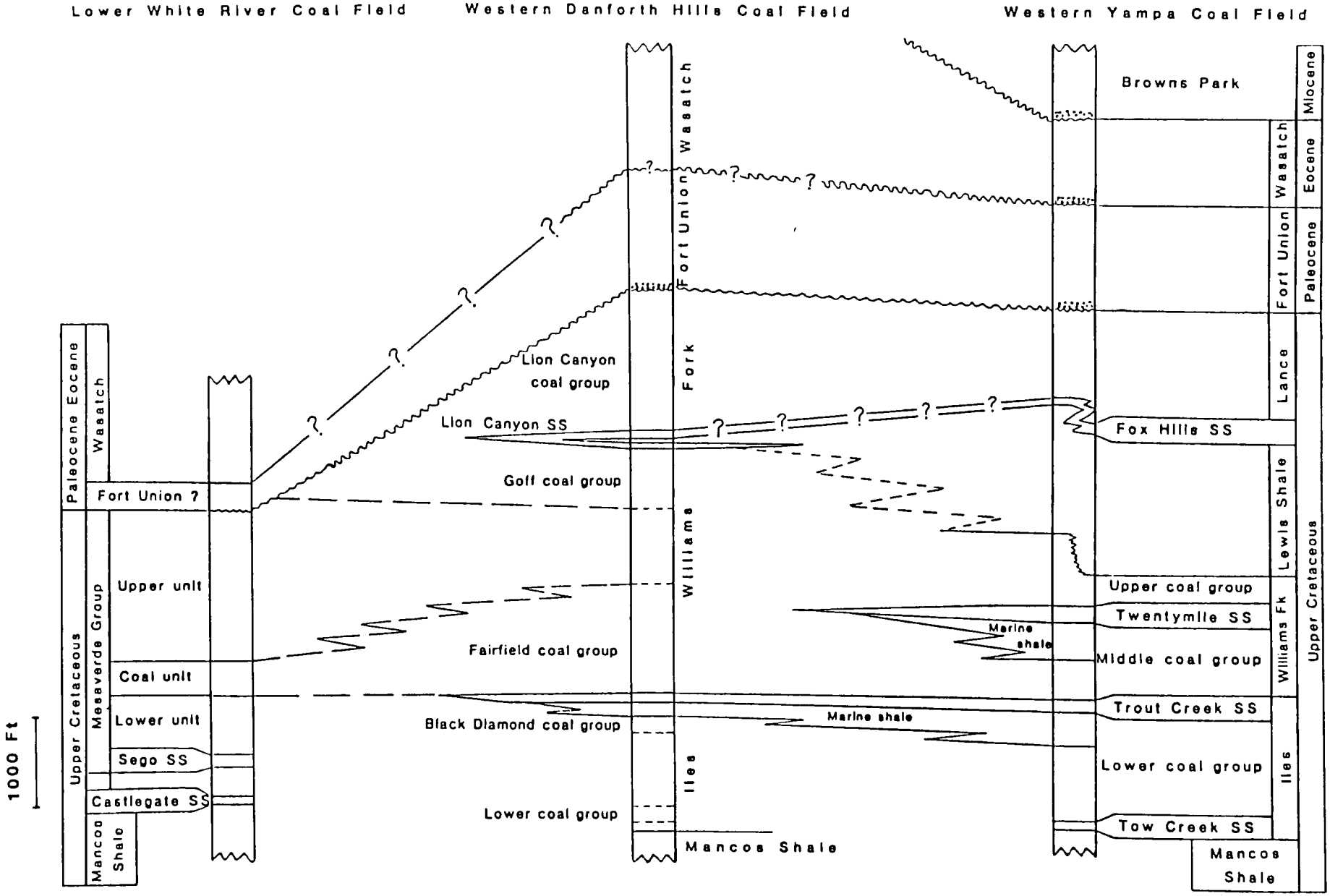

Figure 2. Generalized stratigraphic sections of the coal-bearing formations of northwestern Colorado (from Johnson and Brownfield, 1984).

The Williams Fork Formation, which overlies the Iles Formation and comprises the upper part of the Mesaverde Group, ranges in thickness from 1,100 ft near Mount Harris to nearly 2,000 ft at the west margin of the Yampa coal field. The formation continues to increase in thickness southwestward toward Meeker, where Hancock and Eby (1930) measured as much as 5,050 ft. The formation includes thin to thick sandstone beds, sandy shale, shale, and coal. A massive cliff-forming sandstone about 100 ft thick named the Twentymile Sandstone Member divides the formation into two parts: a lower part containing the so-called middle coal group and an upper part containing the so-called upper coal group of the Mesaverde Group. In the eastern part of the coal field the middle coal group contains several thick coal beds. These beds are named in ascending order: the Wolf Creek, Wadge, and Lennox, and are found in the Mount Harris and Oak Creek areas. To the west in the Williams Fork Mountains these names are not used but many economical beds occur in the middle group. The upper coal group of the Williams Fork Formation lies above the Twentymile Sandstone Member. In the vicinity of Mount Harris, Twentymile Park, and Fish Creek the thickness of the unit is about 200 ft and consists of beds of sandstone, sandy shale, shale, and one coal bed about 3 ft thick. In the Williams Fork Mountains the upper coal group is about 800 ft thick and contains up to nine coal zones (Bass, Eby, and Campbell, 1955).

The Mesaverde Group crops out across much of the southern part of the coal field, including a large area southeast of Hamilton. In addition, a narrow band of outcrops extend north from just east of the Hayden area to the Elkhead Mountains. To the northwest, the Mesaverde Group plunges to several thousand feet under the Sand Wash Basin where it is probably too deep to be of economic interest at the present time. This Group of coal-bearing rocks has been described in various parts of the region by Bass, Eby, and Campbell (1955) for the eastern Yampa coal field, and Hancock (1925) for the western part. The upper part of the Mesaverde Group grades upward into, and interfingers eastward with, marine beds of the Lewis Shale. This unit ranges in thickness from 1,000 to 1,900 ft.

The uppermost Cretaceous rocks of the Lance Formation were deposited under terrestrial conditions which included swamps in which organic debris accumulated and later formed coal beds. Very little study has been done on the Lance Formation in this area but the thickness of the formation is thought to be about 1,050-1,500 ft and it is known to be composed of interbedded sandstone, sandy shale, shale, and thin coal. Ritzma (1955) provides a brief history of the end of the Cretaceous and beginning of early Cenozoic time in this region.

During parts of earliest Tertiary time, in the Paleocene Epoch, fluvial swamps were present and the accumulated organic material became the coal beds of the Fort Union Formation. These coal beds are approximately the same age as the lignites of Montana, North and South Dakota, and of the Denver Basin. The Fort Union Formation overlies the Lance Formation and a regional unconformity marked by a widespread conglomerate seperates the two units. The Fort Union Formation consists of interbedded sandstone, shale, and coal. Northeast of Craig, the formation is about 1,500 ft thick (Bass, Eby, and Campbell, 1955), and contains one thick coal bed named the Seymour. West of Craig the thickness of the formation ranges from 800 to 1,100 ft thick in the Lay Creek area (Brownfield and Anderson, 1979) where it contains three coal zones. The lower zone contains several coal beds up to 10 ft in thickness;

the middle zone contains one thick coal bed called the Emerson which pinches out towards the western margin of the area; and the upper coal zone contains only the Blevins bed.

COAL RESOURCES

Landis (1959) describes the coal resources of the Yampa coal field as being in the Colorado part of the Green River region which is the southern extension of the Wyoming Basin Province of Wyoming and Colorado. Structurally, the region is a broad northwestward-plunging syncline. The coal ranges in rank from subbituminous to anthracite. Most of the coal is of high-volatile C-bituminous rank, but coal along the eastern edge of the field is locally of higher rank due to the close proximity of small intrusions.

The Williams Fork and Iles Formations, from which much of the expected future production will come, contain coals with Btu values that range from 10,000 to 12,000 per pound as-received with a sulfur content that ranges from 0.3 to 1.9 percent. In these same coal beds the range of percentage value of moisture is 8.4-17.6; volatile matter is 37.6-44.0; fixed carbon is 47.9-55.9; and ash is 4.4-11.0. Coal found in the Fort Union Formation is considered to be subbituminous in rank (Bass, Eby, and Campbell, 1955). Coal quality has been determined from several core holes which were drilled through the middle and upper coal zones by the Bureau of Reclamation and Utah International, Inc. Analyses from these Fort Union coals indicate the following average results on an as-received basis:

Moisture (percent)	Ash (percent)	Sulfur (percent)	Volatile matter (percent)	Fixed carbon (percent)	Btu/lb
13	8	0.49	33.47	45.50	10,300

Estimates of reserves in the eastern part of the region were made by F.D. Spencer (Bass, Eby, and Campbell, 1955). Landis (1959) estimated the reserves in the western part of the field based on information contained in reports by Gale (1909, 1910), Hancock (1925), and the U.S. Bureau of Mines (1937). Reserves were estimated by individual bed except for the inferred coal west of long 107°30' W. and south of lat 40°30' N. and for a small area in northern Routt County where reserves were estimated on a coal-zone basis. For the Yampa coal field a total of about 23,607 million tons of coal (76 percent bituminous, 24 percent subbituminous) were estimated by Hornbaker, Holt, and Murray (1976) to have been originally present in an area of 828 mi^2 and an additional area of 852 mi^2 may contain 21,300 tons of coal within 3,000 ft of the surface.

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SELECTED REFERENCES ON THE COAL RESOURCES OF THE NORTH PARK, MIDDLE PARK AND SOUTH PARK COAL FIELDS, COLORADO

GEOLOGIC OVERVIEW

by
Bruce S. Kelso
Colorado Geological Survey

and

SELECTED REFERENCES

(Previously published as "Bibliography - Coal Resources - North Park Coal Fields, Colorado", Colorado Geological Survey Open-File Report 84-17, 1984, revised in 1986 for this publication.)

by
Peter Rushworth
Colorado Geological Survey

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INTRODUCTION

The North Park, Middle Park, and South Park Coal Fields are intermontane basins that contain coals of Paleocene and Cretaceous age. Coal production has been limited to the North Park and South Park Coal Fields only. Middle Park Coal Field is a southern extension of North Park Coal Field and contains minor amounts of coal in lower tertiary sediments. There will be no further discussion of the Middle Park Coal Field in this paper due to a lack of information on the area's limited coal resources. This collection of references pertains to coal and related geologic subjects for the North Park, Middle Park, and South Park Coal Fields of central Colorado. The references were first printed as Colorado Geological Survey Open File Report 84-17 (August 1984) and updated in May 1986. Although all efforts were made to compile a complete listing of references for this report, omissions are the responsibility of the authors and should be brought to the attention of the Colorado Geological Survey for inclusion in future printings.

NORTH PARK COAL FIELD

Physiography

The North Park Coal Field is located in north central Colorado and is a high (8,000 to 9,000 ft.) intermontane basin. It is bounded by Independence Mountain Thrust Fault on the north, the Medicine Bow - Front Range Uplift on the east, the Williams River - Vasquez Mountains on the south, and the Park Range Uplift on the west.

Coal Stratigraphy

Coals in the North Park Coal Field are found in the Late Paleocene and Early Eocene Coalmont Formation. The Coalmont Formation is comprised of arkosic and micaceous sandstones, minor conglomerates, claystones, mudstones, carbonaceous shales, and coals and reaches a maximum thickness of 12,000 feet. Coals are found in the lower 3000 feet of the formation and are associated with braided stream, overbank, and swamp deposits of a rapidly subsiding basin. The Coalmont Formation unconformably overlies the Upper Cretaceous Pierre Shale.

There are two districts, the Coalmont and the McCallum Anticline, in the North Park Coal Field. The districts are separated by the east-northeastern trending Spring Creek Fault, which has 4,900 feet of displacement. The two districts exhibit slightly different coal stratigraphy and each contain one major coal bed. The Coalmont district contains the Riach coal bed which occurs approximately 3,000 feet above the base of the Coalmont Formation. The Riach coal bed ranges in thickness from 20 to 80 feet. The Coalmont district contains numerous northwest trending faults with minor displacement and the Riach coal bed dips from 5° to 26° east-northeast. The McCallum Anticline district contains the Sudduth coal bed which occurs 50-250 feet above the base of the Coalmont Formation and reaches a maximum thickness of 80 feet. The Sudduth coal bed is folded into several anticlines and synclines with dips of 20° to vertical and has very few faults associated with it.

Coal Resources

Coals of the North Park Coal Field are subbituminous A and B in rank. The U.S. Geological Survey has compiled an extensive coal quality data base for

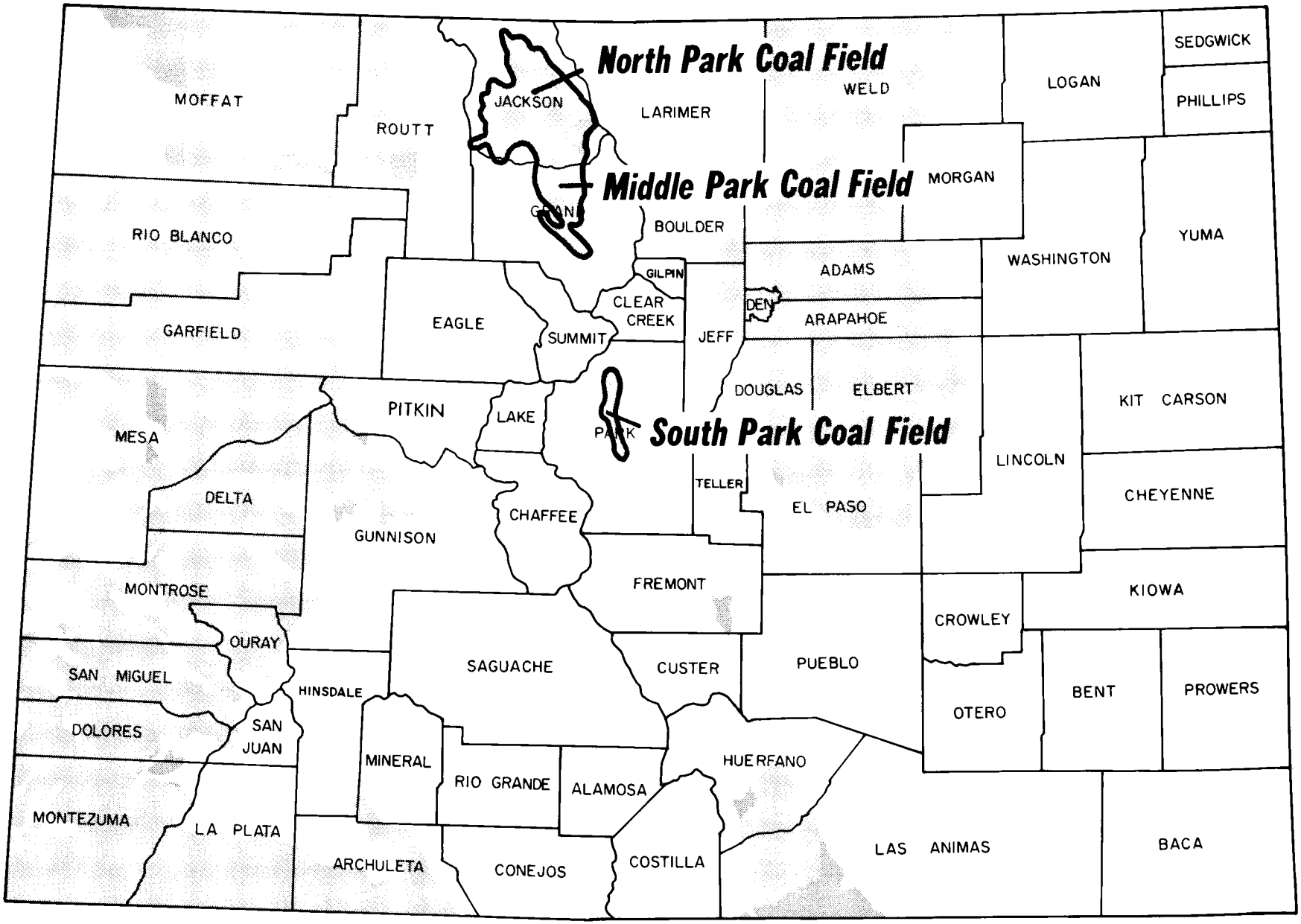

Figure 1. Index map of the North Park, Middle Park, and South Park Coal Fields, Colorado.

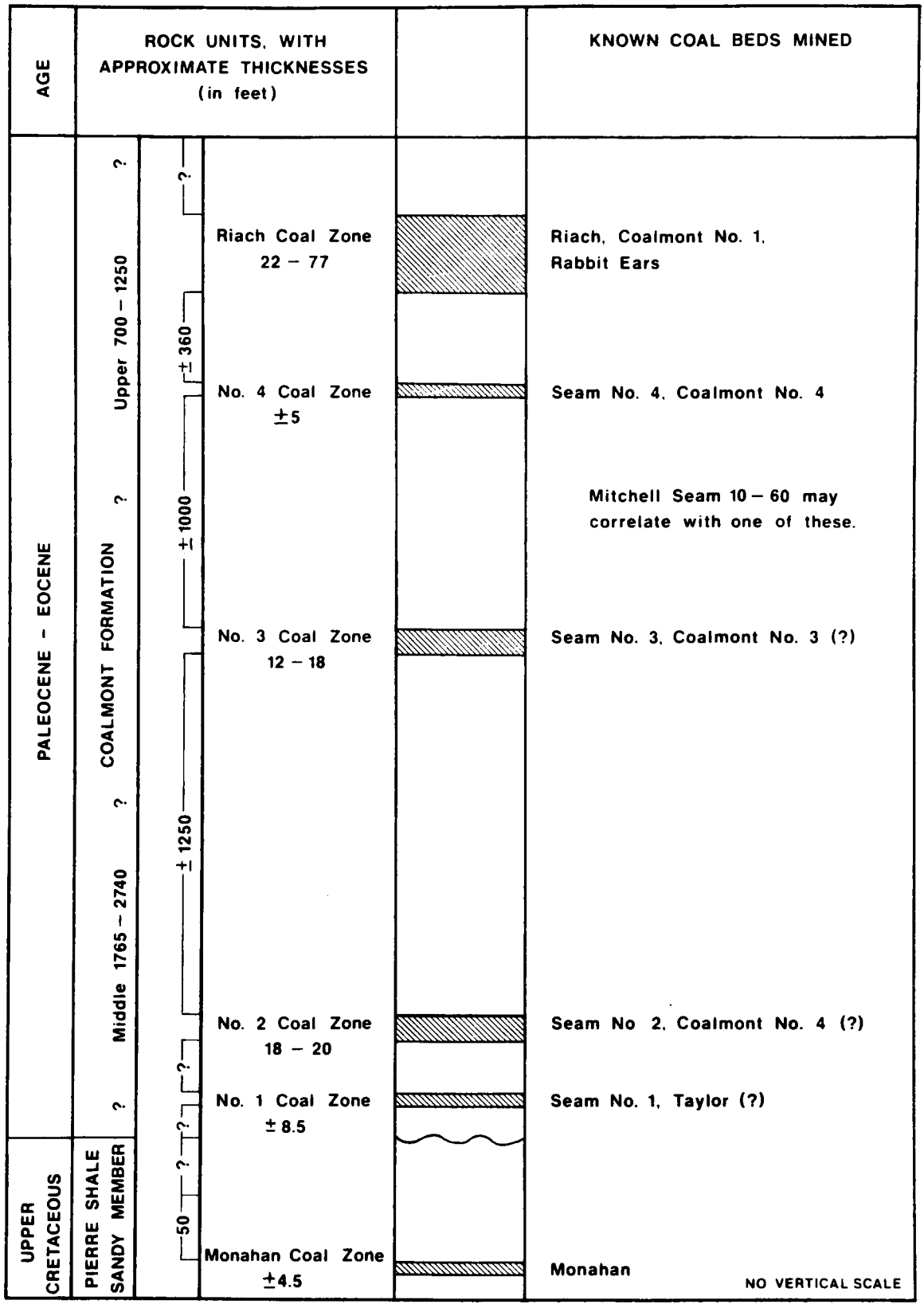

Figure 2. Generalized coal-bearing columnar section of the Coalmont district, North Park Coal Field, Colorado (from Boreck, 1979).

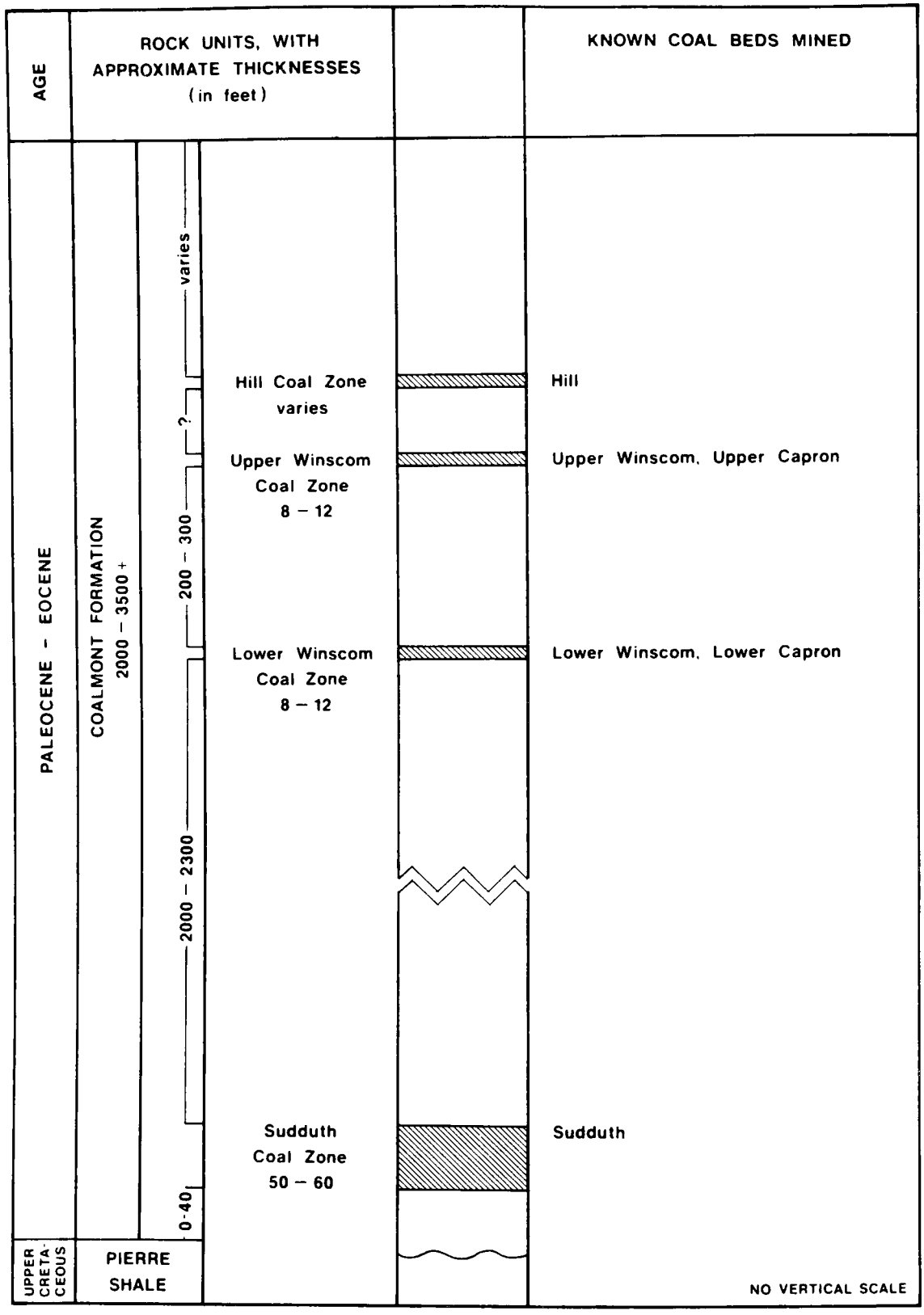

Figure 3. Generalized coal-bearing columnar section of the McCallum Anticline district, North Park Coal Field, Colorado (from Boreck, 1979).

the coals of the Coalmont Formation (Hatch et. al., 1979). In the Coalmont district, coal analyses fall within the following ranges: ash-5.5-13.1%; sulfur-0.6-1.0%; moisture-14.5-20.2%; BTU/lb values-6,510-9,570 (as received). In the McCallum district, the following range of analyses have been collected: ash-2.1-19.2%; sulfur-0.2-0.3%; moisture-12.0-16.1%; BTU/lb value-8,580-11,280.

Coal resources for the North Park Coal Field have been estimated at 3.7 billion tons of subbituminous coal, originally present in a 102 square mile area (Landis, 1959). An additional 750 square miles is probably underlain by minable coals of unknown thicknesses and depths.

SOUTH PARK COAL FIELD

Physiography

South Park Coal Field is an intermontane basin with an average elevation of approximately 9,000 feet. This synclinal basin is bounded by the Mosquito and Ten Mile Ranges on the north and northwest, the Front Range on the east, the Thirtynine Mile Volcanic Field on the south and the Sawatch Range on the west. The eastern and northern portions of the basin are underlain by Jurassic through Paleocene sediments and the western half of the basin is underlain by locally present Mississippian through Permian sediments. The perimeter of the basin is covered by numerous glacial deposits and the center of the basin contains volcanic lake deposits of Tertiary age.

Coal Stratigraphy

Coals in South Park Coal Field are found in the Cretaceous Laramie Formation. The Cretaceous sequence in South Park Coal Field is the same as the Cretaceous Front Range deposits and were contiguous prior to the Laramide Front Range uplift. The Laramie Formation conformably overlies the Fox Hills Sandstone and is conformably overlain by the Denver Formation where present. The Laramie Formation consists of sandstones, shales, volcanic tufts, and coals and ranges in thickness from 0 to 425 feet. Outcrops of the Laramie Formation are found in isolated areas in the north-central part of the basin, in the vacinity of the Michigan Syncline.

Coal Resources

Very limited mining and exploration of Laramie coals has taken place in the South Park Coal Field. Three coal seams have been identified in outcrop in the area of the Michigan Syncline (Washburne, 1910). They range in thickness from 4 to 12 feet. Two other seams, 12 and 6 feet thick, outcroped on a smaller syncline northwest of the Michigan Syncline.

There are no modern coal analyses for the South Park coals but best estimates from historical literature indicate that the coals are subbituminous B in rank. Landis, 1959, states that the coals are probably of bituminous rank based upon physical properties of the coals.

Approximately 92 million tons of bituminous coal have been estimated as the original resource for a 8 square mile area in the South Park Coal Field (Landis, 1959). An additional 12 square mile area may contain minable coal reserves at depths less than 3,000 feet (Landis, 1959).

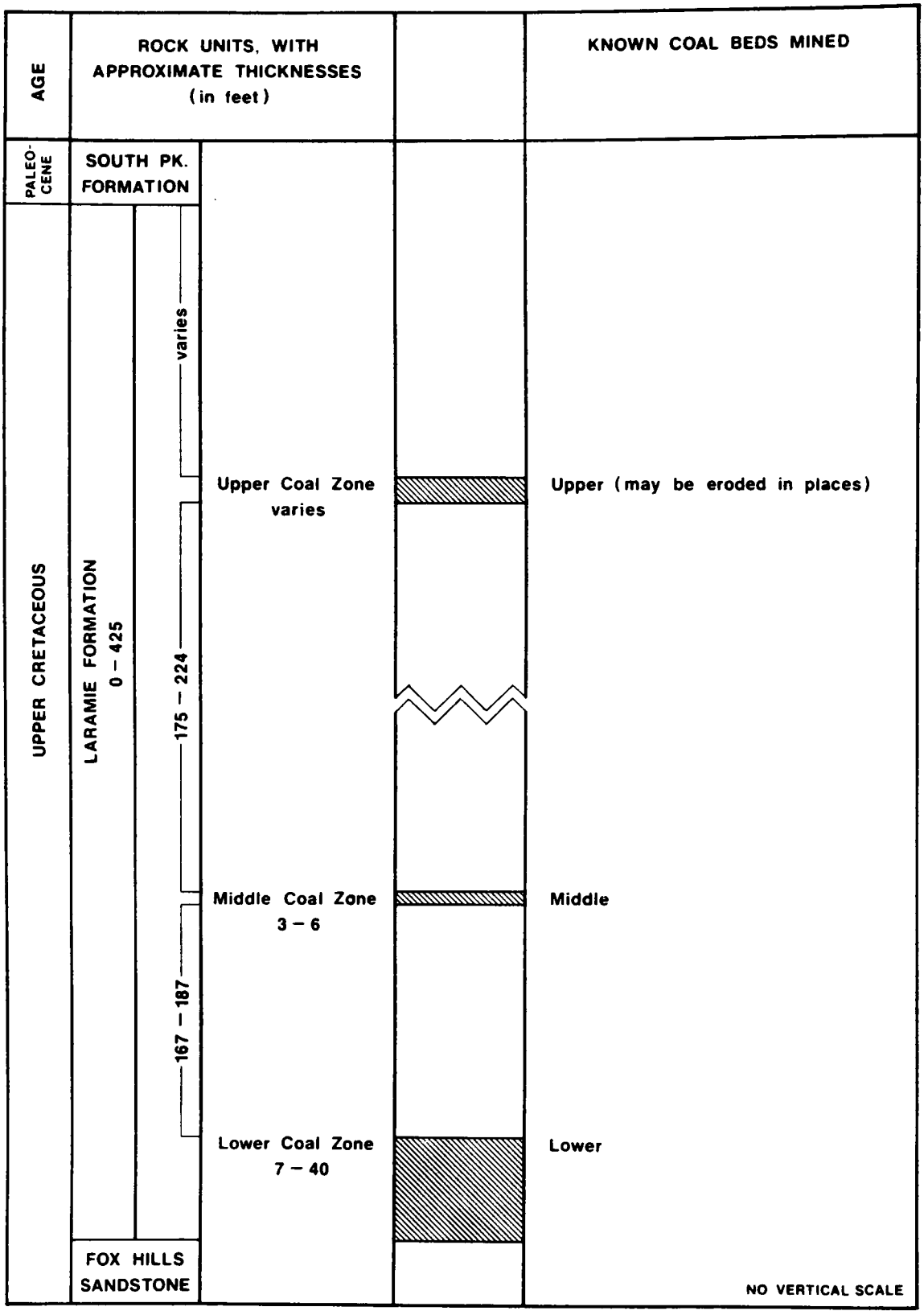

Figure 4. Generalized coal-bearing columnar section of South Park Coal Field, Colorado (from Boreck, 1979).

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SELECTED REFERENCES ON THE COAL RESOURCES OF THE SAN JUAN RIVER COAL REGION, COLORADO

GEOLOGIC OVERVIEW

by
Bruce S. Kelso
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and

SELECTED REFERENCES

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INTRODUCTION

The San Juan River Coal Region of southwestern Colorado is defined by the lower contact of the coal-bearing Dakota Formation (Goolsby et. al., 1979.) The region extends as far north as the Grand Junction-Grand Valley area and includes the San Juan Basin of New Mexico and Colorado. Coals in the region are found in three Cretaceous formations: the Dakota Formation, the Menefee Formation (Mesaverde Group), and the Fruitland Formation. This collection of references pertains to coal and related geologic subjects for the San Juan River Coal Region of southwestern Colorado. The references were first printed as Colorado Geological Survey Open File Report 83-1 (April, 1983) and updated in May 1986. Although all efforts were made to compile a complete listing of references for this report, omissions are the responsibility of the authors and should be brought to the attention of the Colorado Geological Survey for inclusion in future printings.

PHYSIOGRAPHY

The San Juan River Coal Region and San Juan Basin encompasses a large area in southwestern Colorado and northwestern New Mexico. The region includes parts of the Gunnison and Uncompahgre Uplifts to the northwest, north and northeast, the San Juan Basin to the south, and part of the Paradox Basin to the west. The San Juan Basin, only a small portion within Colorado, is bounded by the San Juan mountains on the north, the Archuleta and Nacimiento Uplifts on the east, the Zuni Uplift on the southwest, and the Four Corners Platform on the northwest.

COAL STRATIGRAPHY

The coal bearing formations in the San Juan River Coal Region are all Cretaceous in age. These formations, in ascending order, are the Dakota Formation, the Menefee Formation of the Mesaverde Group, and the Fruitland Formation.

The Dakota Formation represents a transgressive sequence whigh ranges in thickness from 175 to 275 feet. It is informally divided into three units: the lower which unconformably overlies the Morrison Formation and is a coarse fluvial conglomerate; the middle unit which is a paludal, carbonaceous shale and coal sequence with fluvial sandstones; and the upper unit which is a fine grained marginal marine sandstone.

The Mancos Shale is a marine shale which ranges in thickness from 400 to 2,000 feet. It conformably overlies the Dakota Formation and was deposited in a deep water, low energy environment. A thin limestone zone, found near the base of the Mancos Shale, has an upper part containing sandy offshore type deposits.

The Mesaverde Group ranges in thickness from 350 to 1,100 feet and is divided into three formations. In ascending order, they are: the Point Lookout Sandstone, the Menefee Formation and the Cliff House Formation.

The Point Lookout Sandstone is a regressive barrier sandstone which ranges in thickness from 100 to 300 feet. It is conformably overlain by the Menefee Formation and may contain root marks in the contact zone. The Menefee Formation is a paludal series of carbonaceous shales, siltstones, channel

Figure 1. Index map of the San Juan Coal Region, Colorado.

sandstones, flood plain shales and coals. It reaches a maximum thickness of 400 feet. The Cliff House Formation conformably overlies the Menefee Formation and is a transgressive sandstone sequence. It ranges in thickness from 150 to 450 feet. The Cliff House Formation intertongues with the underlying Menefee Formation and overlying Lewis Shale as a result of minor regressions.

The Lewis Shale is a marine shale which ranges in thickness from 100 to 2,500 feet. The Lewis Shale is well known for its betonite marker beds, the most prominant being the Huerfanito Bentonite Bed which is commonly used as a datum for subsurface work in the region.

The Pictures Cliffs Sandstone is a regressive sand unit which ranges in thickness from 125 to 400 feet. In some areas it intertongues with the Fruitland Formation. The Pictured Cliffs Sandstone conformably overlies the Lewis Shale.

The Fruitland Formation is a lower alluvial plain deposit of paludal carbonaceous shales, siltstones, sandstones and coals. Coals in the lower part of the Fruitland Formation were deposited in coastal swamps behind the barrier island Pictured Cliffs Sandstone. The thinner coals of the upper Fruitland Formation were deposited in inter-distributary channels and swamps. The Fruitland Formation ranges in thickness from 100 to 600 feet.

The Kirtland Shale is an upper aluvial plain deposits of shales, siltstones, and sandstones. The Kirtland Shale ranges in thickness from 1,000 to 1,200 feet. The Kirtland Shale conformably overlies the Fruitland Formation and contains no carbonaceous shales or coals, suggesting a depositional environment of high stream gradients and good drainage which prevented peat accumulation.

COAL RESOURCES

Coals of the San Juan River Coal Region in Colorado range in rank from high volatile C bituminous to low volatile bituminous. The coals of the Dakota and Menefee Formations are very lenticular and usually less than 8 feet thick. These coals also have lower ash contents than Fruitland Formation coals. Menefee Formation coals, expecially in the Durango area, are said to have coking properties.

The Dakota Formation coals in the Nucla-Naturita area contain 7 to 10 percent ash, 4 to 6 percent moisture, 0.9 percent sulfur, and have heating values of approximately 12,500 BTU/lb. The limited data available for Dakota coals indicate that they are high volatile bituminous in rank. These coals at greater depths in the San Juan Basin may approach semi-anthracite in rank.

The Menefee Formation coals west of the Durango area contain 5 to 17 percent ash, 3 to 4 percent moisture, 0.75 percent sulfur, and have heating values of 11,500 to 13,000 BTU/lb. Menefee Formation coals at depth in the San Juan Basin may also approach semi-anthracite in rank.

The Fruitland Formation coals of the San Juan Basin average 10 to 20 percent ash, 1 to 5 percent moisture, 0.9 percent sulfur, and have heating values of 10,700 to 14,500 BTU/lb. Fruitland Formation coals in the northern area of the region are usually high volatile to medium volatile bituminous in rank.

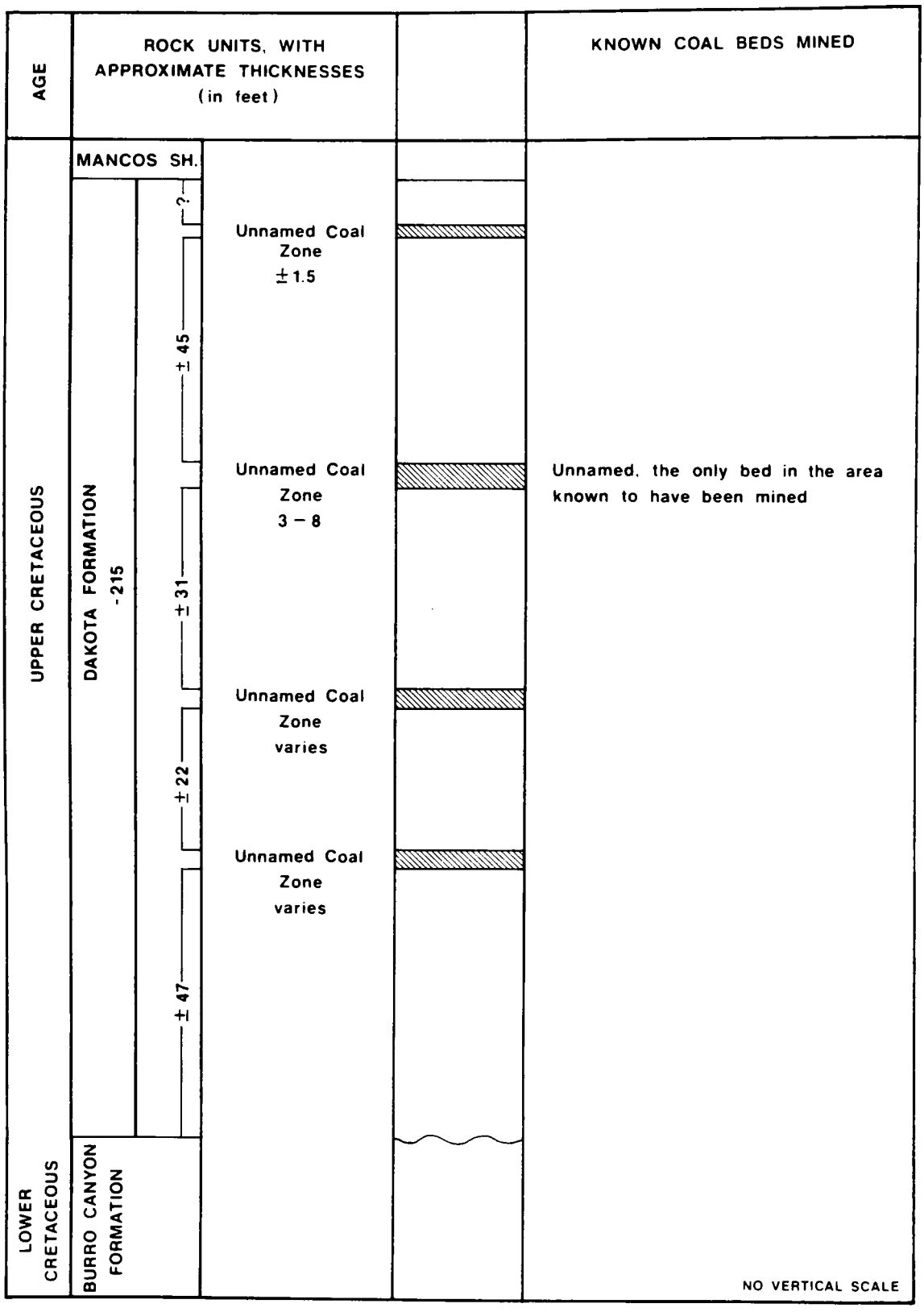

Figure 2. Generalized coal-bearing columnar section of the Cortez area, San Juan River Coal Region, Colorado (from Boreck, 1979).

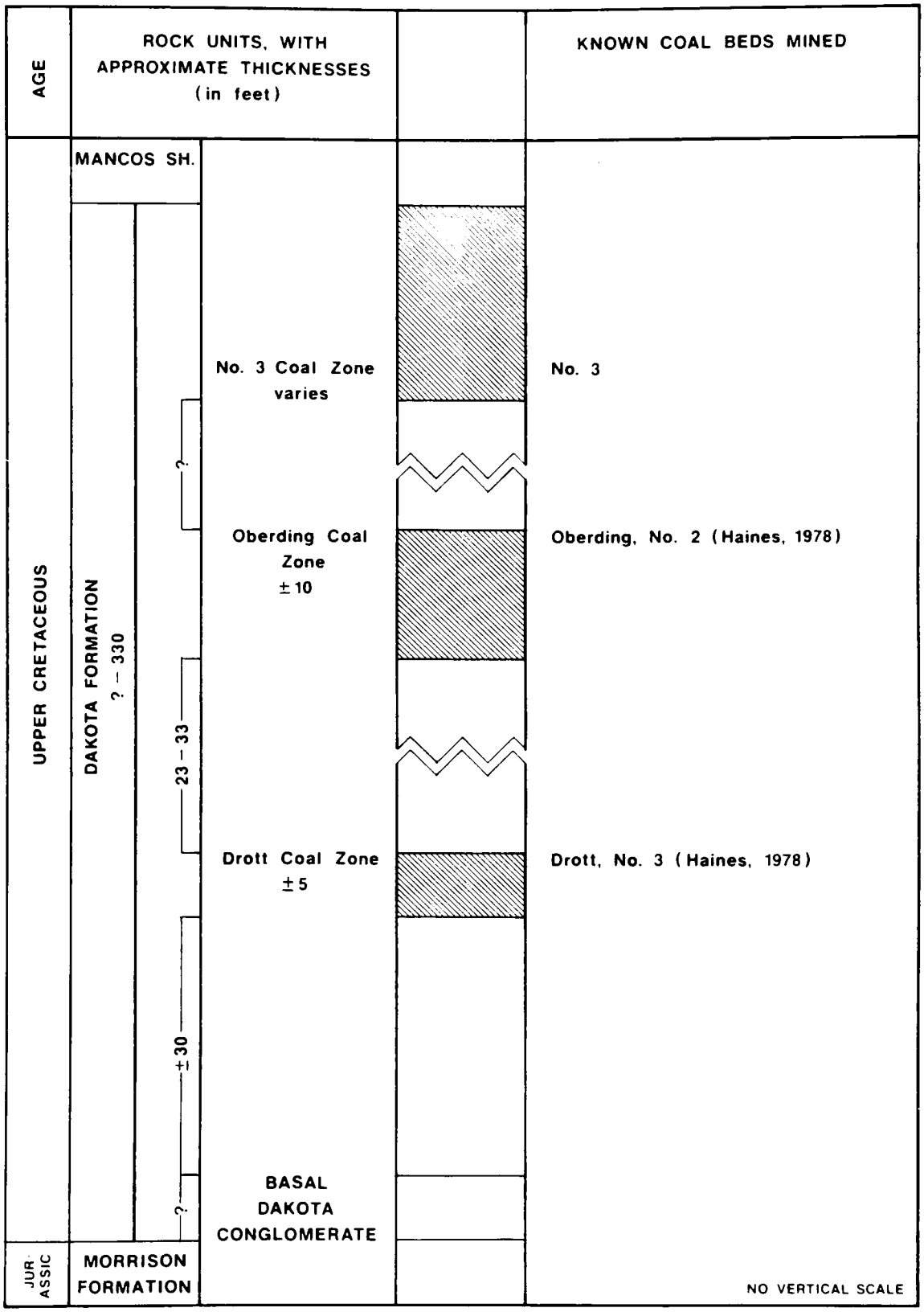

Figure 3. Generalized coal-bearing columnar section of the Nucla-Naturita Coal Field, San Juan River Coal Region, Colorado (from Boreck, 1979).

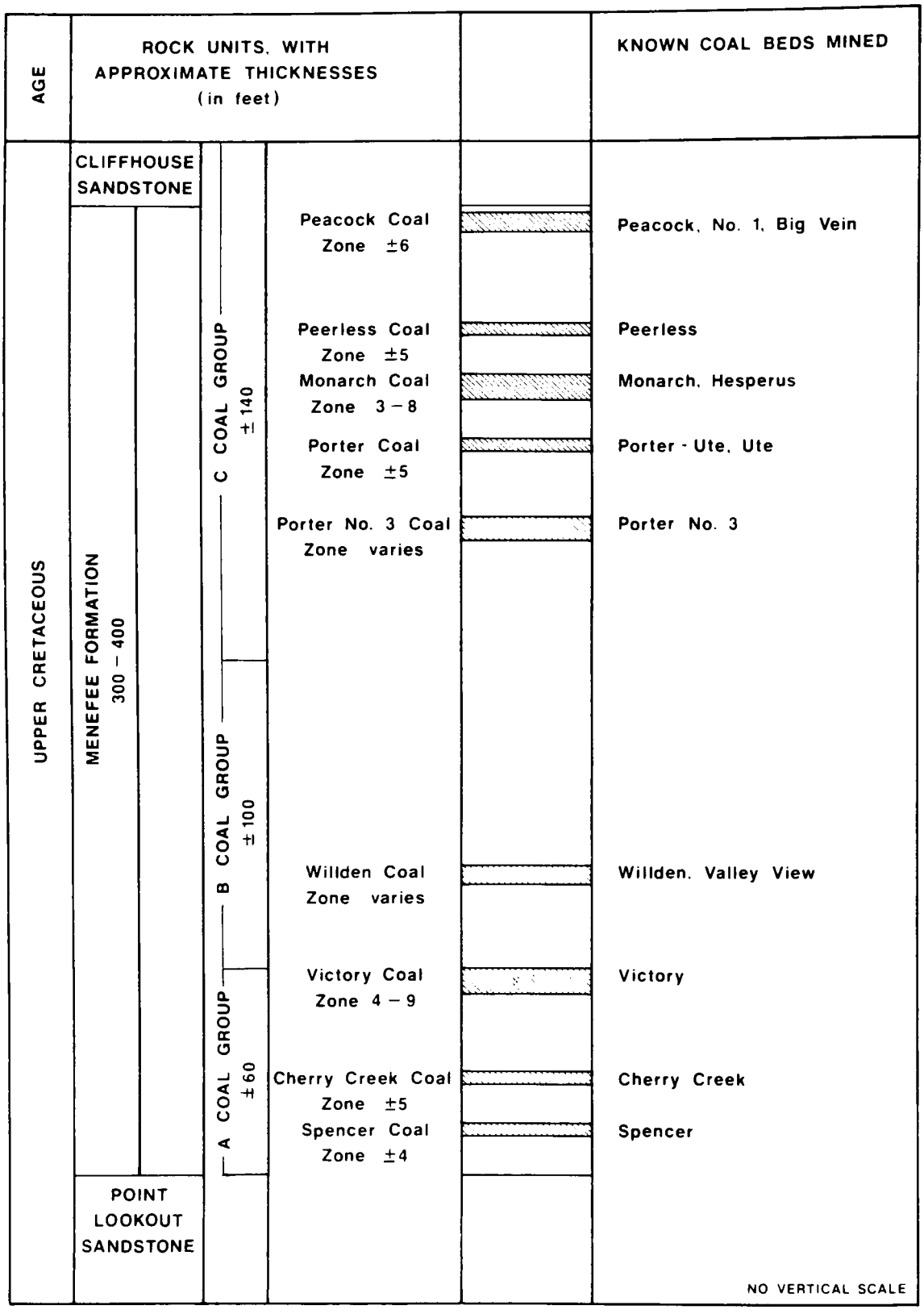

Figure 4. Generalized coal-bearing columnar section of the Menefee Formation, Durango Coal Field, San Juan River Coal Region, Colorado (from Boreck, 1979).

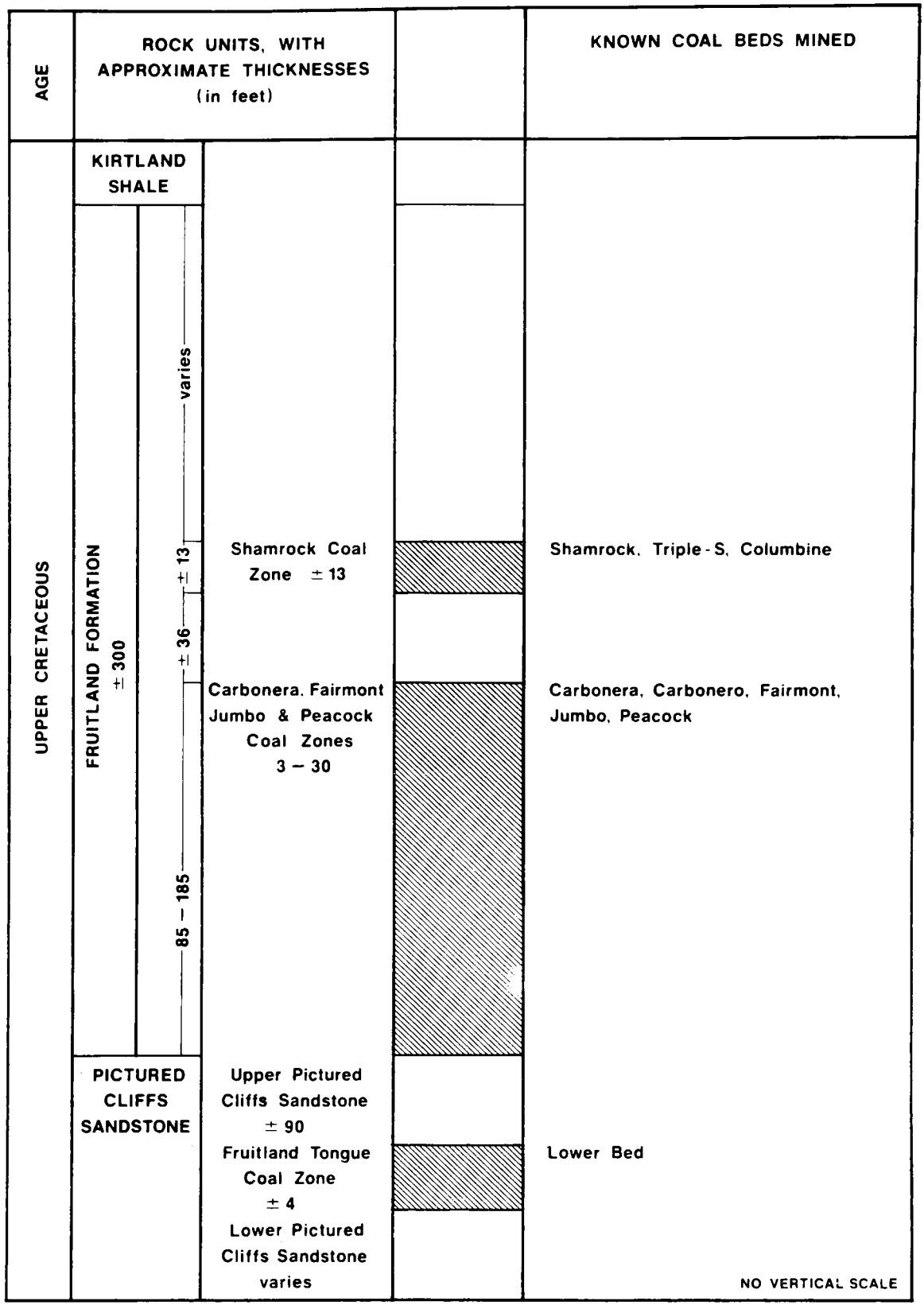

Figure 5. Generalized coal-bearing columnar section of the Fruitland Formation, Durango Coal Field, San Juan River Coal Region, Colorado (from Boreck, 1979).

In New Mexico, the southern portion of the basin contains sub-bituminous and bituminous coals. The higher rank coals in the northern part of the basin are attributed to greater thermal maturity due to the San Juan ingneous complex.

Several authors have calculated coal resource estimates for the region and/or basin. In Colorado, a total of about 9,634 million tons of bituminous coal was estimated to have been originally present in approximately 946 square miles. An additional 1,240 square miles may have minable reserves in the region (Landis, 1959). These estimates include all three coal-bearing formations in a large number of areas in the region. Other resource estimates for parts of the region have been calculated by: Storrs, 1902; Schrader, 1906; Shaler, 1907; Gardner, 1909; Zapp, 1949; Barnes et. al., 1954; Collier, 1919; Taft, 1907; Wanck, 1954; Shomaker et. al., 1971, Fassett and Hinds, 1971; and Shomaker and Holt, 1973.

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SELECTED REFERENCES ON THE COAL RESOURCES OF THE UINTA COAL REGION, COLORADO

GEOLOGIC OVERVIEW

by
Bruce S. Kelso
Colorado Geological Survey

and

SELECTED REFERENCES

(Previously published as "Bibliography - Coal Resources - Uinta Coal Region, Colorado", Colorado Geological Survey Open-File Report 84-1, 1984, revised in 1986 for this publication.)

by
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Colorado Geological Survey

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FIGURES

INTRODUCTION

The Uinta Coal Region of northwestern Colorado, containing the Piceance Creek Basin (approx. 4,000 sq. mi.), covers nearly 7,200 sq. mi. as outlined by the base of the Cretaceous Mesaverde Formation (Group). Coal is found in outcrop and to depths exceeding 12,000 feet. This collection of references pertains to coal and related geologic subjects for the Uinta Coal Region of Colorado (containing the Piceance Creek Basin). The references were first printed as Colorado Geological Survey Open File Report 84-1 (July 1984) and updated in May 1986. Although all efforts were made to compile a complete listing of references for this report, omissions are the responsibility of the author and should be brought to the attention of the Colorado Geological Survey for inclusion in future printings.

PHYSIOGRAPHY

The Uinta Coal Region of Colorado and Piceance Creek Basin are characterized by a variety of topographic features. The river valleys of the Gunnison and Colorado, basalt capped Grand and Battlement Mesas, and the volcanic West Elk Mountains provide for total topographic relief of approximately 7,500 feet. A majority of the region lies between 5,000 and 8,000 feet above sea level. The area encompasses the northwest corner of the Colorado Plateau physiographic province. The Piceance Creek Basin is a laramide, assymetric basin with a northwestern/southeastern trending axis. It is bounded on the north by the Uinta Mountains and Axial Basin Uplift; the Grand Hogback Monocline on the east; the Elk and West Elk Mountains and the Gunnison Uplift to the south; the Uncompahgre Uplift to the southwest; and the Douglas Creek Arch to the west. The Douglas Creek Arch is the boundary separating the Uinta Basin of Utah and the Piceance Creek Basin.

COAL STRATIGRAPHY

The coal bearing formations in this region are all Cretaceous in age. Cretaceous sediments are marine and non-marine in origin and range from 6,000 to 11,000 feet in thickness. In ascending age, the formations are: the Dakota Sandstone, Mancos Shale, and Mesaverde Formation (Group) including the Ohio Creek Conglomerate.

The Dakota Sandstone was deposited in marginal marine, fluvial, and paludal environments. It is primarily composed of sandstones, sandy conglomerates, and carbonaceous shales. Thin, lenticular, uneconomic coal lenses may be present but none have been identified by this author, either in outcrop or in subsurface studies. Thickness ranges from 100 to 200 feet.

The Mancos Shale overlies the Dakota Sandstone and ranges from 4,000 to 7,000 feet in thickness. It is a marine shale that was deposited while the epicontinental shoreline was in eastern Utah. The upper Mancos Shale intertongues with the Mesaverde Group as a result of minor transgressions during the overall regression of the epicontinental seaway.

The Mancos Shale is overlain by the Mesaverde Group (Formation) which includes the Iles, Williams Fork, Mount Garfield, Hunter Canyon, Mesaverde, and Price River Formations. Stratigraphic nomenclature for this unit is confused by a variety of terminology depending on location and author. It ranges in thickness from 2,300 to 6,500 feet. One of the more currently accepted

Figure 1. Index map of Unita Coal Region, Colorado.

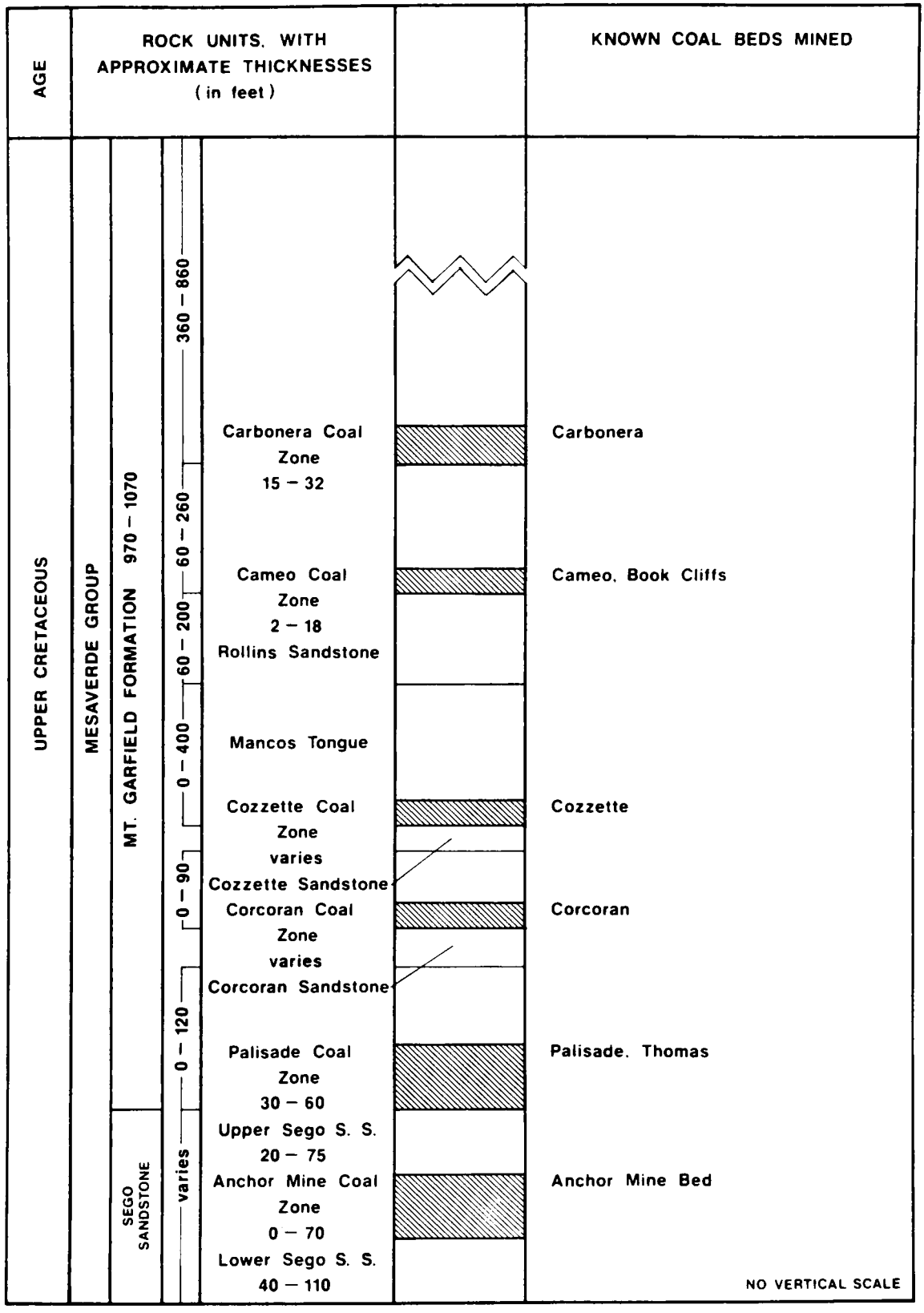

Figure 2. Generalized coal-bearing columnar section of the Book Cliffs Coal Field, Unita Coal Region, Colorado (from Boreck, 1979).

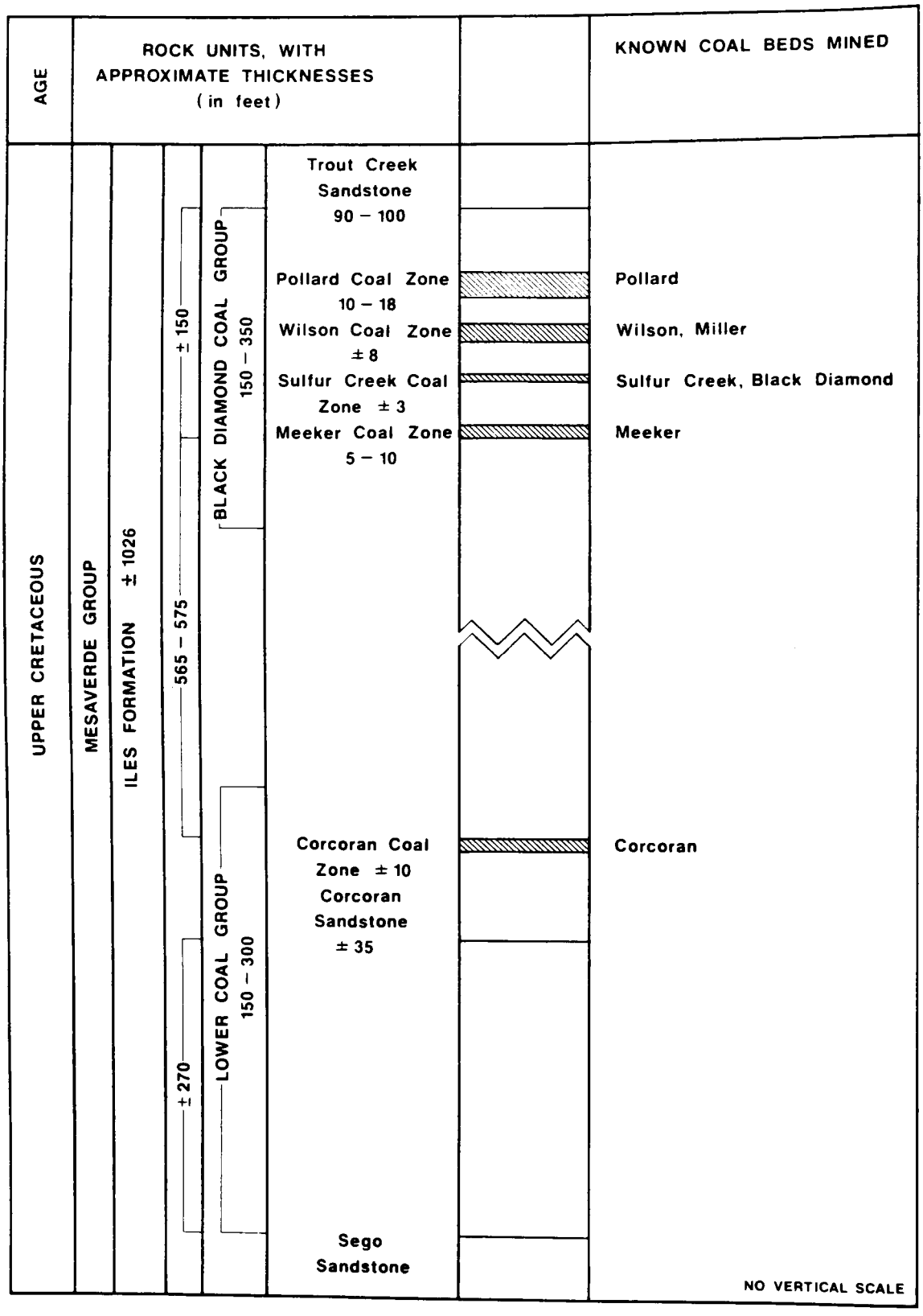

Figure 3. Generalized coal-bearing columnar section of the Iles Formation, Danforth Hills Coal Field, Unita Coal Region, Colorado (from Boreck, 1979).

breakdowns in ascending order, is the Iles Formation, Williams Fork Formation, and the Ohio Creek Conglomerate. The Iles includes the Sego, Corcoran, Cozzette, and Rollins Sandstone units, which may or may not be separated by marine shales. The sandstone units are marine and marginal marine and may have coals associated with them in the back-barrier environments.

The Williams Fork Formation is predominantly a continental sequence of sediments and contains a majority of the coals found in the region. The basal section of the Williams Fork Formation represents a brackish interdistributary environment (Collins, 1976) and hosts the most developed coals of the section. The coals found above the basal section were deposited in fresh water fluvial environments with evidence of splay deposits, mudstones, and channel sandstones. The upper section of the Williams Fork Formation is barren of any well developed coals and grades into the overlying Ohio Creek Member.

The Ohio Creek Member is a series of fluvial sandstones and conglomerates which is unconformably overlain by the Tertiary Wasatch Formation. The Ohio Creek Member is non-coal bearing.

COAL RESOURCES

The Uinta Coal Region of Colorado and the Piceance Creek Basin contains coals ranging in rank from subbituminous A and B(?) to anthracite. Most of the coal falls into the range of high volatile B to low volatile bituminous. The region contains approximately 26 percent of the state's known coal resources (Murray, 1980.) Coal analyses for the region are numerous. Sulfur content ranges from 0.3 percent to 2.5 percent with the mean being 0.6 percent. Ash contents are as low as 1.9 percent and may exceed 50 percent in impure beds. The average is normally less than 10 percent. As received moisture contents range from less than 1 percent to over 15 percent. BTU/lb values range between 10,000 and 15,800. (Khalsa and Ladwig, 1980).

A number of authors have calculated entire or partial coal resources for the region (Tremain, 1980; Collins, 1977; Landis, 1959; Hornbaker et. al., 1976; Choate et. al., 1981.) These resource numbers range from 55 billion tons to 382 billion tons of coal. In addition, other workers have calculated resources within the following eight coal fields of the region: Book Cliffs Coal Field (Hornbaker et. al. 1976; Richardson, 1907, 1909; and Eidmann, 1934; Landis, 1959.); Carbondale Coal Field (Hornbaker et. al., 1976; Landis, 1959); Crested Butte Coal Field (Hornbaker et. al. 1976; Landis, 1959); Danforth Hills Coal Field (Spencer and Erwin, 1953; Landis, 1959; Hornbaker et. al., 1976) Grand Hogback Field (Landis, 1959; Hornbaker et. al. 1976); Grand Mesa Coal Field (Lee, 1909, 1912; Landis, 1959; Hornbaker et. al., 1976.); Lower White River Coal Field (Spencer and Erwin, 1953; Landis, 1959; Gaskill and Horn, 1961; Hornbaker et. al., 1976); and Somerset Coal Field (Landis, 1959; Hornbaker et. al., 1976).

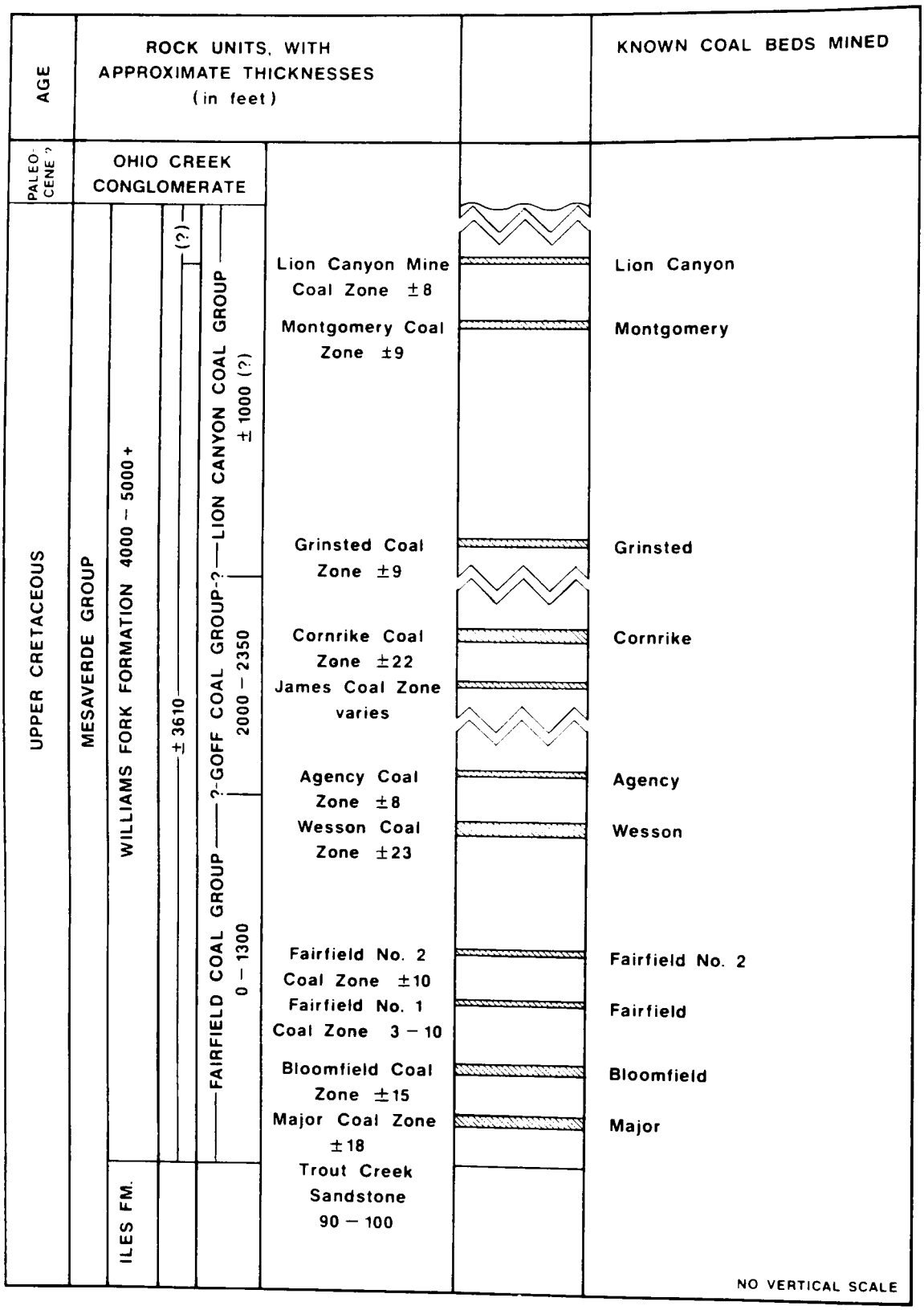

Figure 4. Generalized coal-bearing columnar section of the Williams Fork Formation, Danforth Hills Coal Field, Unita Coal Region, Colorado (from Boreck, 1979).

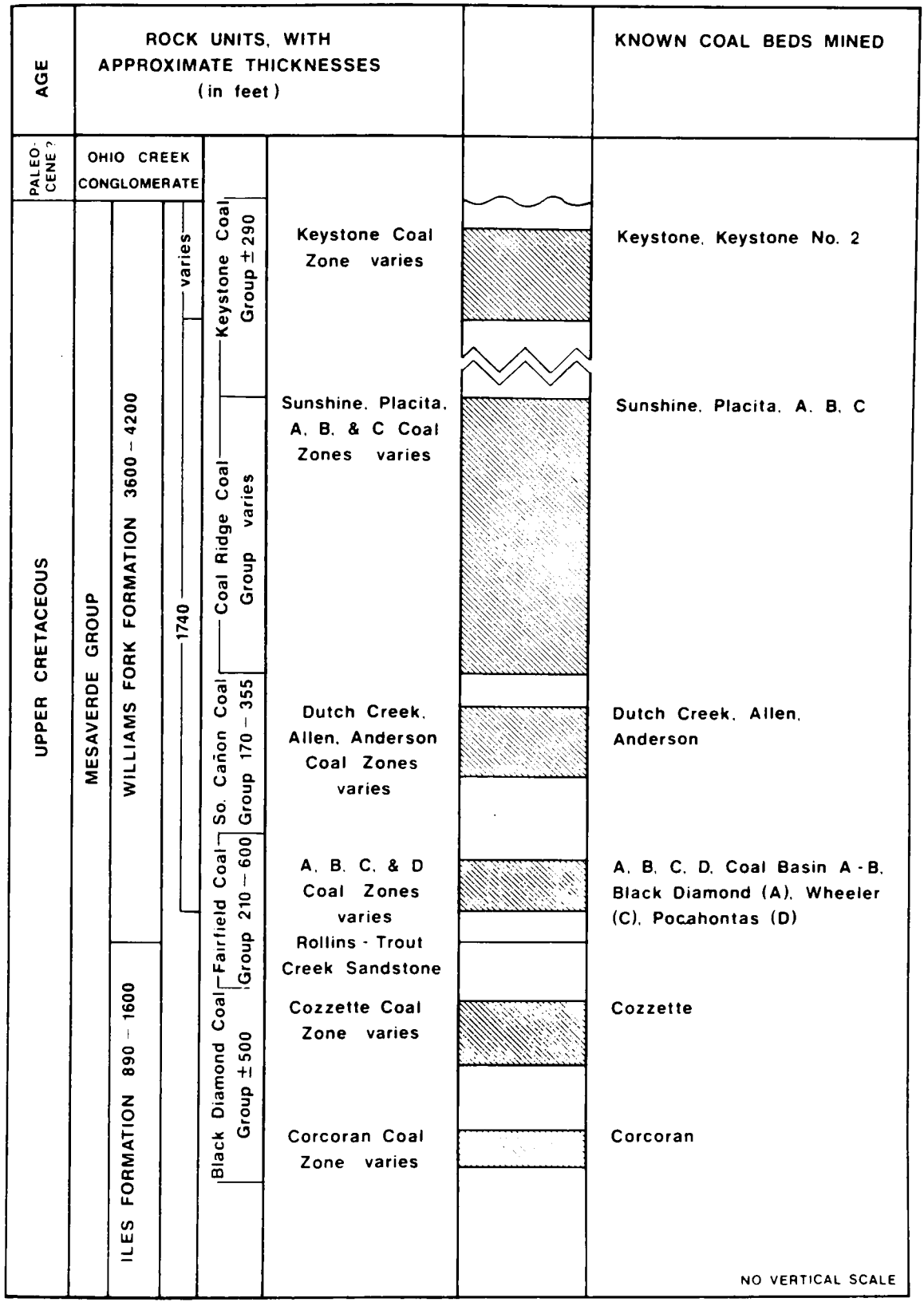

Figure 5. Generalized coal-bearing columnar section of the Grand Hogback and Carbondale Coal Fields, Unita Coal Region, Colorado (from Boreck, 1979).

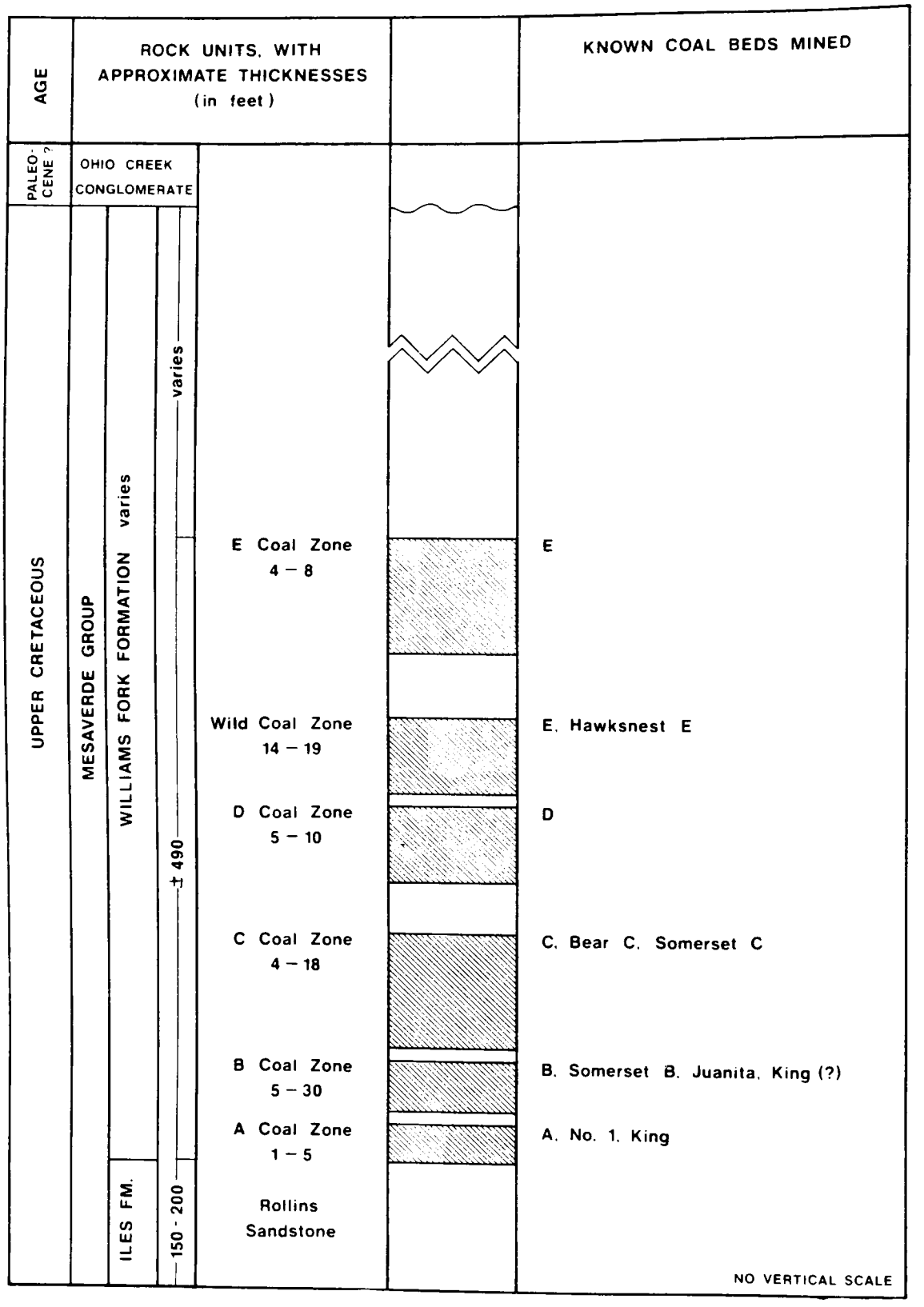

Figure 6. Generalized coal-bearing columnar section of the Somerset Coal Field, Unita Coal Region, Colorado (from Boreck, 1979).

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