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COKING COALS OF WESTERN COLORADO*

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INTRODUCTION

Colorado is presently a major producer of coking quality coal. These resources are located in three Colorado coal regions, two of which lie within the western portion of the state. The Uinta Coal region produces high quality coking coal from a number of active mines while in the San Juan River region the production of coal for coking purposes is extremely limited although reserves appear to be adequate.

The coking coal resources of Colorado have been dealt with in the past by West (1874, 1875) and Weeks (1884) with state-wide coking coal data and by Lakes (1899a). Lakes specifically mentioned coke from coal mined at the Porter and San Juan mines in the "La Plata Field" and in a subsequent article (Lakes, 1899b) described the coal resources of the "Grand River Field," now called the Uinta region.

Numerous authors over the years have presented data on Colorado coking coal deposits; however, the most important publications in recent years are those of Averitt (1966), Jones and Murray (1978), and Goolsby and others (1979). These most recent publications indicate that the Uinta region with the Somerset, Crested Butte, Grand Hogback, and Carbondale fields is the most important western Colorado coking coal producer while the San Juan region has been of historic importance only. Figure 1 shows the outline of these two regions.

COKING COAL CLASSIFICATION

What makes a coking coal? Many classification systems have been devised for determining the desirability of any specific coal for its use in coke oven blends. The problems that are inherent in coal testing and reporting procedures which can lead to discrepancies within any coal classification system are discussed in Lowry (1963), Allen (1964), Rees (1968), Givens (1969) and Givens and Zarzab (1975). Although there are exemptions, few coal classification systems define coal property rigidly enough to adequately predict what the properties of the resultant coke over charge will be.

A complete review of various coking coal classification systems is too long for this paper but can be found in Goolsby and others (1979). The systems used by the Colorado Geological Survey are depicted in Table 1 and are based on ash and sulfur content, as proposed by William S. Sanner, Sr., in conjunction with ASTM coal rank designations.

GEOLOGIC HISTORY

The geologic history of a coal deposit, with all of its variables, governs the final feasibility of using it as a coke feedstock. Weimer (1977) has discussed thoroughly the principle factors that influence the formation of coal deposits in the western United States. Basic considerations of these depositional parameters can aid in the evaluation of potential coking coal resources. These include ash, sulfur, trace elements, thickness, geometry and geographic distribution.

The rank of the coal as shown in Table 1 is important in determining a coke feedstock. The rank is in part determined by the depositional history, i.e., greater depth of burial equals higher rank, for example as reported by Freeman (1979) that the rank of coals in the Uinta region increase to where semi-anthracite coals are found in the deeper parts of the basin. There are important exceptions to this general geothermal gradient relationship in that heat from igneous activity or abnormalities in the geothermal gradient may cause local increases in coal rank.

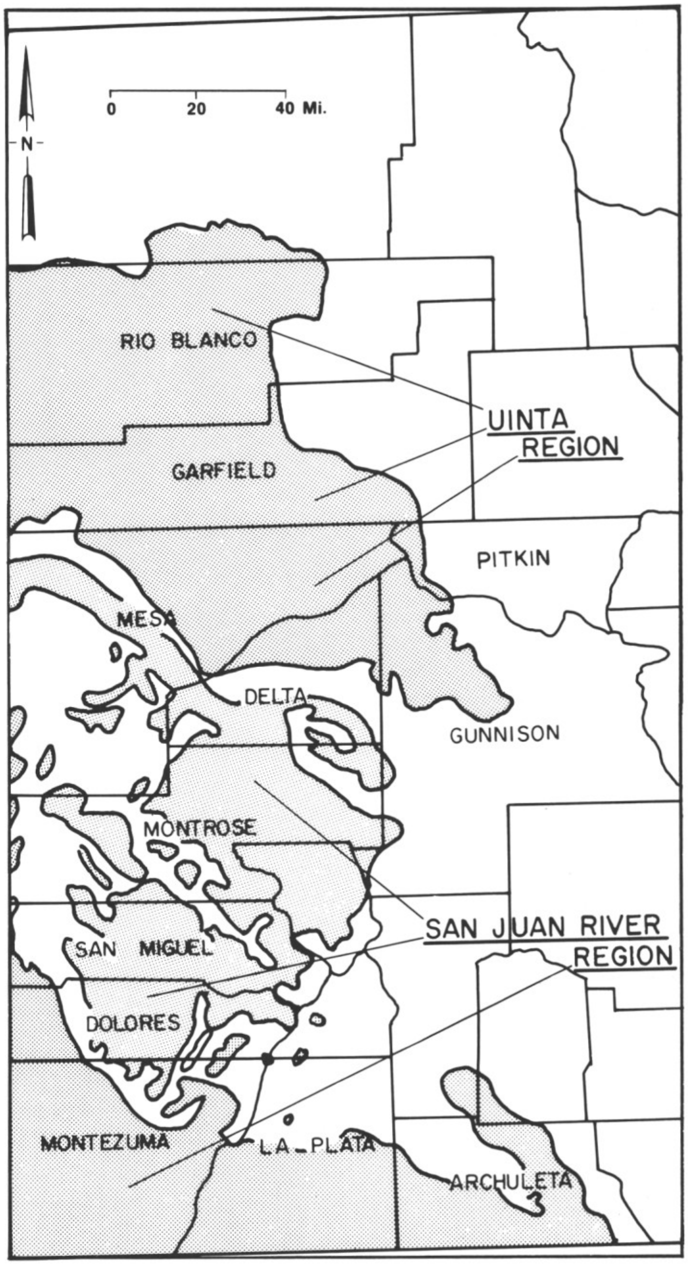

Figure 1. Outline of western Colorado coal regions (stippled) containing coking quality coal.

"Credit to Goolsby and others (1979) for the basis of this article.

Table 1. Coking coal classification system used to evaluate coal resources in Colorado (from Goolsby and others, 1979).

	ASTM COAL RANK (BITUMINOUS)					
COKING COAL GRADE	LOW-VOLATILE	MEDIUM-VOLATILE	HIGH-VOLATILE A	HIGH-VOLATILE B	SULFUR =	ASH =
PREMIUM	PREMIUM GRADE LOW-VOLATILE BITUMINOUS COKING COAL	PREMIUM GRADE MEDIUM-VOLATILE BITUMINOUS COKING COAL	PREMIUM GRADE HIGH-VOLATILE A BITUMINOUS COKING COAL	PREMIUM GRADE HIGH-VOLATILE B BITUMINOUS COKING COAL	0-1.0%	0-8.0%
MARGINAL	MARGINAL GRADE LOW-VOLATILE BITUMINOUS COKING COAL	MARGINAL GRADE MEDIUM-VOLATILE BITUMINOUS COKING COAL	MARGINAL GRADE HIGH-VOLATILE A BITUMINOUS COKING COAL	MARGINAL GRADE HIGH-VOLATILE B BITUMINOUS COKING COAL	1.1-1.8%	8.0-12.0%
LATENT	LATENT GRADE LOW-VOLATILE BITUMINOUS COKING COAL	LATENT GRADE MEDIUM-VOLATILE BITUMINOUS COKING COAL	LATENT GRADE HIGH-VOLATILE A BITUMINOUS COKING COAL	LATENT GRADE HIGH-VOLATILE B BITUMINOUS COKING COAL	1.9-3.0%	12.1-15.0%

GREATEST ← → LEAST

COKING COAL "DESIRABILITY"

GREATEST ↑ ↓ LEAST

COKING COAL "DESIRABILITY"

In certain areas in Colorado, igneous dikes and sills have detrimentally affected the quality of the coal. They have either totally destroyed or have altered the properties of the coal within close proximity to the igneous dike. An example of this is the Crested Butte Field in Gunnison County, Uinta Region (fig. 2) and the Archuleta portion of the San Juan Basin (fig. 3), where numerous Tertiary igneous dikes have altered the coal beds. Because coal uniformity is of major concern to coke producers, coal found in close proximity to igneous dikes generally cannot be used as coke feedstock.

The intrusion of large igneous bodies such as inferred in the Pitkin County portion of the Uinta basin have had a beneficial effect, with resultant medium—volatile bituminous coal being of premium quality as coke feedstock (Goolsby and others, 1979).

COKING COAL REGIONS

San Juan River Region

The San Juan River coal region (fig. 3), as defined by the area underlain by the coal-bearing Dakota Formation, contains coal deposits in three formations of Upper Cretaceous age. These are the Dakota Formation, Menefee Formation of the Mesaverde Group and the Fruitland Formation.

Although large areas of southwestern Colorado are underlain by coals in the Dakota Formation, these coals are generally thin, lenticular and high in ash content. Limited analytical data for these coals indicate that the coal resources are predominantly marginal grade high-volatile B and C bituminous coking coal.

The coal deposits in the Menefee Formation range from premium grade high-volatile C bituminous to marginal grade high-volatile A bituminous coking coal. The rank generally increases to the northwest and along the western margin of the basin where it is premium grade high-volatile C bituminous coking coal. The coal bed stratigraphy of the Menefee Formation is shown on Figure 4; identified coking coal reserves for the entire region (all formations) are shown in Table 2.

Uinta Region

This coal-bearing region is defined as that portion of the basin marked by the contact of the coal-bearing Mesaverde Group with the underlying Mancos Shale. This region is divided into eight coal fields (Landis, 1959), of which four have important coking coal resources. These are the Somerset (Delta and Gunnison Counties), Crested Butte (Gunnison County), Grand Hogback (Garfield County) and Carbondale (Pitkin and Garfield Counties) fields (figs. 5 and 6).

The Somerset field contains premium to marginal high-volatile A and B bituminous coking coal. The Crested Butte field has been influenced heavily by Tertiary intrusions, folding and faulting and consequently the coal rank varies from high-volatile C bituminous to anthracite. The Grand Hogback field contains a high-volatile A bituminous coal in the vicinity of Township 5 South with non- coking coal both north and south of this area. The southern portion of the Carbondale field has the most "desirable" coking coal in the west with rank varying from high-volatile A bituminous to medium-volatile bituminous. Identified reserves for these fields are shown in Table 3.

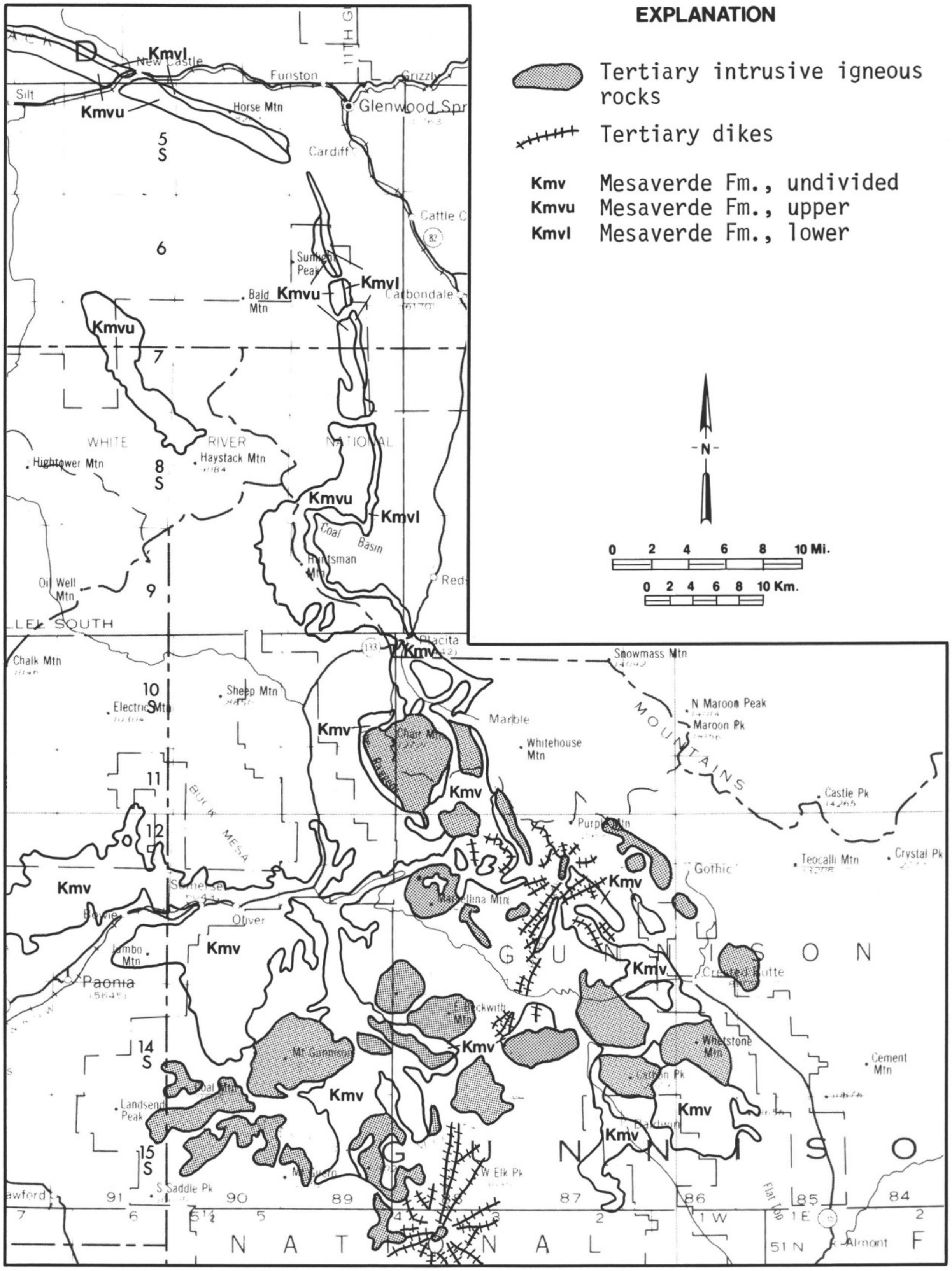

Figure 2. Location of Tertiary intrusions and dikes in the Crested Butte field, Uinta Region (revised from Goolsby and others, 1979).

Table 2. Identified original in-place coking coal reserves in the Durango, Nucla-Naturita, and Pagosa Springs fields, the San Juan River region (from Goolsby and others, 1979).

Coking Coal Classification	Short tons x 1,000,000	% of total
Premium to marginal grade high-volatile A bituminous	87.23	4.90
Premium to marginal grade high-volatile A to B bituminous	585.99	32.92
Premium to marginal grade high-volatile B bituminous	14.50	0.81
Marginal grade high-volatile A bituminous	155.37	8.73
Marginal to latent grade high-volatile A bituminous	365.26	20.52
Marginal to latent grade high-volatile B bituminous	7.73	0.43
Latent grade high-volatile A bituminous	171.71	9.65
Unclassified high-volatile bituminous	392.08	22.03
Total	1,779.87	99.99[1]

1) Does not equal 100% due to independent rounding.

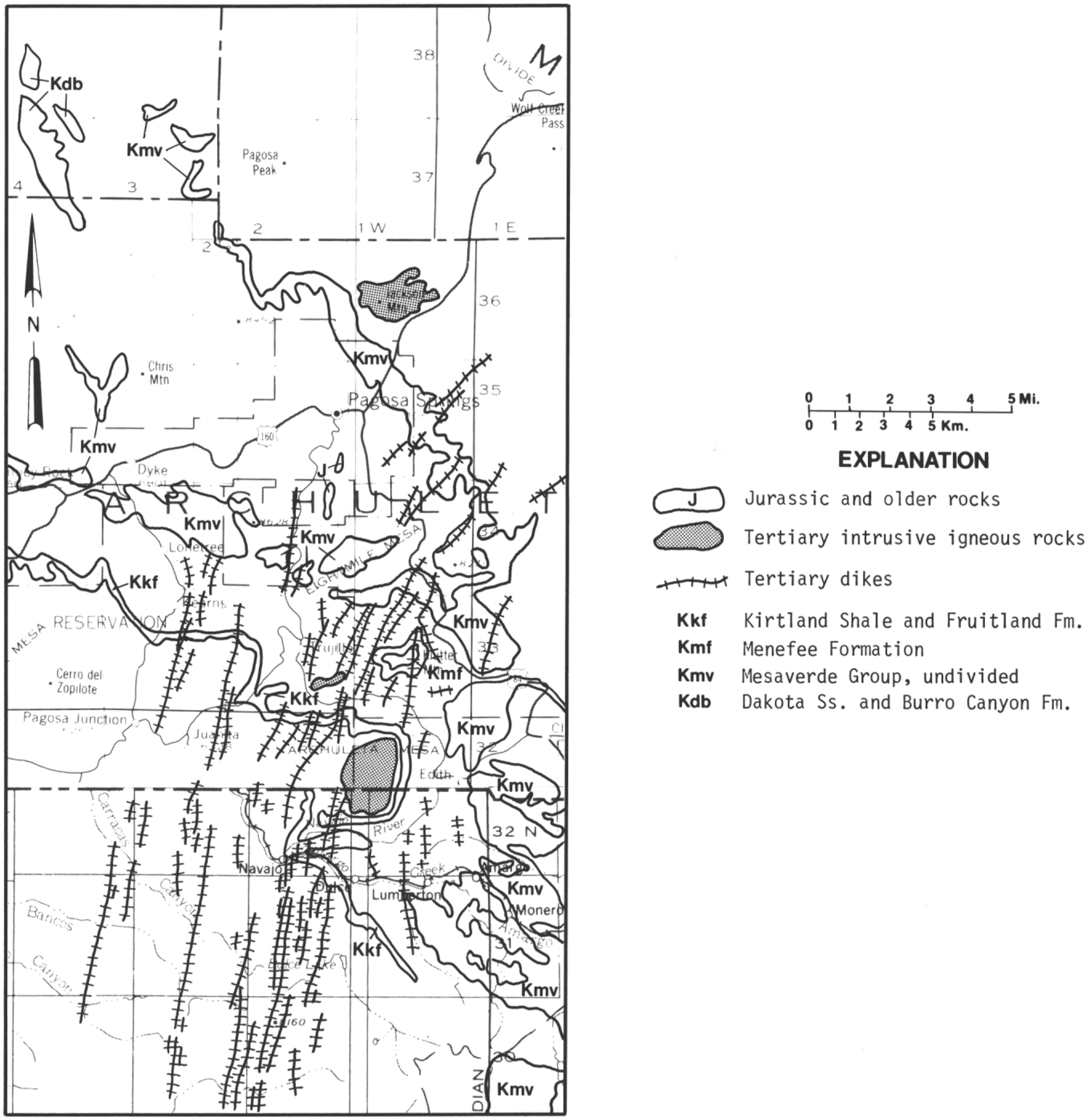

Figure 3. Location of Tertiary intrusions and dikes in the Archuleta County portion of the San Juan River region (revised from Goolsby and others, 1979).

Table 3. Identified original in-place coking coal reserves in the Grand Hogback, Carbondale, Crested Butte, and Somerset coal fields, the Uinta region (from Goolsby and others, 1979).

Coking Coal Classification	Short Tons x 10^6	% of Total
Premium grade high-volatile A to medium-volatile bituminous	21.23	4.75
Premium grade high-volatile A bituminous	128.05	28.66
Premium grade high-volatile B bituminous	78.86	17.65
Premium grade high-volatile A to B bituminous	129.37	28.96
Premium to marginal grade high-volatile B bituminous	54.04	12.10
Marginal grade high-volatile B bituminous	35.17	7.87
Total	446.72	99.99*

*Note: Total does not equal 100% due to independent rounding

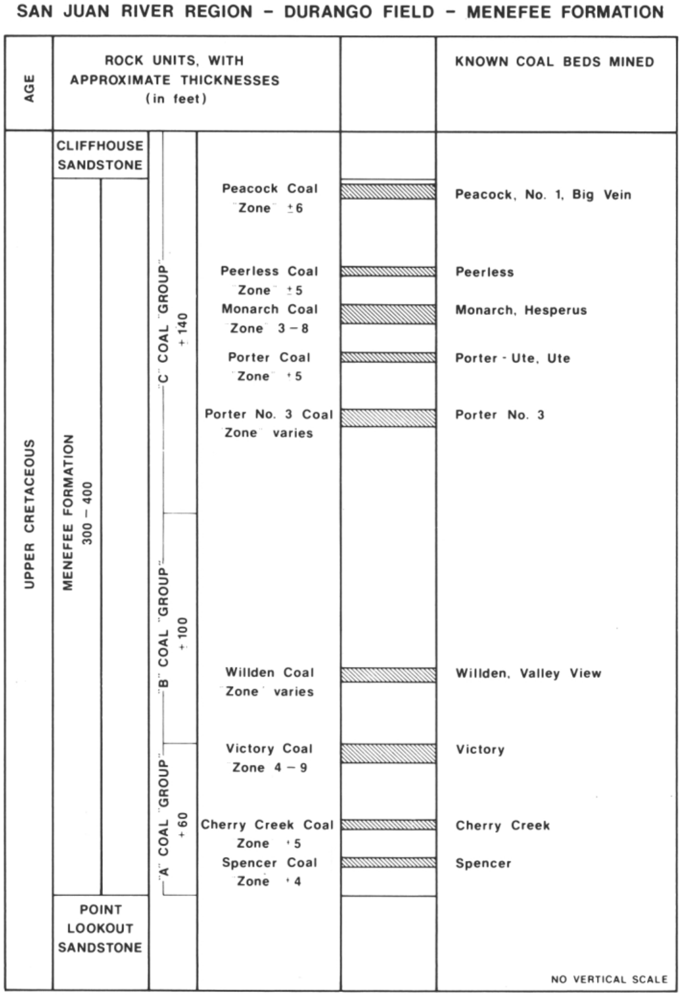
SAN JUAN RIVER REGION – DURANGO FIELD – MENEFEE FORMATION

Figure 4. The stratigraphy of the Menefee Formation in the Durango field, San Juan River region, Colorado (from Boreck and Murray, 1979).

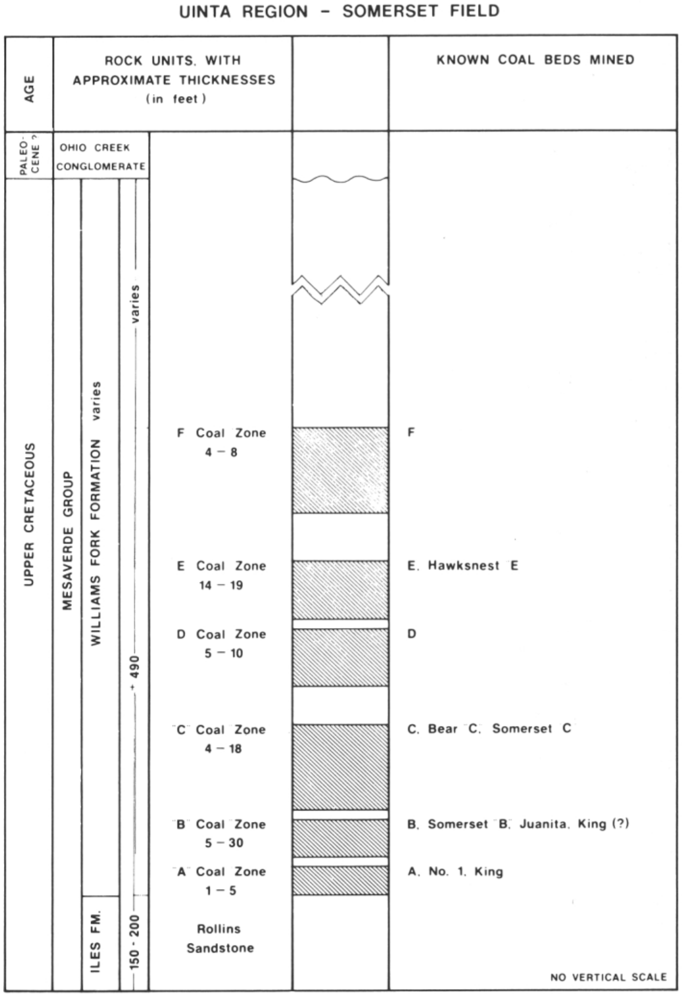
UINTA REGION – SOMERSET FIELD

Figure 5. Coal-bearing formation, coal zone, and coal bed stratigraphy of the Somerset field, Colorado (from Boreck and Murray, 1979).

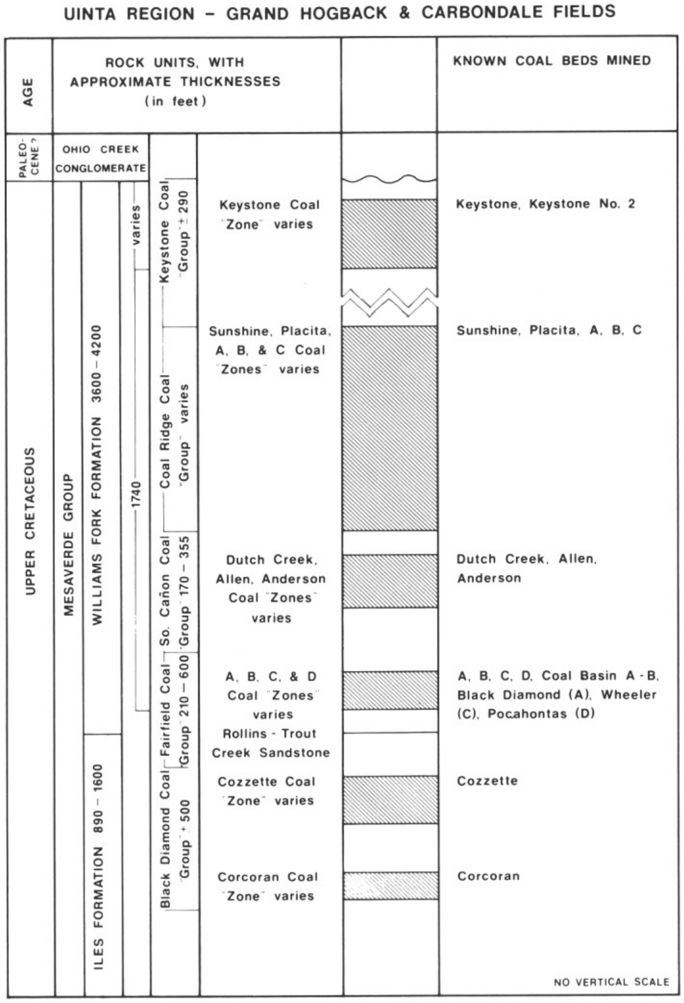

Figure 6. Coal-bearing formation, coal zone, and coal bed stratigraphy of the Grand Hogback and Carbondale fields, Colorado (from Boreck and Murray, 1979).

CONCLUSION

The coking coal resources of western Colorado have been exploited since the late 1800's and still make up a significant portion of total current coal production. These resources should continue to be a vital part of the Colorado coal industry for years to come as additional exploration pinpoints economically minable beds.

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