

Chapter SD

SUMMARY OF TERTIARY COAL RESOURCES OF
THE DENVER BASIN, COLORADO

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INTRODUCTION

The Denver Basin of northeastern Colorado contains rocks predominantly of Late Cretaceous and early Tertiary age (fig. SD-1). Coal of Tertiary (early Paleocene) age is present in the upper part of the Denver Formation in the basin (fig. SD-2). These coal deposits have low importance in the current National Coal Resource Assessment. They are unlikely to be utilized within the next 20-30 years because they are of lower quality than other coal available in nearby areas. This report briefly summarizes the geology, occurrence, quality, and production history of these coal resources. Additional information can be found in the references. Coal deposits of Late Cretaceous age that also are present in the Denver Basin are not discussed in this summary.

STRATIGRAPHY

Figure SD-3 shows the generalized uppermost Cretaceous and lower Tertiary stratigraphy of the Denver Basin. Coal (lignite) of early Paleocene age is in the “Denver lignite zone” (Kirkham and Ladwig, 1979) within the Denver Formation. The Denver Formation itself ranges in age from Late Cretaceous (Maastrichtian) to early Paleocene. It overlies the Arapahoe Formation of Late Cretaceous age, and it is partially overlain by the mostly correlative Dawson Arkose, a unit of Maastrichtian to Eocene age present primarily in the southern part of the basin, and which lacks significant coal beds (Landis, 1959; Soister, 1978; Soister and Tschudy, 1978; Kirkham and Ladwig, 1979; Kluth and Nelson, 1988). The Denver Formation ranges in thickness from 600 to 1,580 ft and consists primarily of claystone, siltstone, and fine-grained sandstone; it includes minor conglomerate beds and local

lava flows. Carbonaceous shale and lignite are present in the upper 300-500 ft of the formation east of the basin axis (Kirkham and Ladwig, 1979).

As shown in [figure SD-2](#), the Denver lignite zone has two principal areas of occurrence within the basin, the Scranton district to the north, east of the city of Denver, and the Ramah-Fondis area to the south (Landis, 1959). The stratigraphy of the lignite zone differs in these two areas, as shown in [figure SD-4](#), and the names of the significant lignite beds differ as well. The coal bed names are informal.

DESCRIPTION OF COAL ZONE

Outcrops of the Denver Formation lignite are scarce, and data on the thickness and lateral extent of beds is based on drill holes (Kirkham, 1978a). In the Scranton district the principal lignite beds range in thickness from 10 to 30 ft; the E lignite bed (also known as the Watkins bed) reaches a maximum thickness of 54.5 ft, and it can be traced for as much as 24 mi (Kirkham and Ladwig, 1979). There is no stratigraphic continuity of lignite beds between the northern and southern lignite areas, however. The region between the productive areas is nearly barren of lignite (Kirkham and Ladwig, 1979).

In the Ramah-Fondis area the principal beds range in thickness from 5 to 10 ft or more except for the Wolf bed, which is the thickest; it ranges from 18 to 28 ft thick (Kirkham and Ladwig, 1979). In both areas, thinner lignite beds are present also.

Most of the coal beds in the Denver lignite zone contain several non-coal partings, at least some of which are deposits of volcanic ash; others are

claystone, siltstone, or sandstone (fig. SD-5). Parting thicknesses range from less than 0.1 in to more than 2 ft. The cumulative thickness of partings amounts to 5-30 percent of the total thickness of individual beds (Kirkham and Ladwig, 1979).

Detailed isopach maps of the principal lignite beds were published by Kirkham and Ladwig (1979, plates 2-4) for both the Scranton district and the Ramah-Fondis area. Brand and Eakins (1980, plates 12-22) published isopach and structure maps of the lignite beds, an isopach map of overburden, and cross sections of the Denver lignite zone in the Watkins-Lowry area (Scranton district). In the Watkins area the E lignite bed is less than 200 ft below the surface. Overburden thickness is highly variable in the Ramah-Fondis area due to erosional downcutting by local streams. Throughout much of this area the Comanche bed is within 200 ft of the surface, although west of West Bijou Creek the overburden is more than 300 ft thick. Alluvial valley floors occupy parts of both areas.

COAL QUALITY

Kirkham and Ladwig (1979) state that most analyses of lignite from the Denver Formation indicate that the rank of the coal is lignite A, although a few thin intervals within thick beds may rank as high as subbituminous C coal. The Comanche bed in the Ramah-Fondis area appears to have the highest quality of all Denver lignite zone deposits. The ranges of typical analyses are shown in table 1 (data from Tremain and others, 1996); detailed data are available in Kirkham (1978b) and Khalsa and Ladwig (1981).

Table SD-1. Ranges of analyses of Denver Formation lignite (as-received basis)

Btu's per pound	Moisture (%)	Ash (%)	Sulfur (%)
4,000-7,000	22-40	8-30	0.2-0.6

ORIGINAL RESOURCES

Landis (1959) estimated 489 million tons of lignite to have been originally present in the Scranton district and 474 million tons in the Ramah-Fondis area. Hornbaker and others (1976) revised these estimates upward to a total of 12,469 million tons for all Paleocene coal in the Denver Basin. Kirkham and Ladwig (1979) accepted an estimate of 10-15 billion tons of lignite to be present in beds 4 ft or more in thickness within 1,000 ft of the surface in the Denver Formation.

PRODUCTION HISTORY

Mining of coal from the Denver lignite zone apparently began in the late 1800's. Peak production occurred in the 1920's and 1930's (Kirkham and Ladwig, 1980). Total production from early mines operating in the Scranton district was 35,789 tons (Kirkham and Ladwig, 1979). Five mines near Ramah and four near Fondis, Colorado, were in operation between 1909 and 1940; they produced a total of 3,047 tons of lignite (Kirkham and Ladwig,

1979). No mining of Denver Formation lignite deposits has taken place since 1940.

CONCLUSIONS

The last mine that extracted lignite from the Denver Formation closed in 1940. These resources probably will not be used in power plants in the next 20-30 years because of the relative abundance of coal of better quality in nearby areas (Kirkham and Ladwig, 1980). Those areas include western Colorado and northeastern Wyoming. The present and future importance of the Denver Basin with regard to energy production is more closely linked to oil and gas resources than to coal (Higley and others, 1995).

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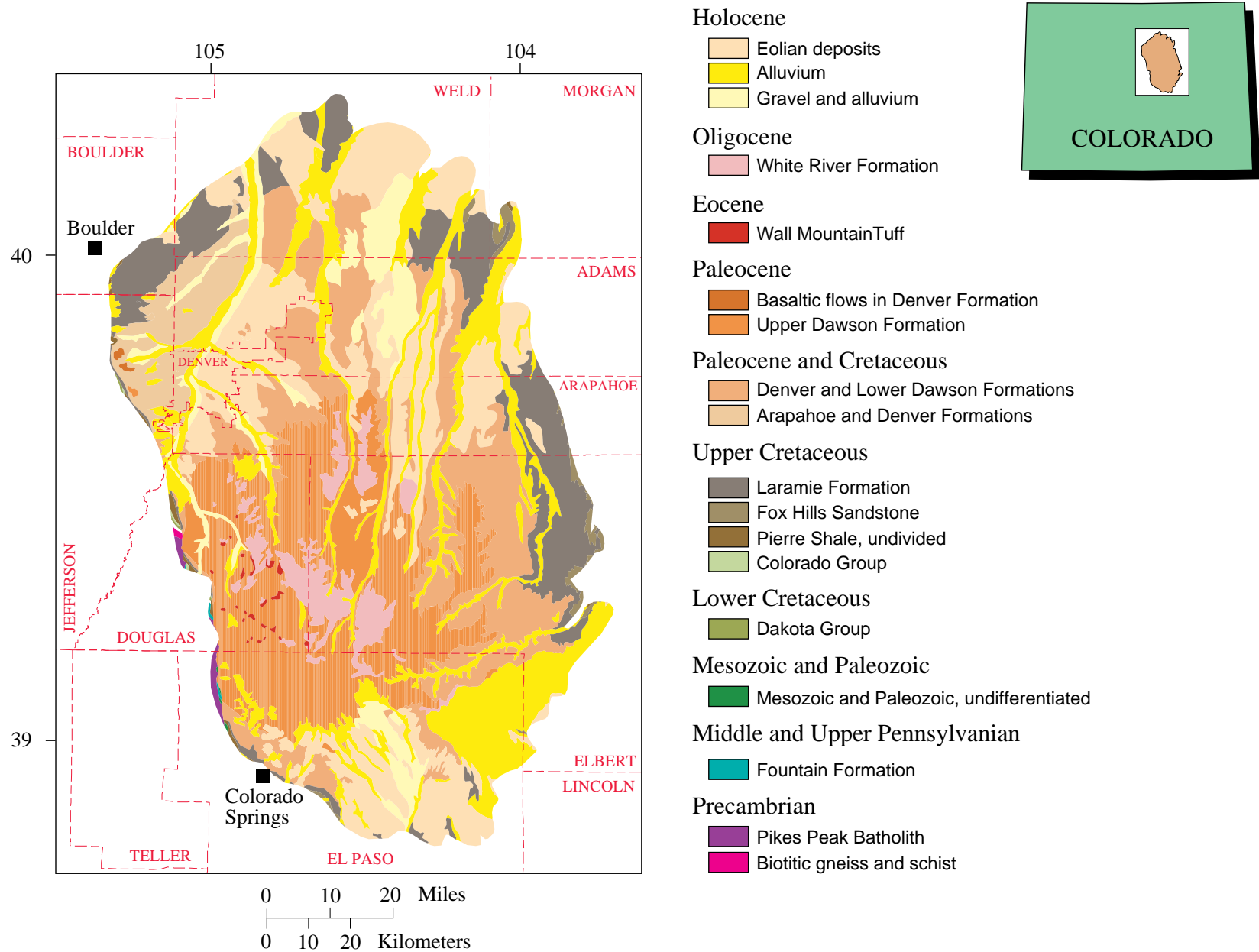


Figure SD-1. Geologic map of the Denver Basin.

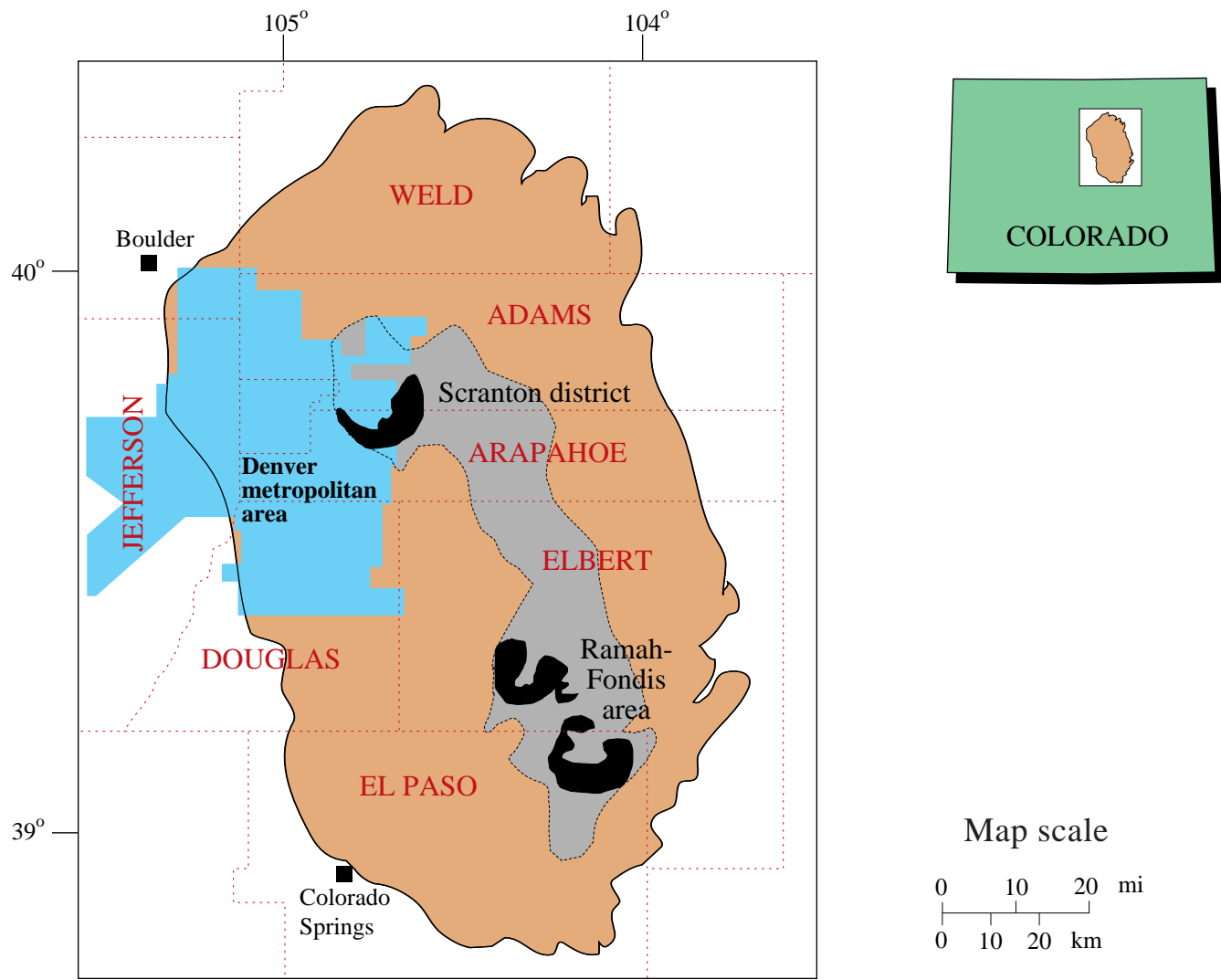


Figure SD-2. Index map of the Denver Basin (orange), Colorado, showing counties, the Denver metropolitan area, other major cities, area of occurrence of potentially strippable lignite (defined as beds less than 200 ft in depth, shown in gray on map) in the Denver Formation, and coalfields where mines were active in the past (black). The basin margin is drawn at the base of the coal-bearing part of the Upper Cretaceous Laramie Formation. Modified from Landis (1959) and Kirkham and Ladwig (1979, 1980).

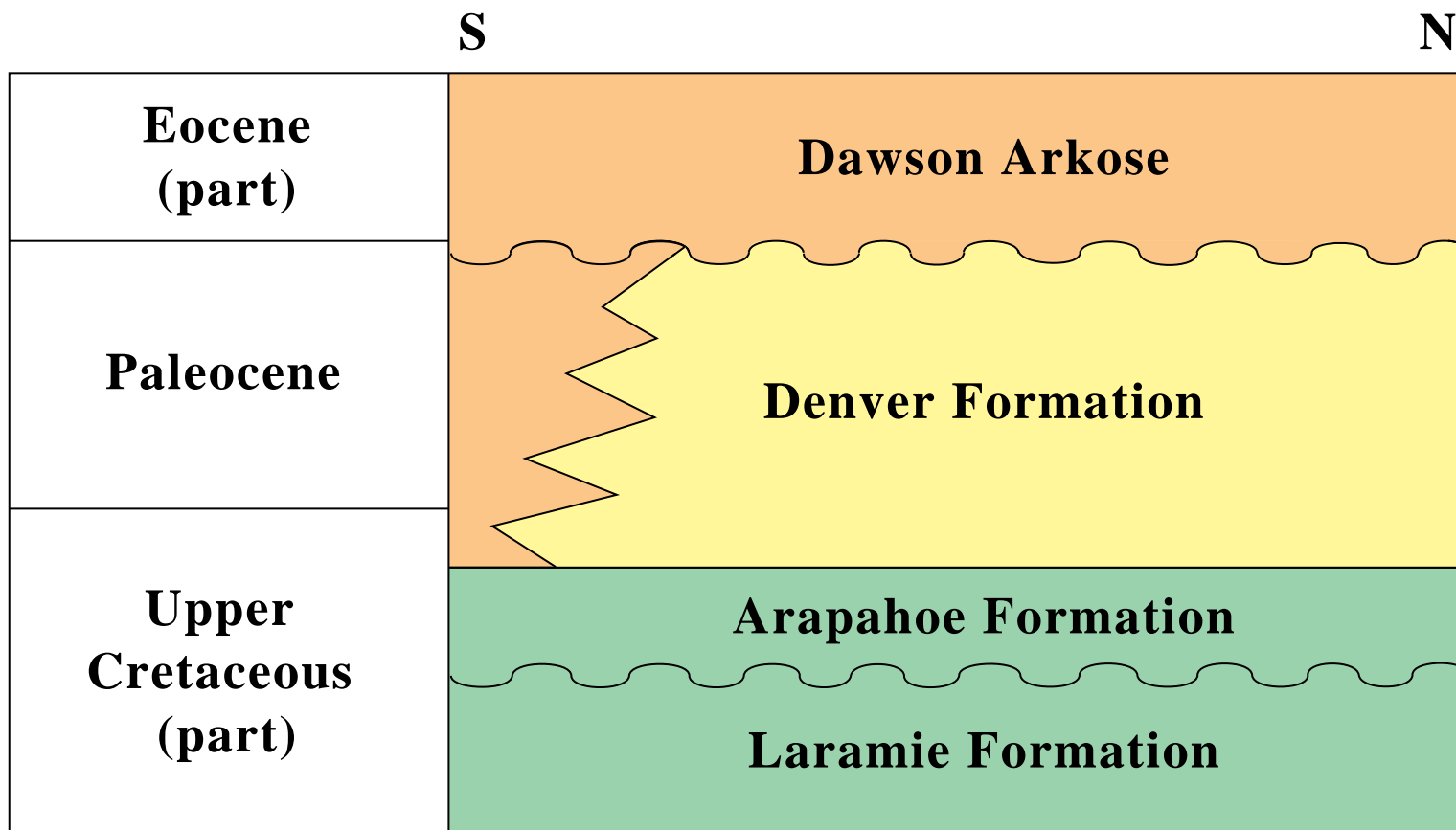


Figure SD-3. Generalized stratigraphy of the uppermost Cretaceous and lower Tertiary rocks in the Denver Basin. Lignite deposits of early Paleocene age exist in the Denver Formation. Modified from Landis (1959) and Kirkham and Ladwig (1979), incorporating age data from Soister and Tschudy (1978) and Kluth and Nelson (1988).

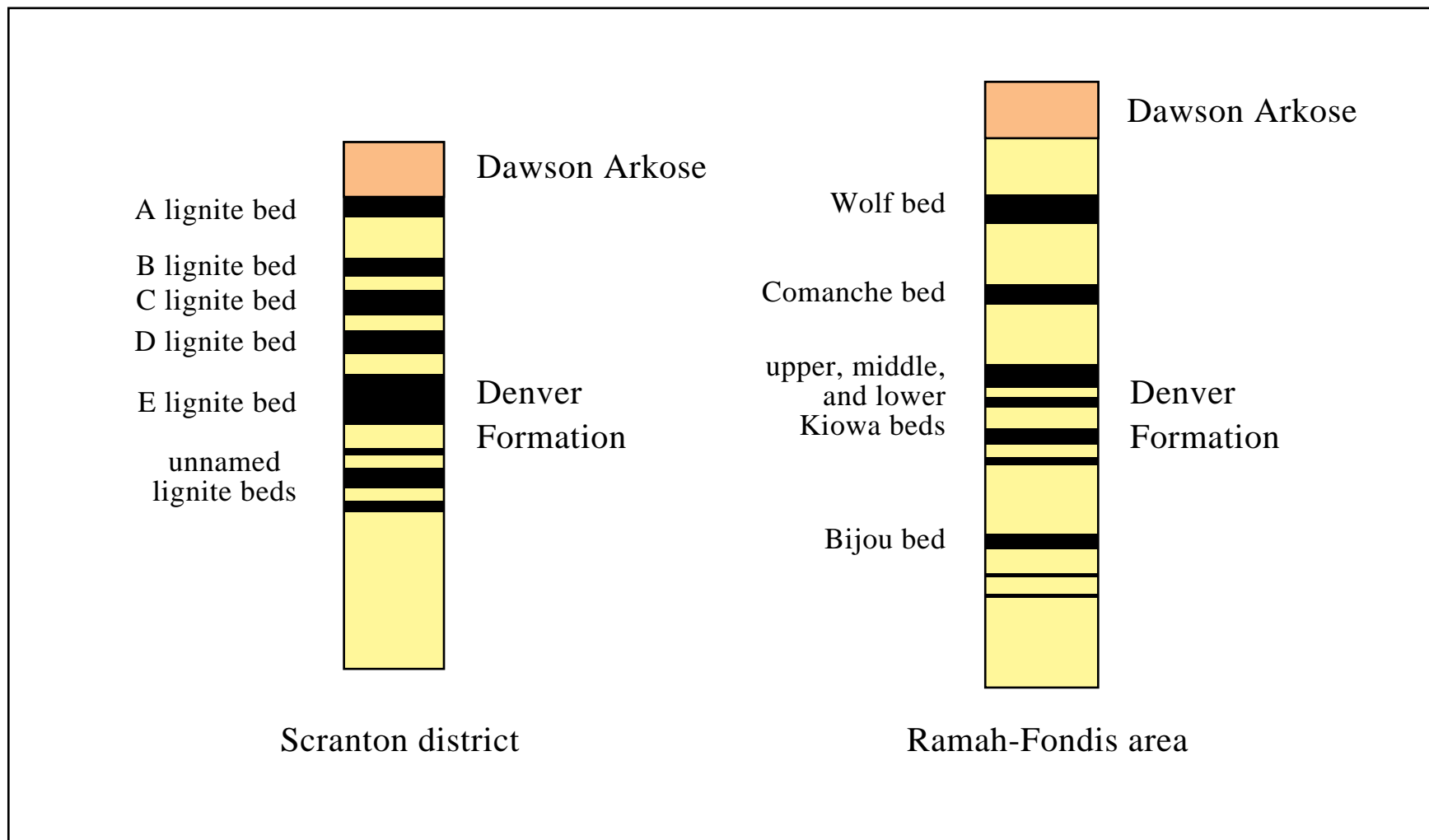


Figure SD-4. Generalized stratigraphy of the Denver lignite zone in the Scranton district (central Denver Basin) and Ramah-Fondis area (southern Denver Basin). After Kirkham and Ladwig (1979); not to scale.



Figure SD-5. Lignite bed of the Denver Formation in outcrop in Big Gulch, Elbert County, Colorado, in the Ramah-Fondis area. Note prominent non-coal parting.