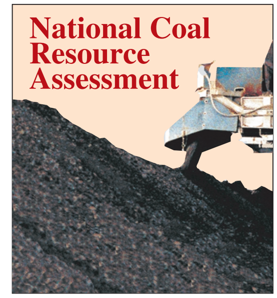
Chapter K

Summary of Geology and Coal Resources of the Blackhawk Formation in the Southern Wasatch Plateau, Central Utah



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By Russell F. Dubiel[1]

Chapter K *of*

Geologic Assessment of Coal in the Colorado Plateau: Arizona, Colorado, New Mexico, and Utah

Edited by M.A. Kirschbaum, L.N.R. Roberts, *and* L.R.H. Biewick

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By Russell F. Dubiel

Introduction

The southern Wasatch Plateau is one of 12 priority assessment areas within the Colorado Plateau region of the Western United States. The area is high priority because it contains significant coal resources and currently has one active coal mine. The coal resources lie beneath Federal, State, and private land, and the mineral rights to these resources are held by Federal, State, and private concerns. The assessment of coal resources in the southern Wasatch Plateau is part of the U.S. Geological Survey National Coal Resource Assessment project that was initiated in 1994 (U.S. Geological Survey, 1996). This report provides a brief summary of the geology and the coal resources in the southern Wasatch Plateau of central Utah. For a more detailed report on the geology and coal resources of the southern Wasatch Plateau, see Dubiel and others (chap. S, this CD-ROM).

Photograph. View east looking down Convulsion Canyon in the southern Wasatch Plateau.

Location of the Southern Wasatch Plateau

The southern Wasatch Plateau is located in central Utah to the west of the San Rafael Swell (fig. 1*A*). The southern Wasatch Plateau is contiguous with the northern Wasatch Plateau (see report by Tabet and others, 1999). Together, the two areas form the Wasatch Plateau coal field described in earlier reports (e.g., Spieker, 1931; Doelling, 1972a, 1972b; Davis and Doelling, 1977). Coal-bearing rocks in the southern Wasatch Plateau are a southward extension of the strata exposed in the Book Cliffs to the north and east of the study area.

The Wasatch Plateau coal field extends for about 90 miles NNE. from just south of I-70 at Last Chance Creek north to U.S. Highway 6 near Soldier Summit and the town of Scofield, Utah. The Southern Wasatch Plateau study area covers approximately the southern half of the coal field and extends north from about I-70 to just south of the towns of Orangeville, Huntington, and Castle Dale, Utah (fig. 1*B*). The towns of Emery, Ferron, Castle Dale, Huntington, and Orangeville are just east of the study area along State Highway 10, which extends north from I-70 to the town of Price.

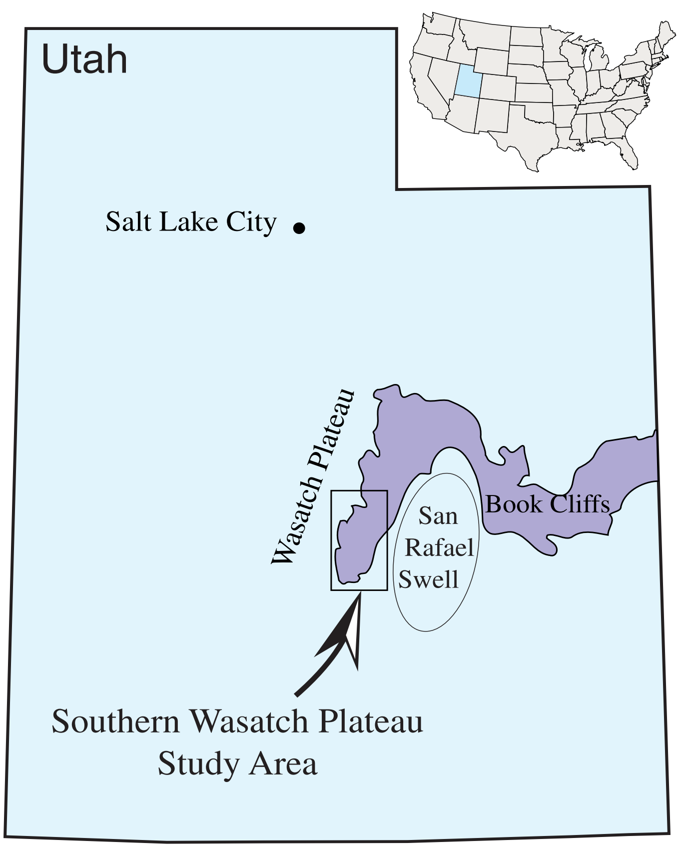


Figure 1*A*. Location of the Southern Wasatch Plateau study area in central Utah.

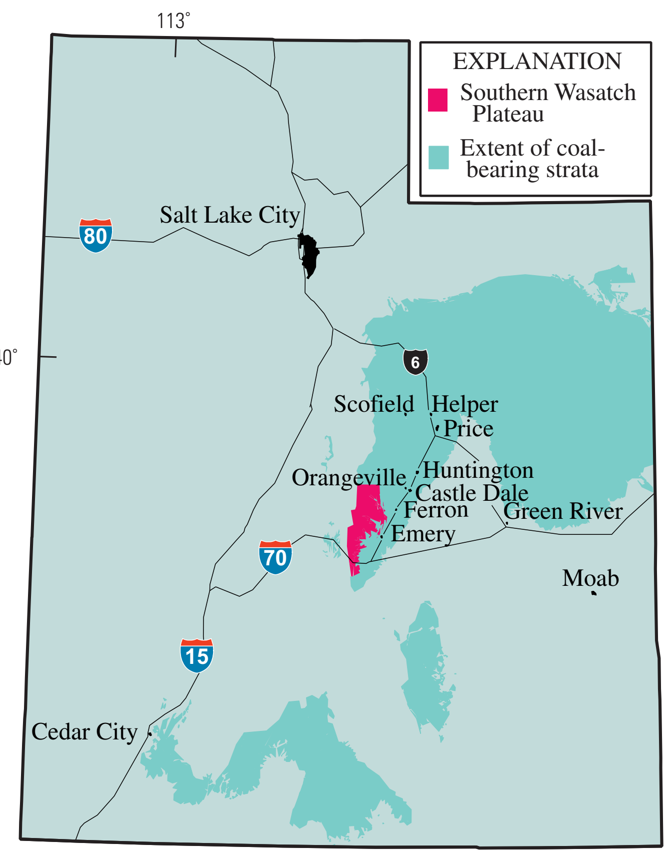
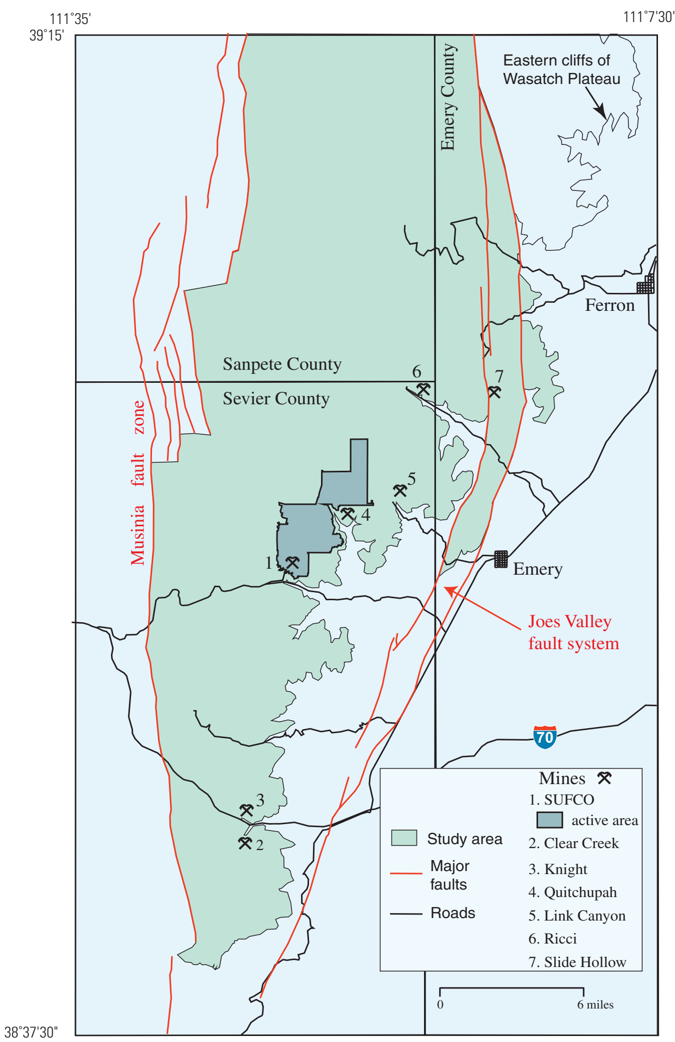


Figure 1*B*. The southern Wasatch Plateau in relation to Cretaceous coal-bearing strata in Utah.

The Southern Wasatch Plateau Study Area

Study Area Boundary

Coal within the southern Wasatch Plateau study area is primarily in the Upper Cretaceous Blackhawk Formation, which lies directly on the Upper Cretaceous Star Point Sandstone. The boundaries of the study area (fig. 2*A*) were chosen to reflect the geologic distribution of these two rock units and the coal in the Blackhawk; the boundary is defined by geologic contacts and by major faults.



East of the study area, the Blackhawk Formation and the Star Point Sandstone form an erosional escarpment on the western flank of the San Rafael Swell. The eastern boundary of the study area corresponds with the contact between the Blackhawk Formation and the underlying Star Point Sandstone. The southern boundary of the study area is formed by the intersection of outcrops of the Star Point and Blackhawk with the north-south-trending Musinia fault zone. The western boundary is at several major north-trending faults of the Musinia fault zone. The northern boundary of the study area is an east-west line at lat 39°15′N. that coincides with the southern boundary of the Northern Wasatch Plateau study area. The area east of the Joes Valley fault system is geologically contiguous with and is included in the Northern Wasatch Plateau study area (see Rohrbacher and others, chap. F, this CD-ROM).

Figure 2*A* (facing column). Southern Wasatch Plateau study area, showing the study area boundary defined by geology and faults and the location of active and inactive mines.

Mining Activity

Coal was discovered in the Wasatch Plateau in 1874, and mining started in 1875 in Huntington Canyon in the northern part of the Wasatch Plateau. Mines were developed gradually in the Wasatch Plateau coal field as demand increased, and the larger mines were concentrated in the northern Wasatch Plateau because of the preexisting railroad and the closer proximity to markets. Coal production from the Wasatch Plateau gradually increased until 1920 then and decreased slightly until World War II. During and after World War II, Utah coal production peaked, followed by another decline in 1957. During the 1960's renewed interest in coal power resulted in an increase in lease activity on the Wasatch Plateau. Through 1969, after 95 years of mining, almost 100 million short tons of coal had been removed from the Wasatch Plateau (Doelling, 1972a).

Mining in the southern Wasatch Plateau proceeded at a slower pace, primarily due to the long distance to markets. Several small mines have been active in the past, and only the SUFCO mine is presently active in the study area (see fig. 2*A*).

Photograph. Loadout area of the SUFCO mine in Convulsion Canyon.

Physiography

The southern Wasatch Plateau is an area of rugged topography with deep canyons cut on its eastern flank (fig. 2*B*). The eastern plateau edge is a steep cliff formed by the Star Point Sandstone that is overlain by steep slopes of the Blackhawk Formation, with total relief on the eastern escarpment of about 1,000 ft. Elevations range from about 7,000 ft on the eastern escarpment to almost 10,000 ft on plateau summits near the central and western parts of the study area. Major drainages such as Rock Canyon Creek, Ferron Creek, Muddy Creek, Quitchupah Creek, and Ivie Creek all have headwaters at high elevations on the Wasatch Plateau and flow southeast, eventually emptying into the Colorado River.

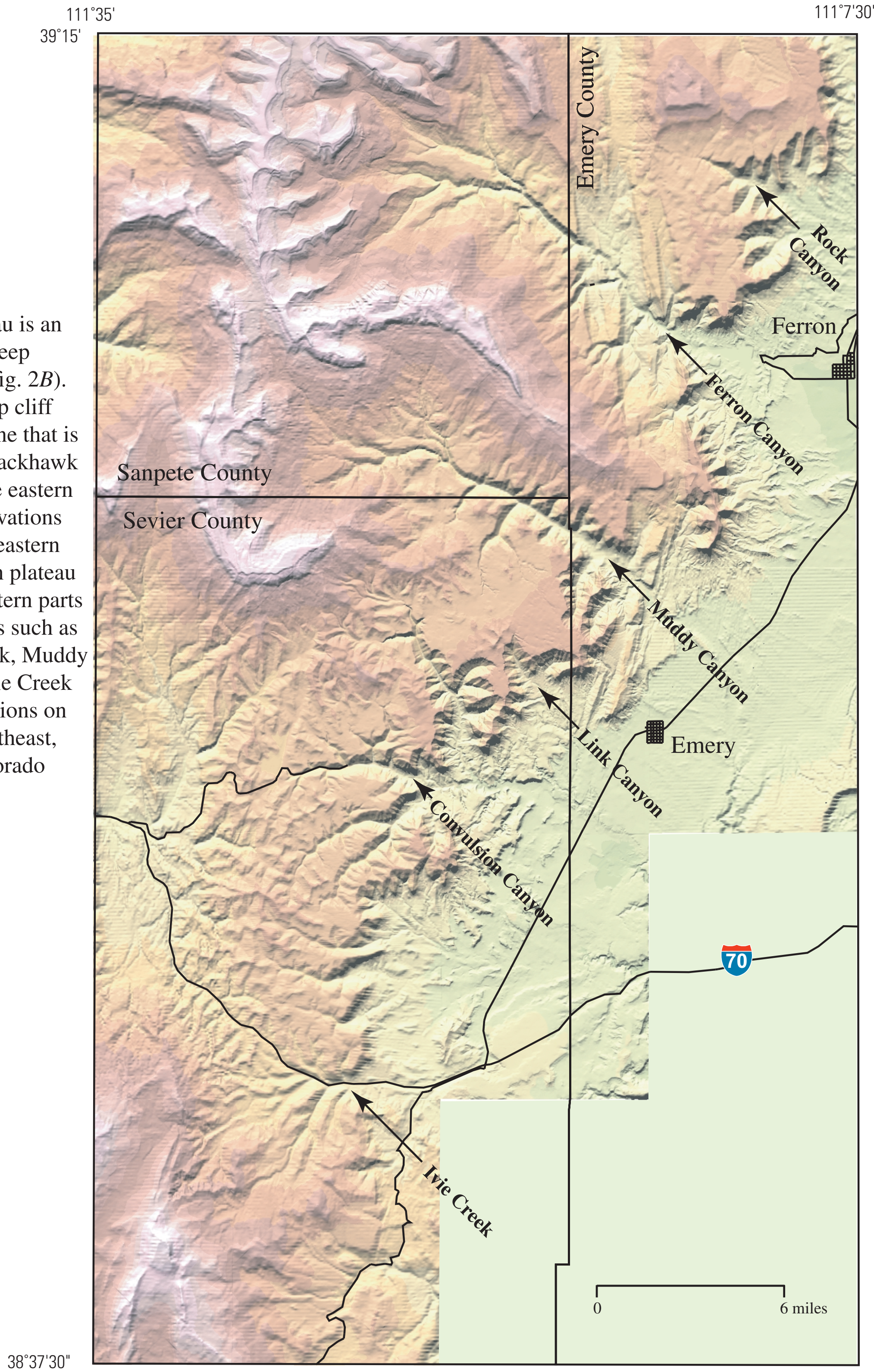


Figure 2*B*. Physiography and major canyons in the southern Wasatch Plateau.

Quadrangles

The southern Wasatch Plateau covers about 550 mi² in parts of 15 7.5′ quadrangles in eastern Sanpete and Sevier Counties and in the extreme western part of Emery County, Utah.

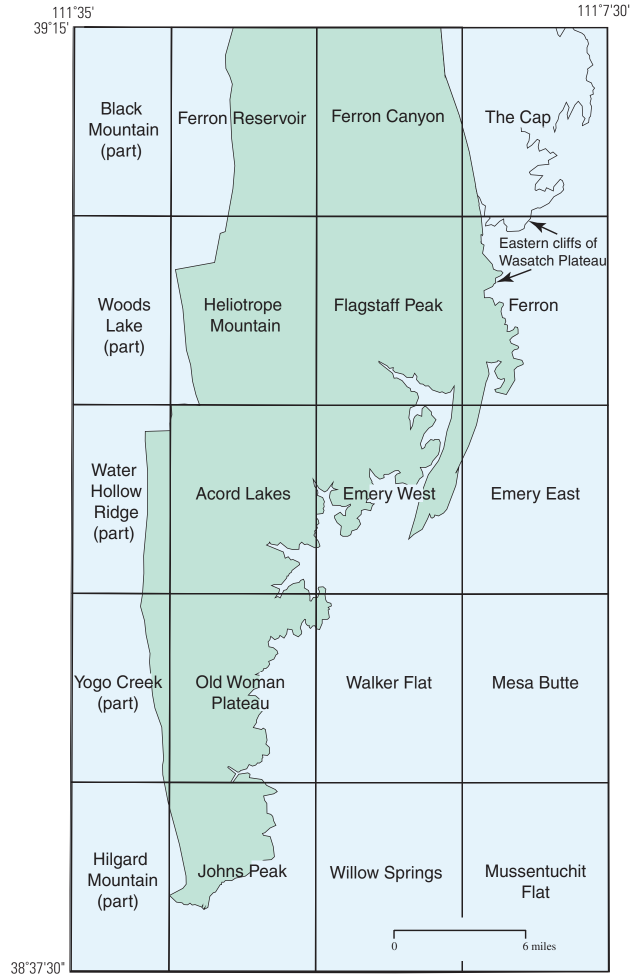
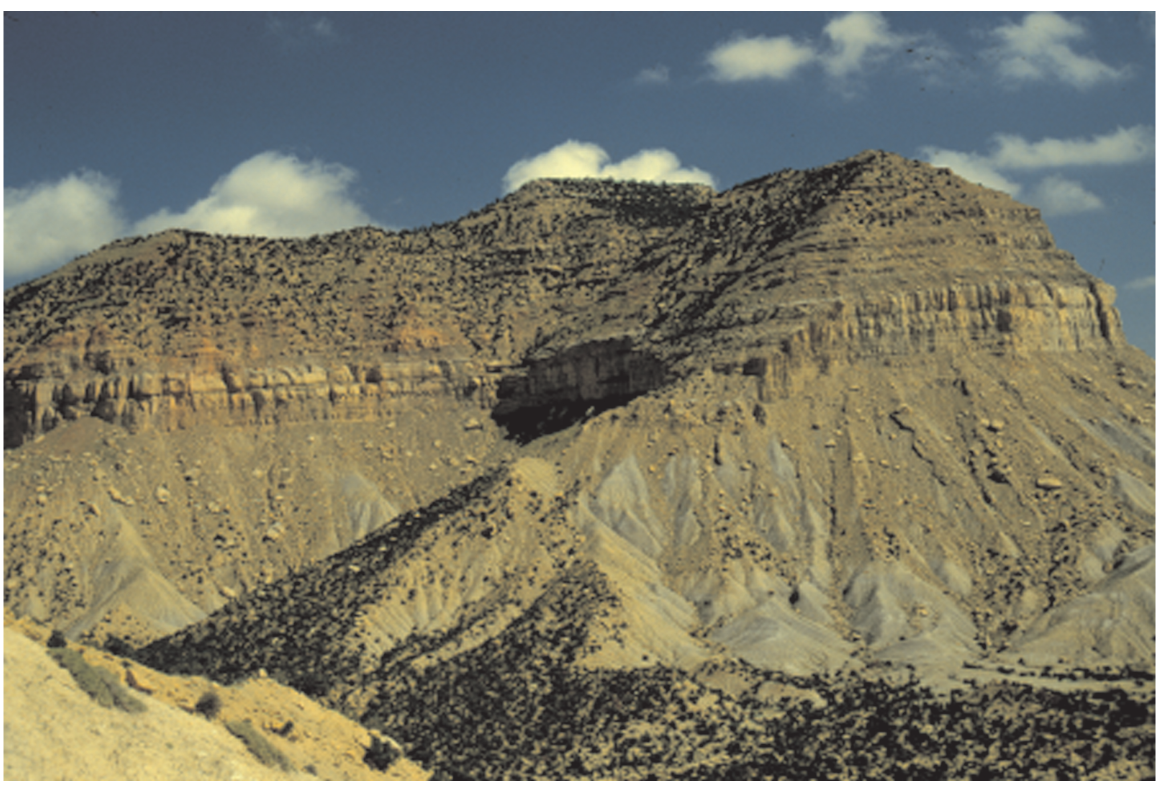


Figure 3 (facing column). The 7.5′ quadrangles in and adjacent to the southern Wasatch Plateau.

Photograph (below). Quitchipah Point in the southern Wasatch Plateau.



Geology of the Southern Wasatch Plateau

The eastern edge of the coal field consists of cliff exposures of the Upper Cretaceous Star Point Sandstone and Blackhawk Formation that dip gently west off of the San Rafael Swell (fig. 4). To the west, the coal-bearing rocks continue to dip away from the San Rafael Swell into the subsurface at about 5° to 7°, where they are overlain by younger Cretaceous and Tertiary rocks. These strata are displaced along major normal faults near the western margin of the Wasatch Plateau. To the north of the study area, coal-bearing Cretaceous rocks dip to the north into the Uinta Basin, and to the south of the study area they are covered by volcanic rocks of the Fish Lake Plateau. The southern Wasatch Plateau is bounded on the east and west by a series of north-south-trending normal faults.

The geology and the coal resources of the southern Wasatch Plateau were investigated by examining data at stratigraphic sections measured on outcrops during this study and from measured stratigraphic sections and drill-hole geophysical logs and cores reported in the literature. Data points used in the assessment of the coal resources of the study area are shown on the adjacent geologic map (fig. 4), along with the major geologic units and the distribution of faults.

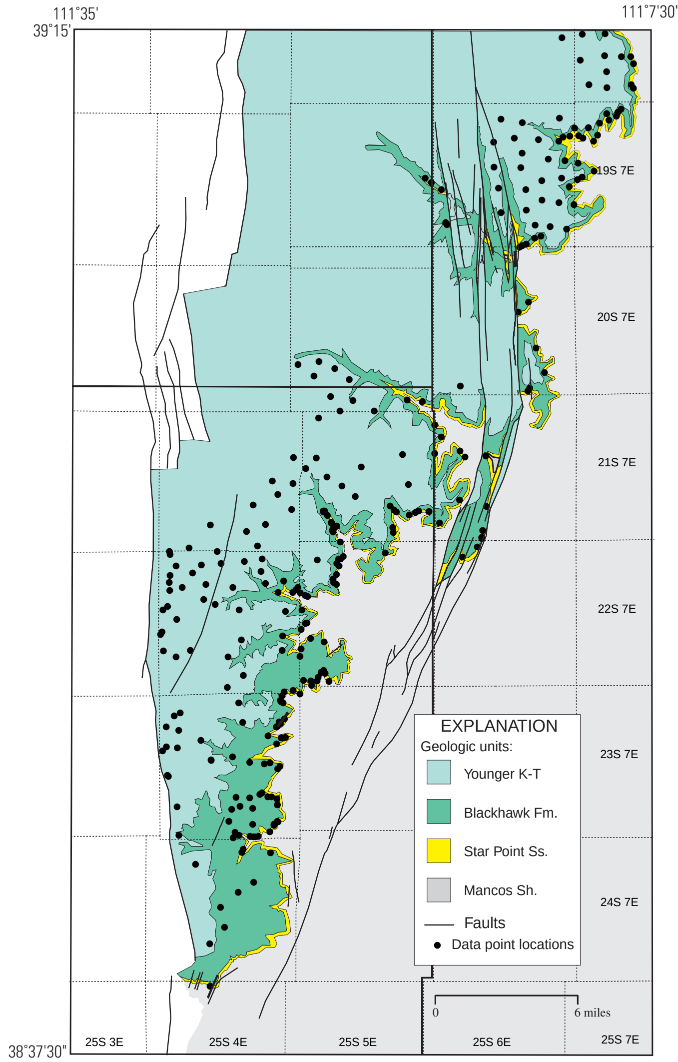
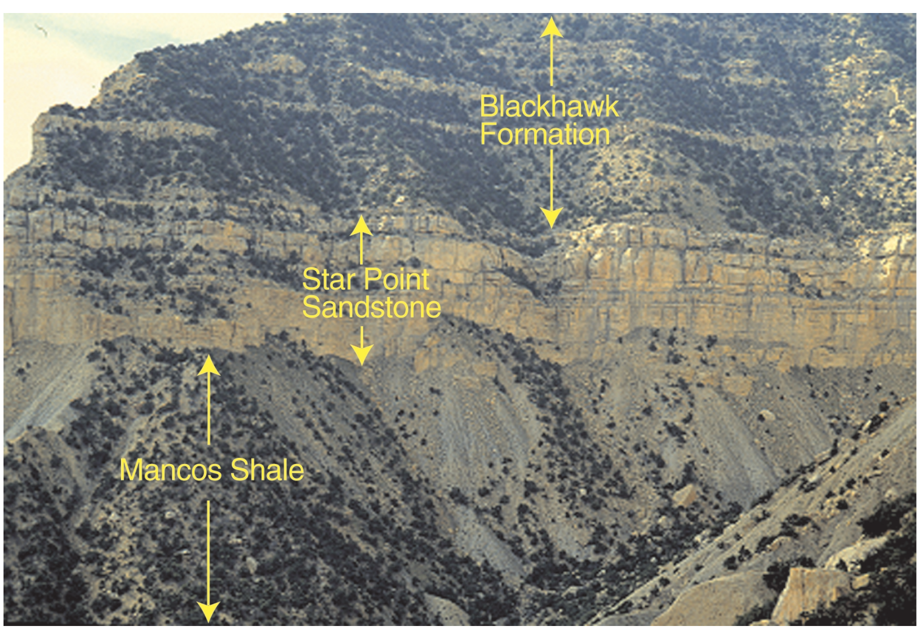


Figure 4 (facing column). Geology of the southern Wasatch Plateau.



Photograph. Exposures of the Blackhawk Formation, Star Point Sandstone, and Mancos Shale in Convulsion Canyon.

Ownership of Coal and Subsurface Mineral Rights

The Federal Government owns the majority of coal (fig. 5*A*) and surface (fig. 5*B*) rights in the southern Wasatch Plateau, whereas State and private interests hold small tracts of both mineral and surface ownership throughout the study area.

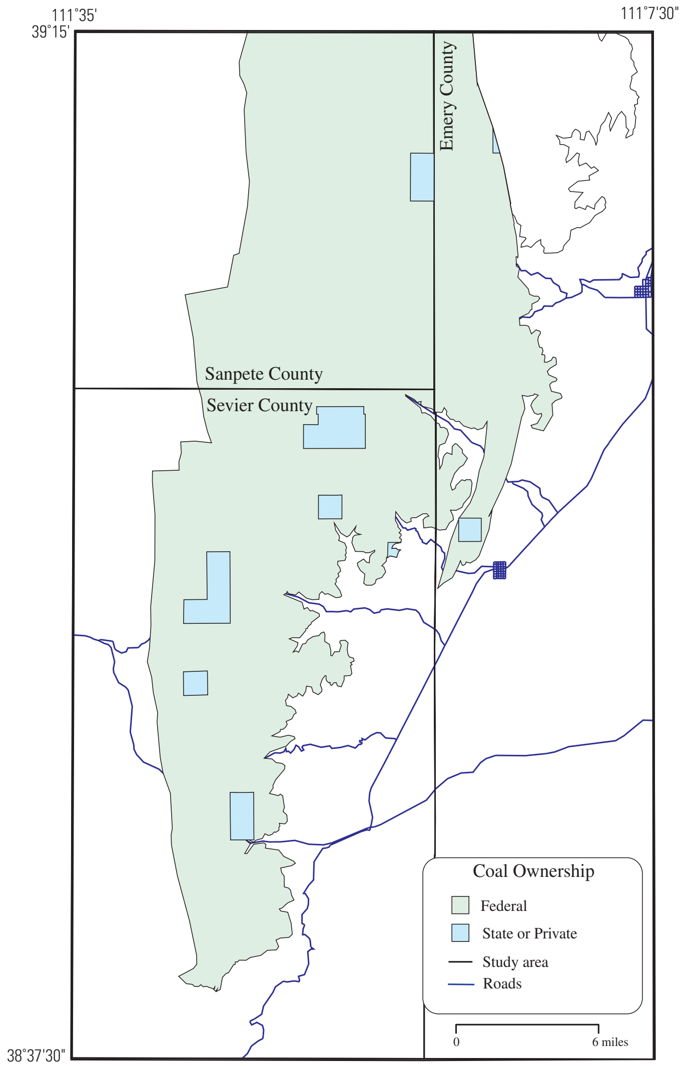


Figure 5*A*. Coal ownership in the southern Wasatch Plateau.

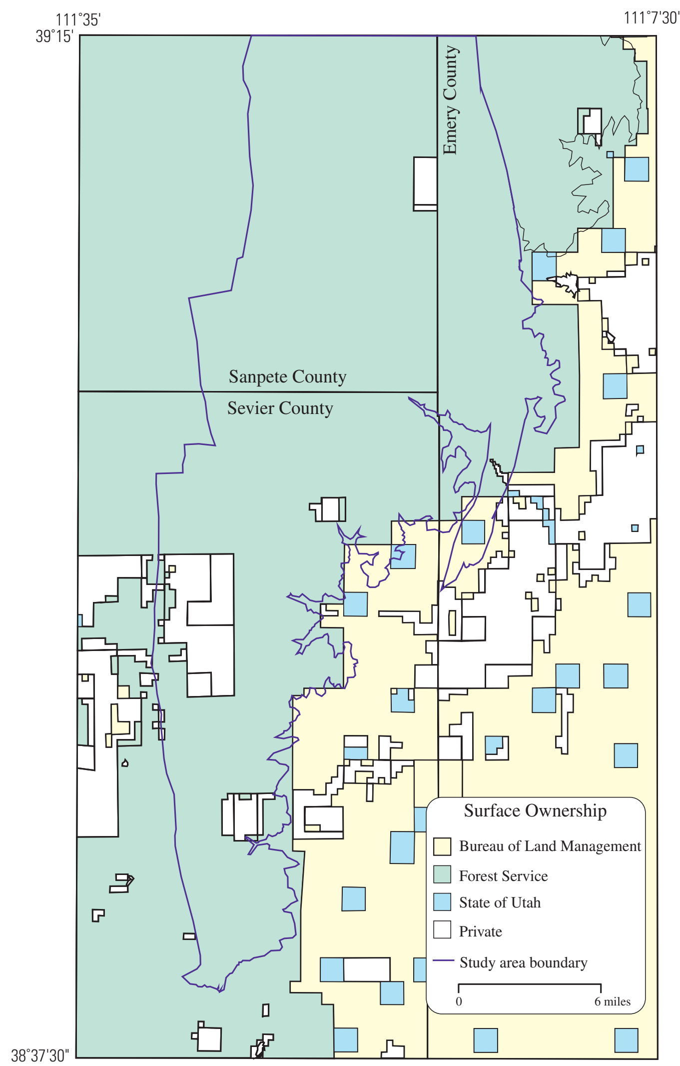


Figure 5*B*. Surface ownership in the southern Wasatch Plateau.

Faults, Folds, and Shattered Zones

In the eastern part of the Wasatch Plateau, three graben systems form the eastward extension of the basin-and-range faulting: the Joes Valley fault zone, the Pleasant Valley fault zone, and the North Gordon fault zone. The Pleasant Valley and North Gordon fault zones are in the northern part of the Wasatch Plateau. The Joes Valley fault zone is a 75-mile-long system of normal faults with vertical downward displacement in a central graben of between 1,500 and 2,500 ft (fig. 6) (Spieker, 1931). The graben is several miles wide and contains numerous minor faults parallel to the major faults, along with innumerable subsidiary fractures. Between the Joes Valley fault zone and the western boundary of the study area, the strata are relatively unbroken, except for a single normal fault about 3 miles west of Convulsion Canyon and several minor faults near the southern margin of the study area.

Strata in the southern Wasatch Plateau dip west at attitudes less than 5°, except locally near faults where they may dip as much as 20° (Doelling, 1972a). Strata have been gently warped into broad anticlines and synclines that trend east-west, perpendicular to the major north-trending fault systems.

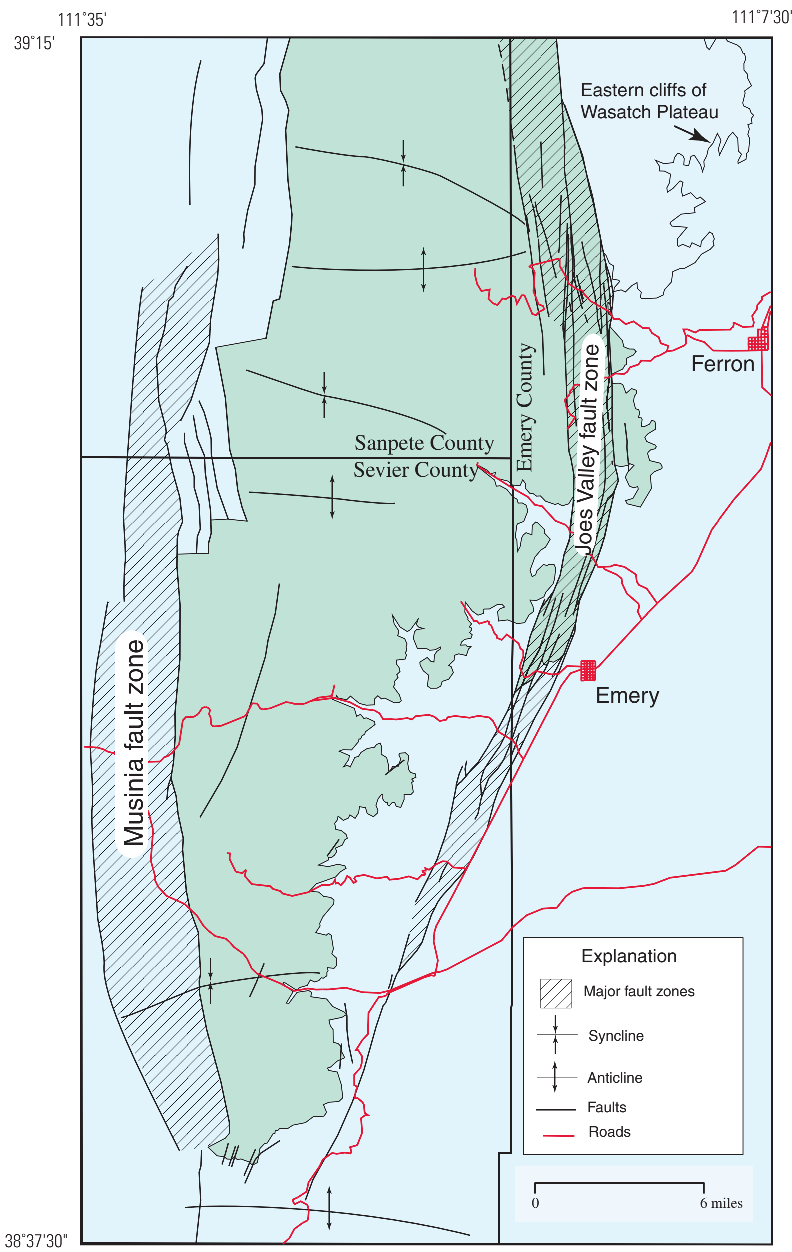


Figure 6. Faults and folds in the southern Wasatch Plateau.

Paleogeography

During the Late Cretaceous (approximately 65 to 98 million years ago), the region now forming the southern Wasatch Plateau was located about 45°N. paleolatitude within the Cretaceous Rocky Mountain foreland basin (fig. 7). Clastic sediment was sourced from the west in the Sevier Highlands and was deposited in coastal-plain settings and along shorelines on the western margin of the Cretaceous Western Interior Seaway (Weimer, 1986; Roberts and Kirschbaum, 1995). The sediments that were deposited in this Cretaceous coastal setting included a variety of continental, coastal-plain, marginal-marine, and offshore-marine facies.

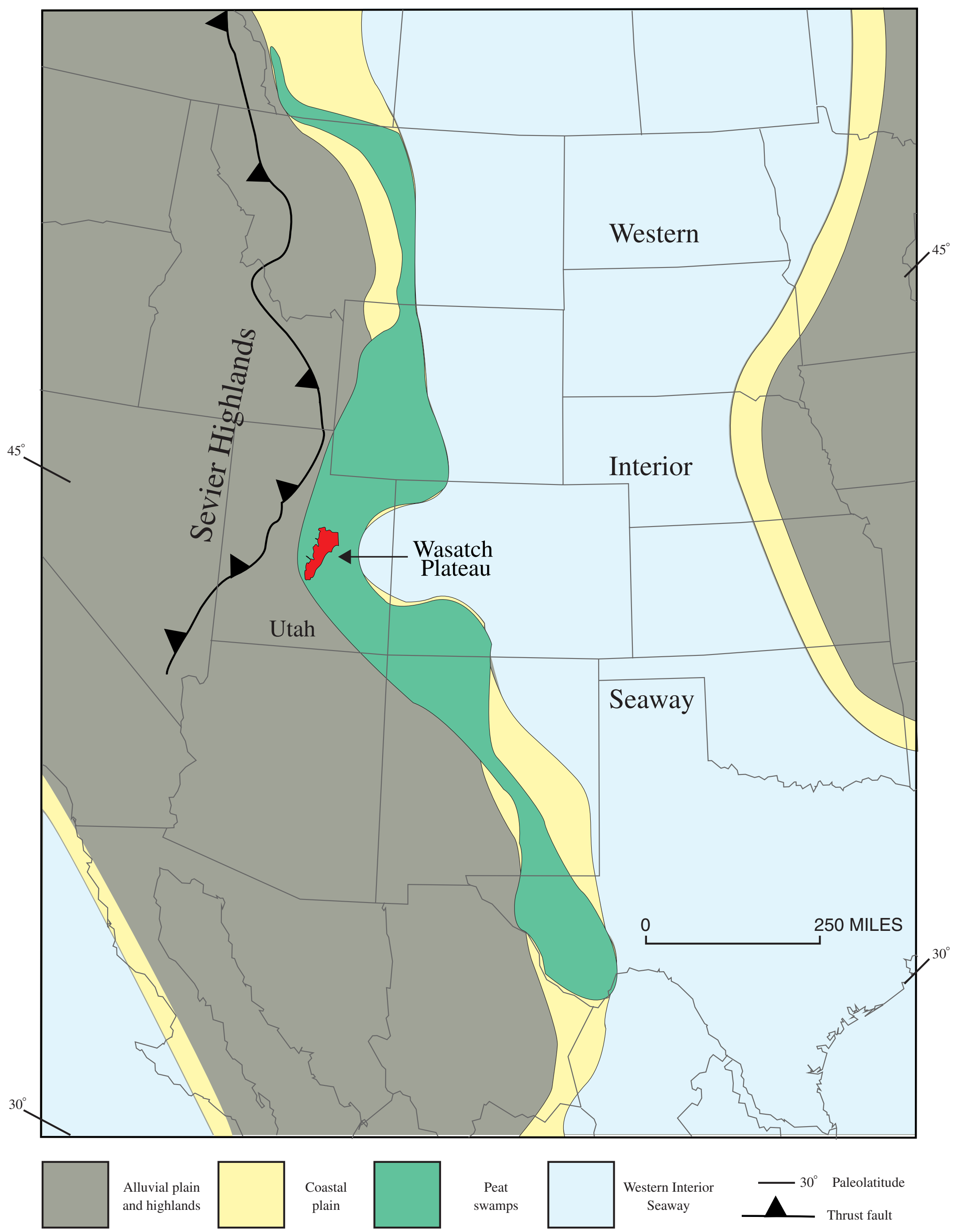


Figure 7. Late Cretaceous paleogeography of the Western United States.

General Stratigraphy

Rocks in the vicinity of the Wasatch Plateau range in age from Late Cretaceous to early Eocene (fig. 8*A*) (Hintze, 1980). The thickness of the stratigraphic section of rocks exposed at Castle Valley east of the study area near the towns of Emery, Ferron, and Castle Dale, Utah, and extending to the tops of the highest points in the southern Wasatch Plateau exceeds 10,000 ft. In the central part of the San Rafael Swell, east of the study area, the Lower Permian White Rim Sandstone and Kaibab Limestone are the oldest rocks exposed (Hintze, 1980). Units exposed on the gently dipping western flank of the San Rafael Swell comprise these Lower Permian strata, through Triassic, Jurassic, and Cretaceous rocks to lower Eocene units, which are located west of the study area.

In the Wasatch Plateau, the Upper Cretaceous section consists of, in ascending order, the Dakota Sandstone; Mancos Shale with its Tununk, Ferron Sandstone, Blue Gate Shale, Emery Sandstone, Masuk Shale Members; and Mesaverde Group. The Upper Cretaceous Mesaverde Group consists of upper Campanian strata assigned to the Star Point Sandstone, Blackhawk Formation, Castlegate Sandstone Member of the Price River Formation, and the main body of the Price River Formation. These rocks, in turn, are overlain by the Cretaceous and Tertiary North Horn Formation and by the Tertiary Flagstaff Limestone, Colton Formation, and Green River Formation (Fouch and others, 1983).

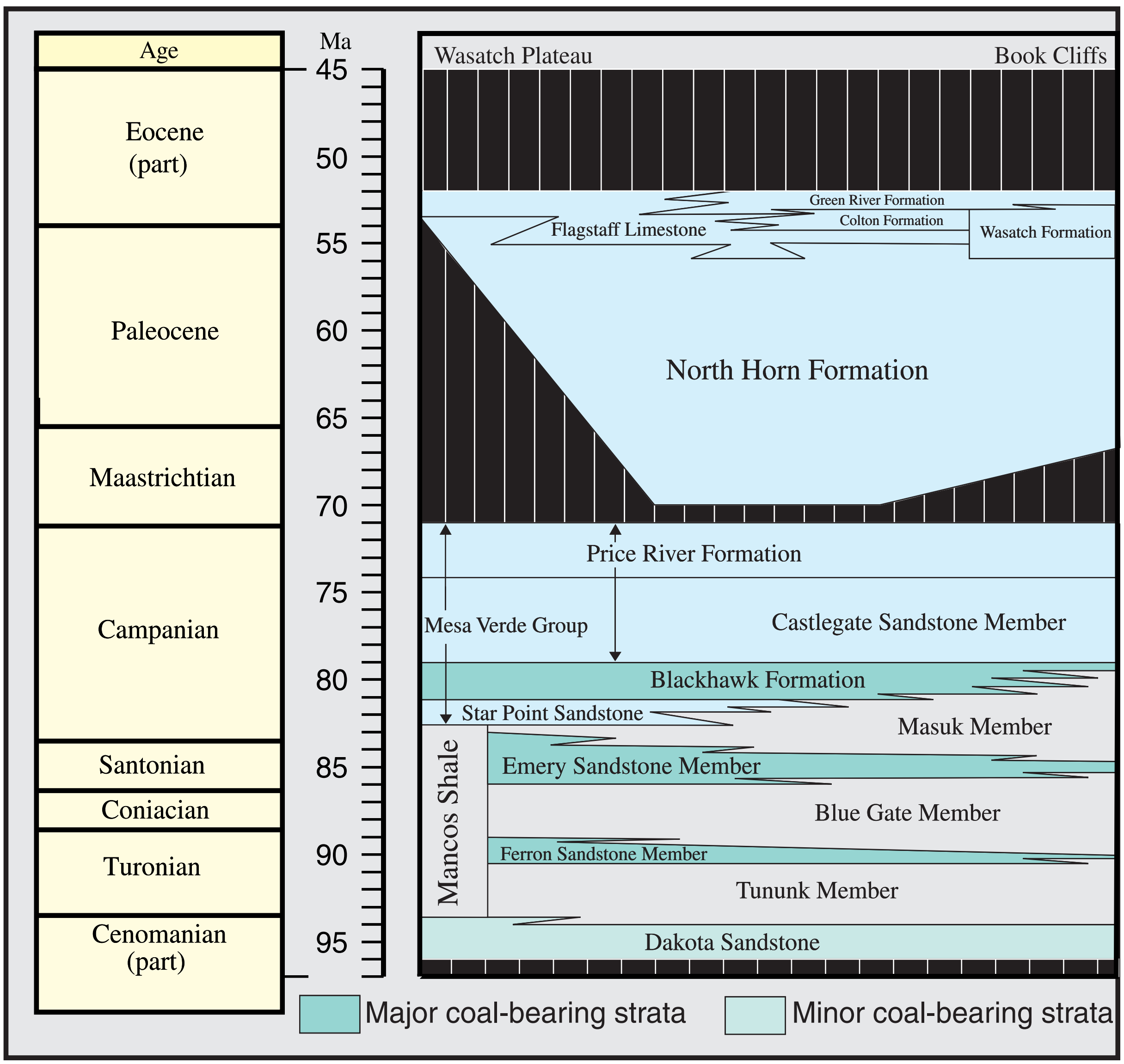


Figure 8*A*. General stratigraphy of the Wasatch Plateau.

Stratigraphy of Upper Cretaceous Rocks

The eastern boundary of the southern Wasatch Plateau study area was chosen at the outcrop contact between the Star Point Sandstone and the underlying Mancos Shale. This contact was picked because the overlying Blackhawk Formation is the major coal-bearing unit in the Wasatch Plateau and because the stacking patterns of the marine-shoreface sandstones of the Star Point influenced the distribution of the coals in the Blackhawk (fig. 8*B*). Four geologic units are designated on the geologic map for the study area (fig. 4) and they are shown within the stratigraphic section (fig. 8*B*). In ascending order, they are (1) the Upper Cretaceous Mancos Shale, (2) the Upper Cretaceous Star Point Sandstone, (3) the Upper Cretaceous Blackhawk Formation, and (4) undifferentiated Cretaceous and Tertiary strata, which include the Castlegate Sandstone Member of the Price River Formation and the main body of the Price River Formation, North Horn Formation, Flagstaff Limestone, and Colton Formation.

The Star Point Sandstone consists of stacked shoreface sandstones that prograde to the east and interfinger with the Mancos Shale. Each of the shoreface sandstones in the Star Point has associated with it an overlying coal that extends west in a paleo-landward direction into the nonmarine deposits of the Blackhawk Formation.

In the study area, some coals may be present at great depth in the Cretaceous Dakota Sandstone and in the Ferron and Emery Sandstone Members of the Mancos Shale; however, the majority of thick, continuous coal beds at depths to 5,000 ft occur within the Cretaceous Blackhawk Formation.

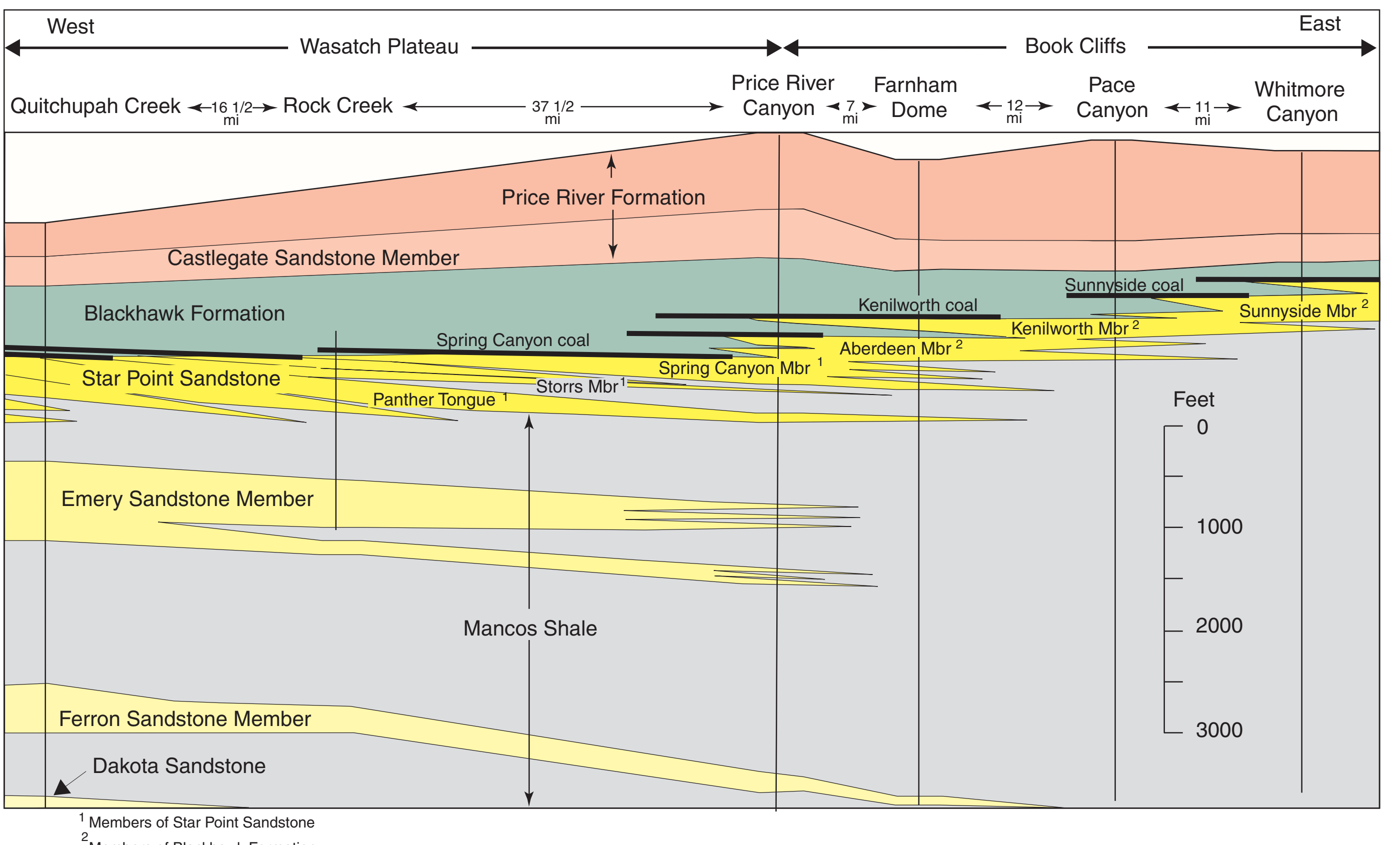


Figure 8*B*. Stratigraphy of Upper Cretaceous rocks in the Wasatch Plateau.

Stratigraphy of the Star Point Sandstone and Blackhawk Formation

Spieker and Reeside (1925) named the Star Point Sandstone after a prominent headland of the Wasatch Plateau and the Blackhawk Formation for exposures near the Blackhawk mine near the coal town of Hiawatha. Clark (1928) included the Star Point as the base of the Mesaverde Group in the Book Cliffs. Clark's (1928) Star Point comprised, in ascending order, the Panther, Storrs, and Spring Canyon Tongues (the latter two now called members) (fig. 8*C*). Clark (1928) also named the Aberdeen Sandstone Member of the Blackhawk Formation, which overlies the Spring Canyon. Young (1955) redefined the Star Point to contain only the Panther and Storrs, and he combined the Spring Canyon Tongue with Clark's (1928) Spring Canyon coal group into the Spring Canyon Member and placed it in the overlying Blackhawk Formation beneath the Aberdeen Member to conform with his classification scheme in the Book Cliffs. This scheme also named the overlying Kenilworth, Sunnyside, Grassy, and Desert Members of the Blackhawk Formation. Sedimentologic studies for this project identified several as yet unnamed shoreface sandstones beneath the Panther Tongue that are also part of the Star Point Sandstone.

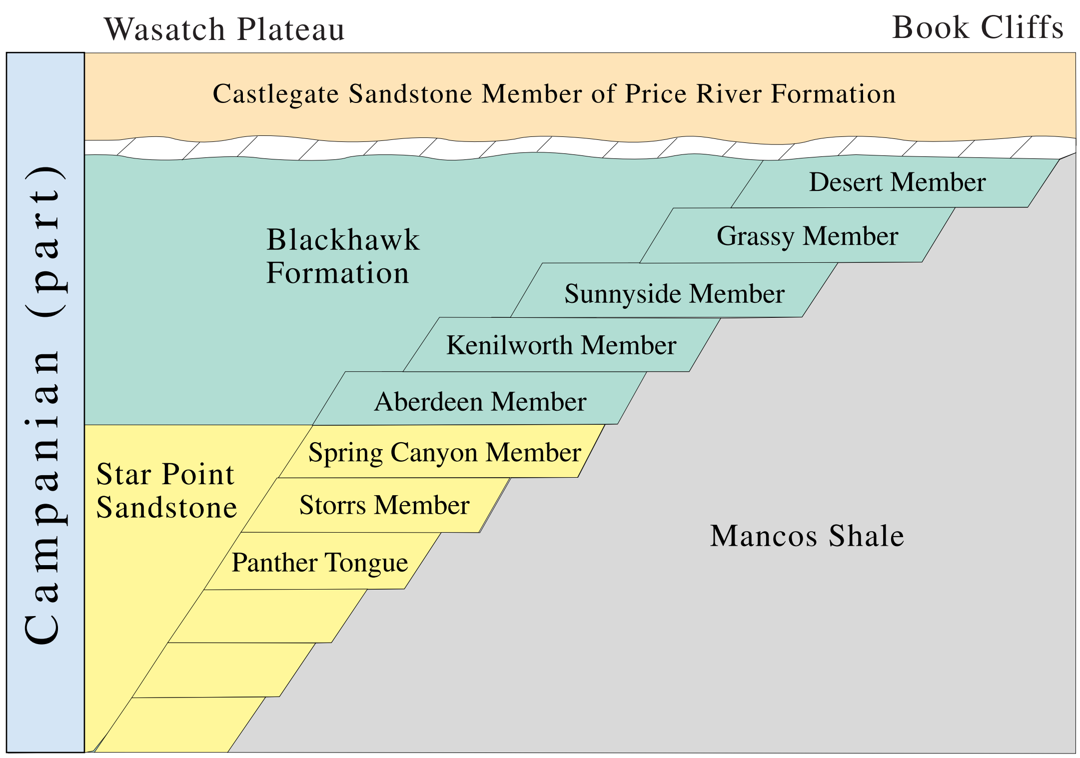
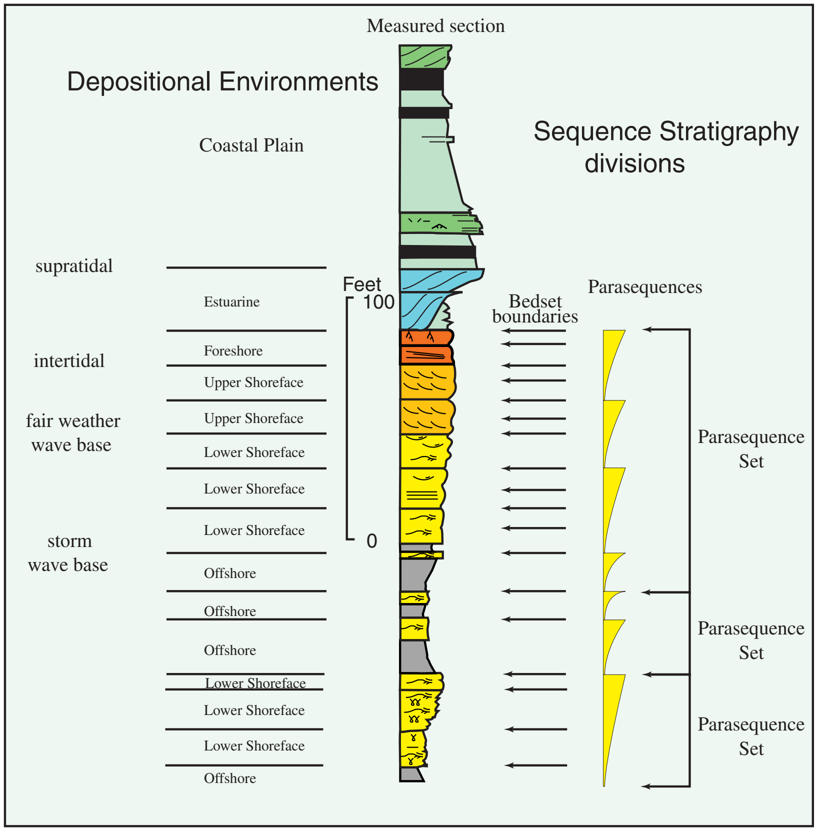


Figure 8*C*. Stratigraphy of the Star Point Sandstone and Blackhawk Formation.

Sedimentology

The Star Point Sandstone and Blackhawk Formation contain a variety of marine, marginal-marine, lagoonal, and continental rocks (fig. 9*A*). The Star Point Sandstone is composed of massive cliff-forming shoreface sandstones that generally coarsen upward. The Blackhawk contains coal, siltstone, shale, and sandstone. Coal beds occur depositionally landward of the updip pinch-outs of Star Point marine shoreface sandstones. The Star Point in the Wasatch Plateau and in the Southern Wasatch Plateau study area comprises at least three parasequence sets of shoreface and deltaic sandstones (fig. 9*A*).

Definitions

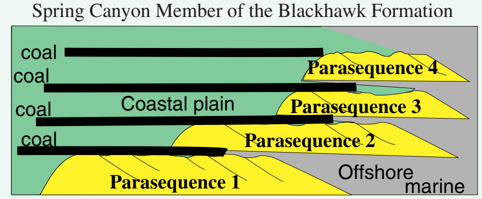


Bedset: Consists of two or more superposed beds characterized by the same composition, texture, and sedimentary structures. Bedsets are separated by a surface of erosion, nondeposition, or an abrupt change in character (from Van Wagoner and others, 1990).

Parasequence: A relatively conformable succession of genetically related beds or bedsets bounded by marine-flooding surfaces or their correlative surfaces. A flooding surface is a surface separating younger from older strata across which there is evidence of an abrupt increase in water depth (from Van Wagoner and others, 1990).

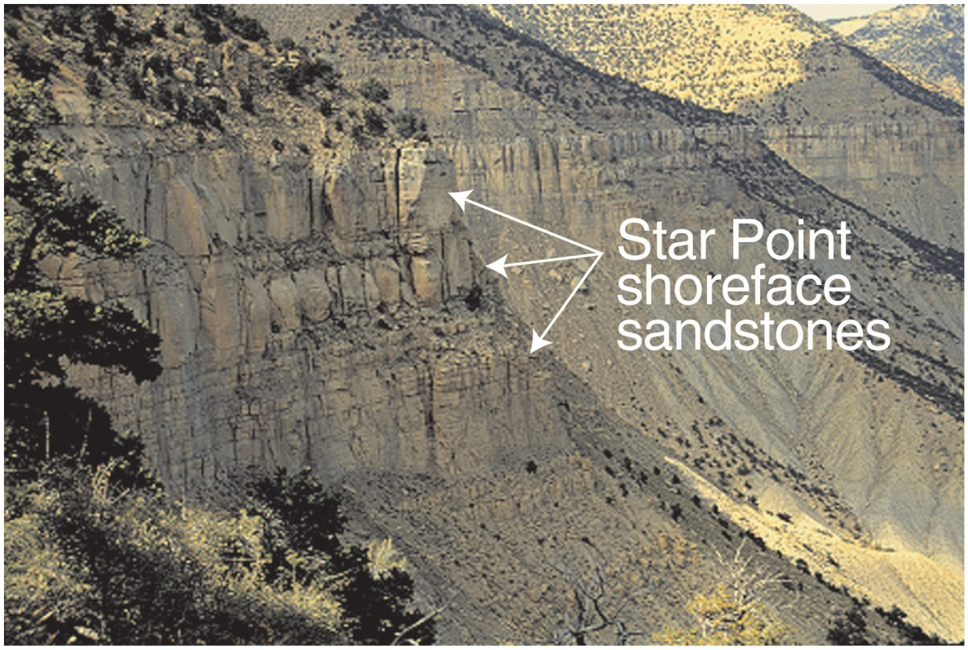
Parasequence set: A parasequence set is a succession of genetically related parasequences forming a distinctive stacking pattern bounded by major marine-flooding surfaces and their correlative surfaces. Stacking patterns of parasequences sets are progradational, retrogradational, or aggradational (from Van Wagoner and others, 1990).

Progradational Parasequences in the Spring Canyon Member of the Blackhawk Formation

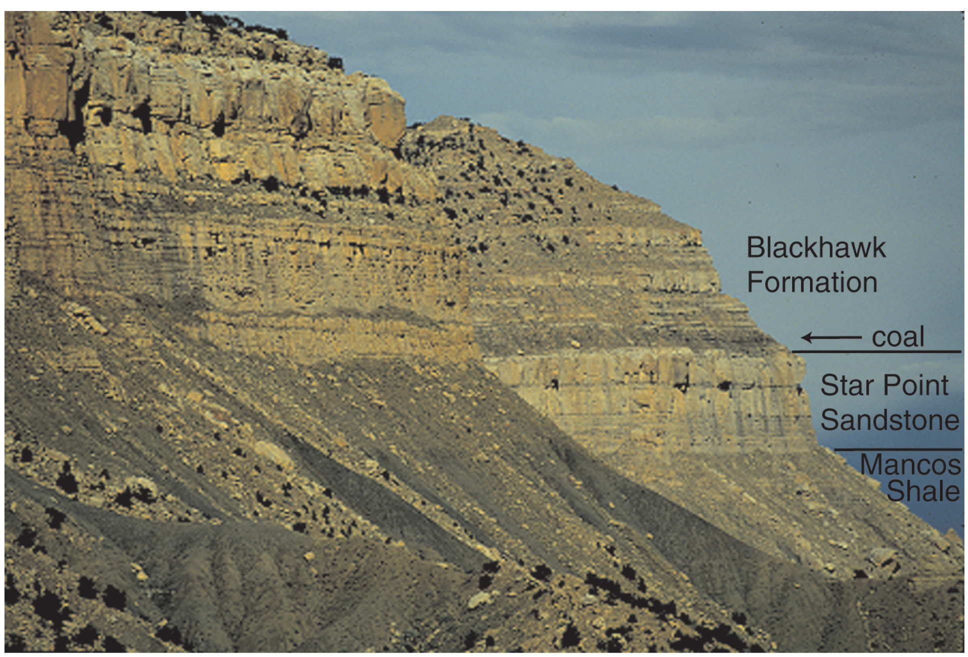


Kamola and Huntoon (1995) recognized that the Spring Canyon Member was composed of stacks of shoreface sandstones in which four progradational to aggradational shoreface parasequences form a parasequence set.

Figure 9*A*. Definitions for sedimentology and sequence stratigraphy.



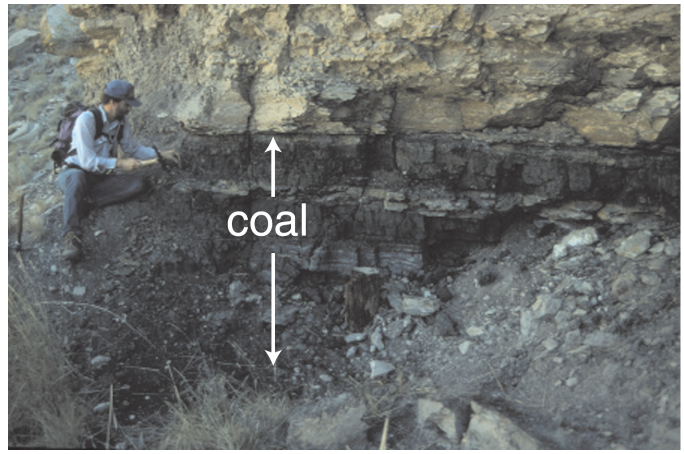
Photograph. Shoreface sandstones of the Star Point in Quitchipah Canyon.



Photograph. Outcrops in Convulsion Canyon showing occurrence of coal at the base of the Blackhawk Formation.

Lower Blackhawk Coal Zone

In the southern Wasatch Plateau, coal occurs primarily in and is produced exclusively from the Blackhawk Formation (fig. 8*B*). Spieker (1931) noted that all of the principal coal beds occur in the lower 250 to 350 ft of the Blackhawk Formation. In general, the lower Blackhawk Formation in the southern Wasatch Plateau contains from one to four, laterally extensive, thick coal beds in a stratigraphic interval that extends about 150 ft above the Star Point Sandstone. For the purposes of this study, the lower Blackhawk coal zone (fig. 9*B*) was defined as the lower part of the Blackhawk Formation that contains significant, thick, and laterally extensive coal beds that could be traced and correlated in well logs and on the outcrop. The coals that extend landward from the upper surfaces of the shoreface sandstones can be correlated in the subsurface based both on stratigraphic position above the Star Point Sandstone and on similarity of geophysical log response (fig. 9*B*). In this study, coals were color-coded for correlation and are referred to as the red coal, blue coal, etc.



Photograph. Coal in the Kenilworth Member of the Blackhawk Formation.

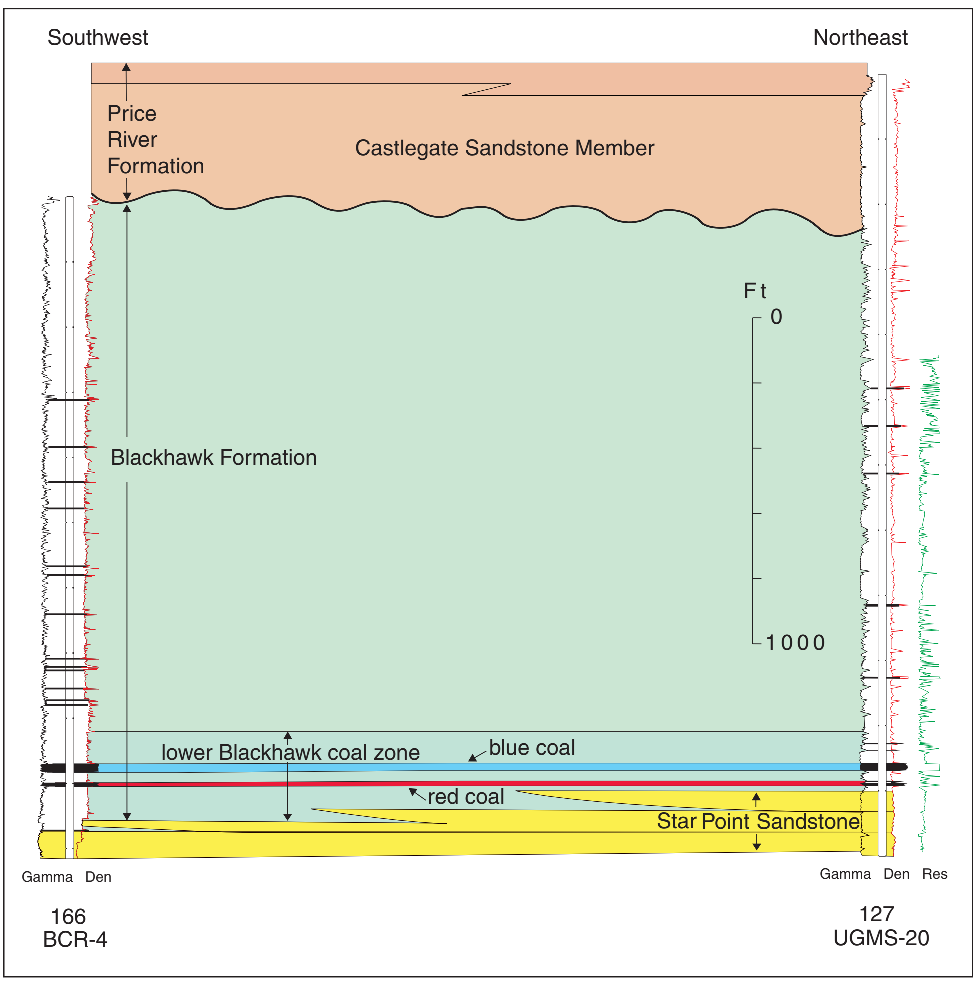
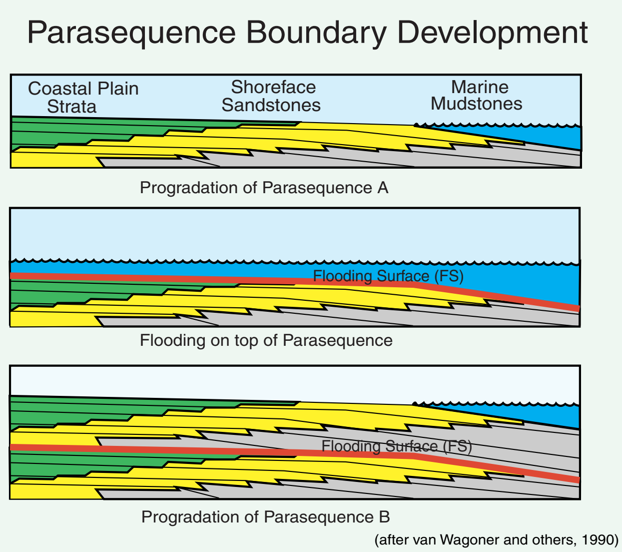


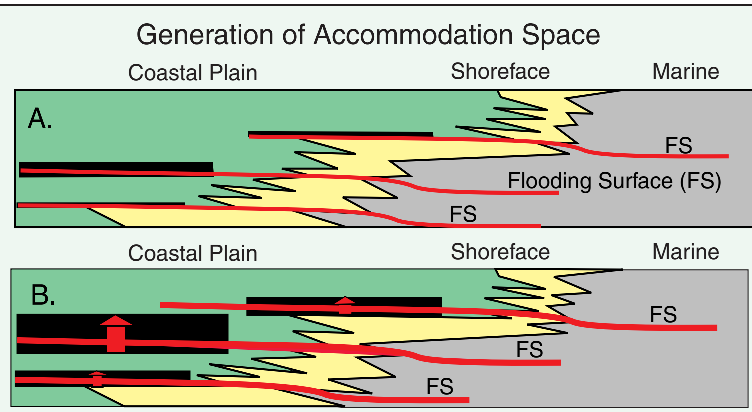
Figure 9*B*. Schematic diagram showing geophysical well logs, stratigraphic units and interfingering, and the lower Blackhawk coal zone.

Sequence Stratigraphy

Tongues of the Star Point shoreface sandstones interfinger eastward into the marine Mancos Shale, and they also interfinger and pinch out westward into nonmarine rocks of the Blackhawk (fig. 8*B*). Our current interpretation is that the westward interfingerings or pinch-outs represent the successive landward pinch-outs of shoreface parasequences (fig. 10*A*) that were deposited by marine flooding and subsequent basinward migration of the shoreline. Marine flooding surfaces that indicate an abrupt increase in water depth separate individual parasequences within the parasequence sets. The increase in water depth with flooding also served to elevate water tables in the nonmarine and continental settings, thereby providing the accommodation space for plant growth, peat development, and coal preservation. Each of these westward pinch-outs of shoreface sandstone parasequences (see photograph on next page) has associated coal that extends from on top of the shoreface sandstone landward into the nonmarine strata. In a seaward direction, the coals commonly thin and pinch out below the next stratigraphically higher shoreface sandstone (fig. 8*B*).

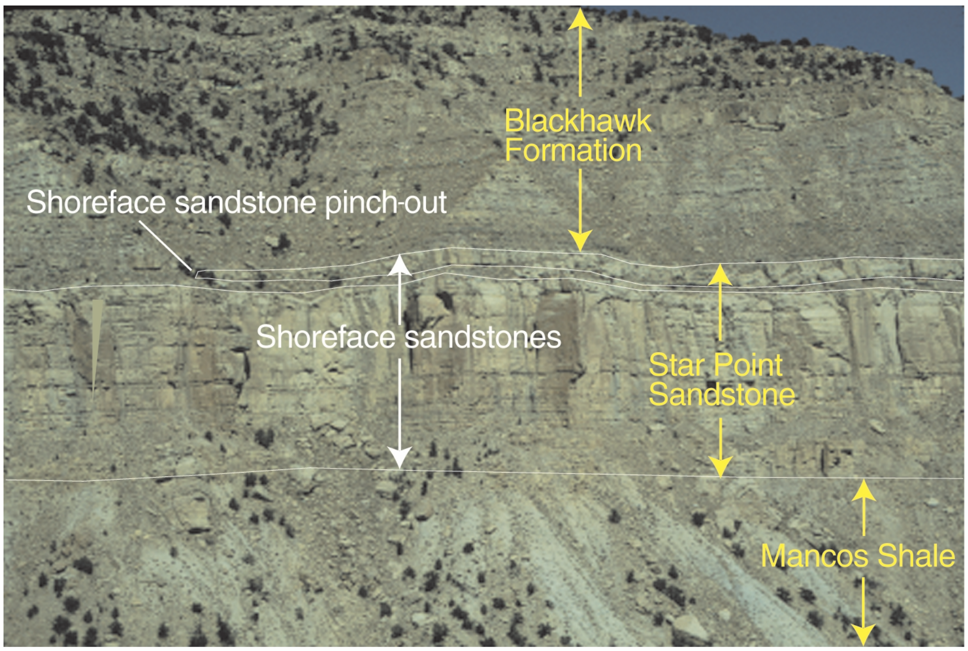


A parasequence boundary develops when rapid water-depth increase floods the top of parasequence A. Progradation of parasequence B occurs when the rate of deposition exceeds the rate of water-depth increase. These two parasequences are aggradational, and parasequences can also stack retrogradationally or progradationally depending on the ratio of the rate of water-depth increase to the rate of sediment supply.



The occurrence, distribution, and thickness of coals are related to shoreface parasequence and parasequence set stacking patterns. Thin coals are associated with strongly progradational stacking patterns, whereas thick coals are associated with the greater accommodation space generated by aggradationally stacked patterns. The thickest coals develop where successive peat deposits overlie each other as a result of parasequence set development.

Figure 10*A*. Models for development of parasequence boundaries and accommodation space.



Photograph. North wall of Convulsion Canyon showing the westward pinch-out of one of the Star Point shoreface sandstones.

Paleoshorelines

Recognizing the updip extent of the shoreface parasequence pinch-outs is important because coal beds that extend westward in a paleo-landward direction from the pinch-outs either directly overlie the shoreface sandstones or they overlie lagoonal rocks that are about 10 ft thick on top of the shoreface sandstones. To the northeast in the study area, stratigraphically higher shoreface sandstones successively pinch out to the southwest into nonmarine rocks of the Blackhawk (fig. 10*B*), as they do in the Book Cliffs (Young, 1955; Balsley and Horne, 1980; Kamola and Van Wagoner, 1995). These pinch-outs represent the successive paleoshorelines of the Star Point. The coals that extend landward from the upper surfaces of the shoreface sandstones can be correlated in the subsurface based on stratigraphic position above the Star Point Sandstone and based on similarity of geophysical log response. A crucial step in correlating individual coal beds is to recognize the geographical location and stratigraphic position of the sandstone parasequence pinch-outs in the well-log cross section.

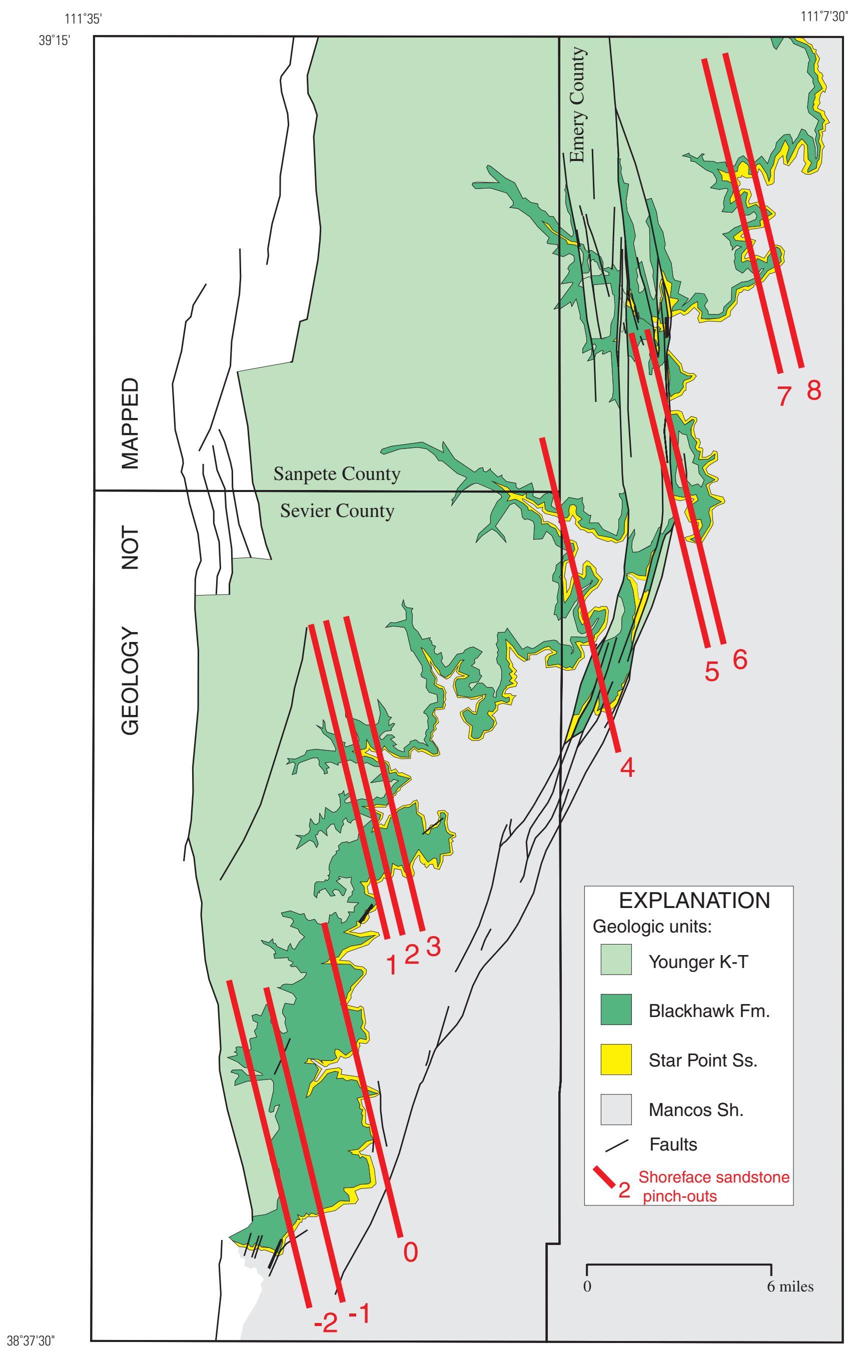


Figure 10*B*. Map of the study area showing location of the westward pinch-outs of the Star Point shoreface sandstones and number-labels showing their relative stratigraphic position: (0, stratigraphically lowest; 8, stratigraphically highest).

Calculating Coal Resources: Four Steps

Step 1—Structure Map

Coal resources in the Southern Wasatch Plateau study area were calculated using the methodology of Wood and others (1983). To assess the coal resources of the southern Wasatch Plateau, digital files were created for various geologic, geographic, physiographic, and cultural features.

For each outcrop and subsurface data point within the database, files were generated that contain the elevation of a datum used to calculate a structure contour map of a horizon on which to calculate the overburden thickness at each point. In the southern Wasatch Plateau, the top of the Star Point Sandstone (equivalent to the base of the coal-bearing Blackhawk Formation) was used because it is an easily identifiable stratigraphic unit recognizable in virtually all of the surface and subsurface data points in the database. The generated file also contains data on coal thickness and overburden thickness (thickness from the coal to the ground surface) at each data point.

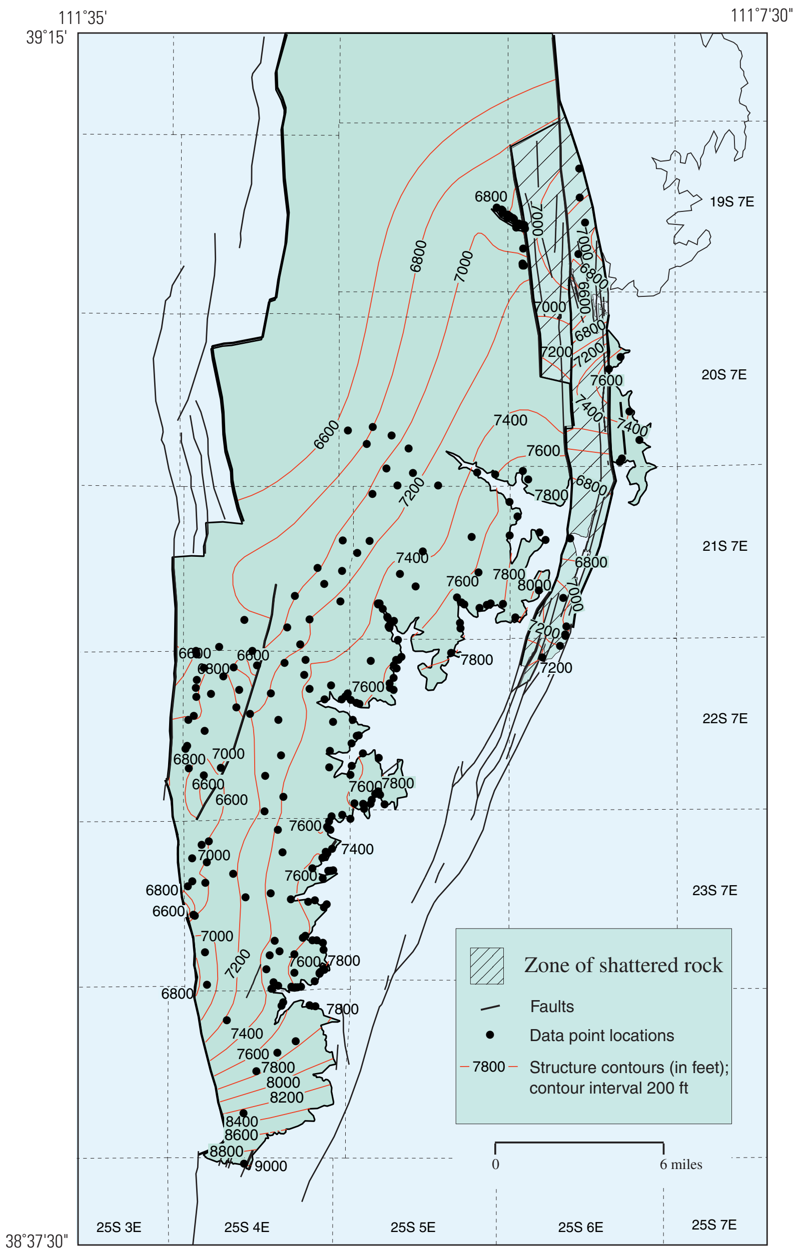


Figure 11. Structure contours on top of the Star Point Sandstone.

Step 2—Thickness Categories

Coal resources reported for the southern Wasatch Plateau represent all beds of coal within the lower Blackhawk coal zone that are greater than 1.2 ft thick and under less than about 5,500 ft of overburden (fig. 12). Coal that is deeper than 6,000 ft is not considered to be a resource according to Wood and others (1983), and, within the southern Wasatch Plateau study area, Blackhawk coal beds do not occur at depths greater than about 5,500 ft. Coal resources were determined by multiplying the volume of coal by the average density of coal. The volume of coal was the product of the net-coal thickness and the areal distribution of coal greater than 1.2 ft thick as shown on the net-coal isopach map.

The area in the Joes Valley graben system has been mapped as a zone of intensely shattered and broken rock (Spieker, 1931; Doelling, 1972a). Due to its highly broken nature, the shattered zone is denoted as a separate polygon, and coal resources in that polygon are calculated separate from the rest of the study area.

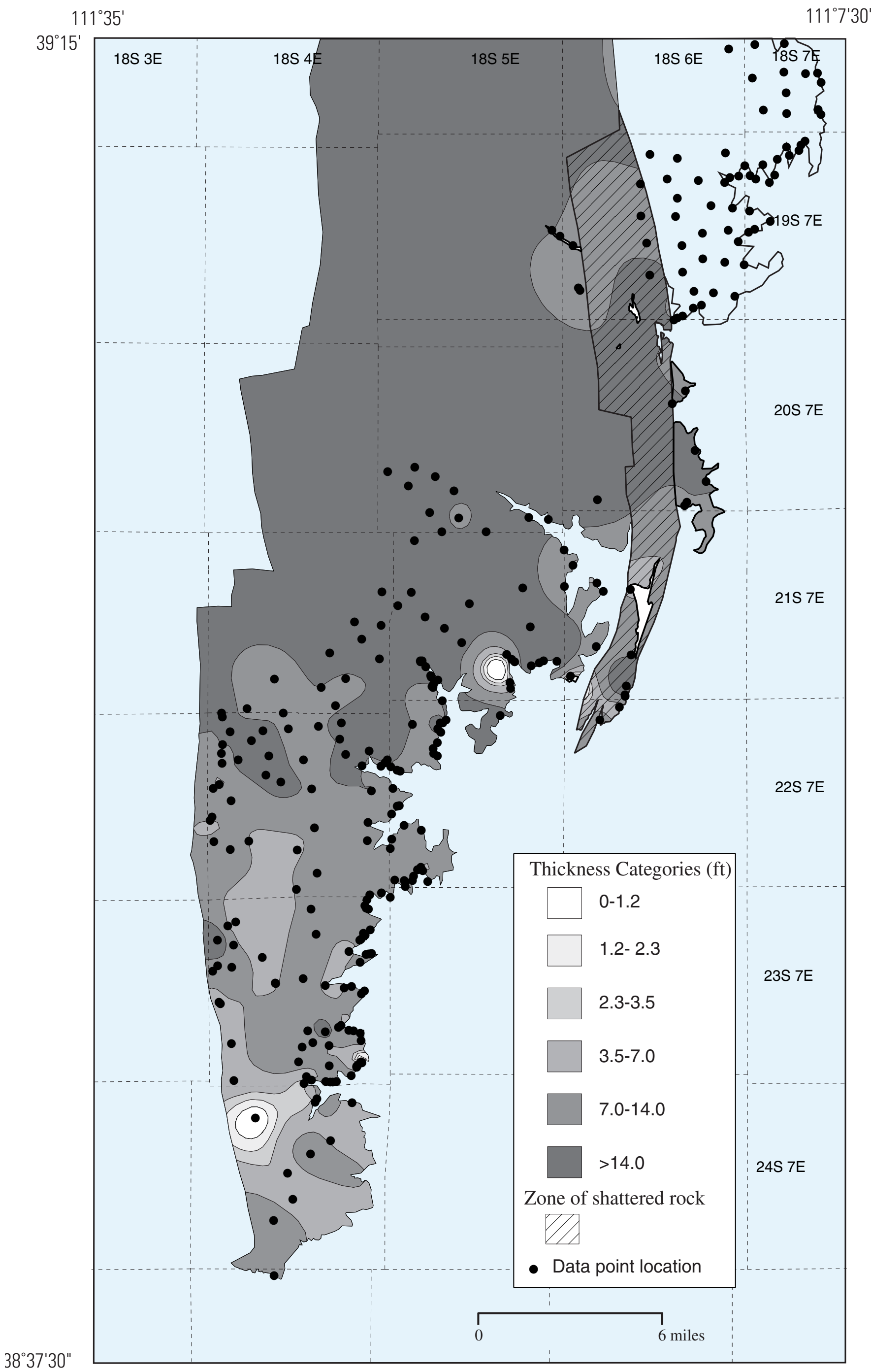


Figure 12. Map of net-coal thickness in the Blackhawk Formation according to thickness categories of Wood and others (1983). Note that isopachs show net coal and not individual bed thickness.

Photograph. Darrah Siding loadout in the northern part of the Wasatch Plateau.

Step 3—Overburden Categories

Coal resources are reported by coal overburden categories. Overburden categories represent a maximum overburden because the overburden thickness was calculated from the Earth's surface to the top of the Star Point Sandstone (which is equivalent to the base of the lower Blackhawk coal zone). The top of the Star Point Sandstone was used because (1) this horizon is easily identified in both measured sections and geophysical logs and (2) it is a relatively uniformly dipping surface (except for the small area of parasequence pinch-outs) upon which to make the structure contour map. Overburden thickness (fig. 13) was calculated by computer-gridding the elevation data for the top of the Star Point Sandstone in both measured sections and in drill holes and then subtracting that grid from the surface elevation grid imported from 1:24,000 digital elevation models for each of the 7.5′ quadrangles in the study area. Maximum overburden lines are shown on resultant maps at intervals of 500, 1,000, 2,000, and 3,000 ft.

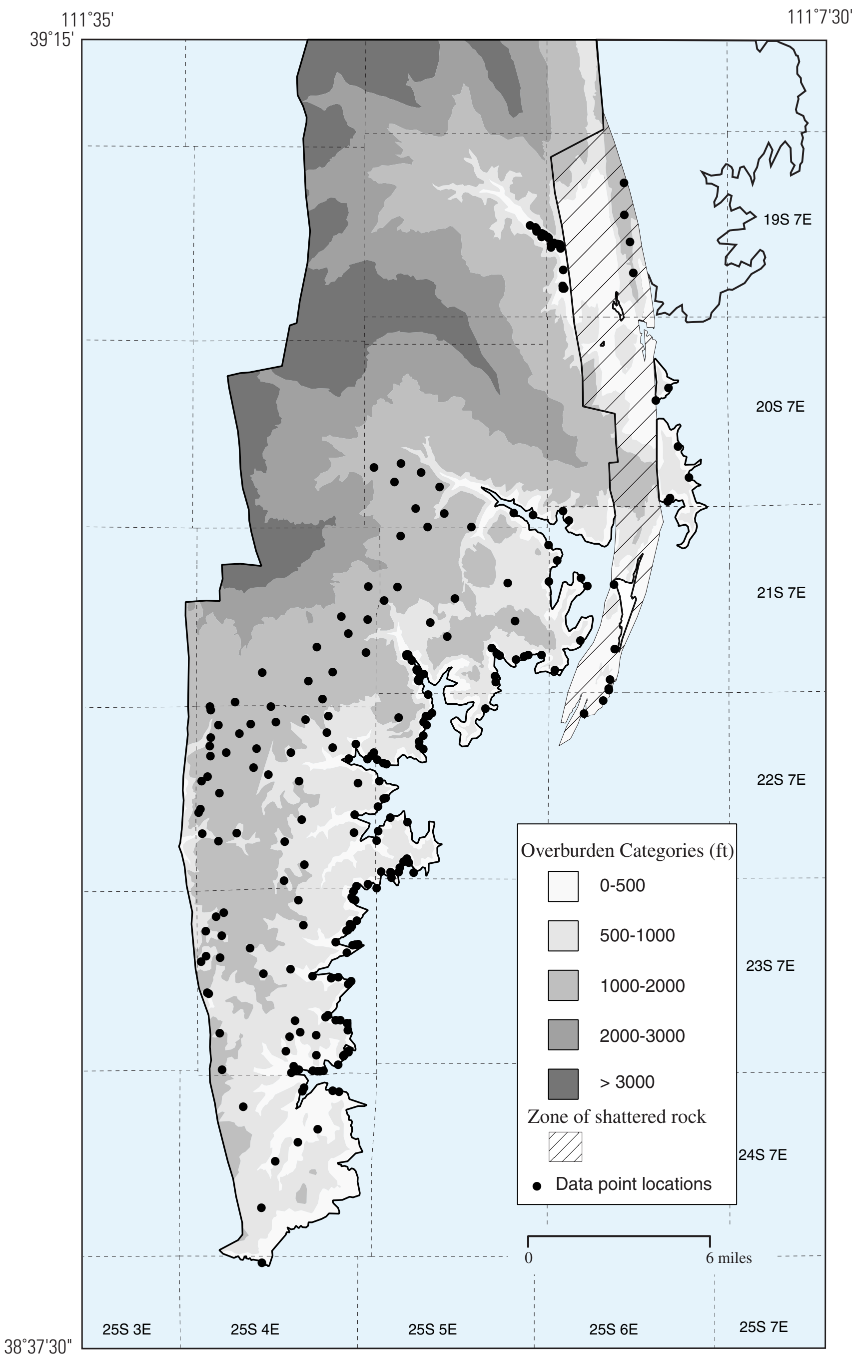


Figure 13. Map showing overburden thickness above coals in the Blackhawk Formation.

Step 4—Reliability Categories

Reliability categories (fig. 14) are based on the distance that a given coal resource occurs from a data point of measured coal thickness. Identified resources are located within a 3-mile radius of a data point, and hypothetical resources are located beyond a 3-mile radius from a data point (Wood and others, 1983). The majority of the southern Wasatch Plateau is considered to contain identified resources. In the northwestern part of the study area, where there is both a lack of data from measured sections due to no outcrops and a lack of drill hole data, the resources are primarily hypothetical. The area just west of the zone of shattered rocks that lies in the northeastern part of the study area contains little subsurface data, but the resources calculated there are considered to be in the identified category because the data that was used from measured stratigraphic sections and from drill holes east of the zone of shattered rock were within a 3-mile radius, even though they are located in the Northern Wasatch Plateau study area east of the shattered zone.

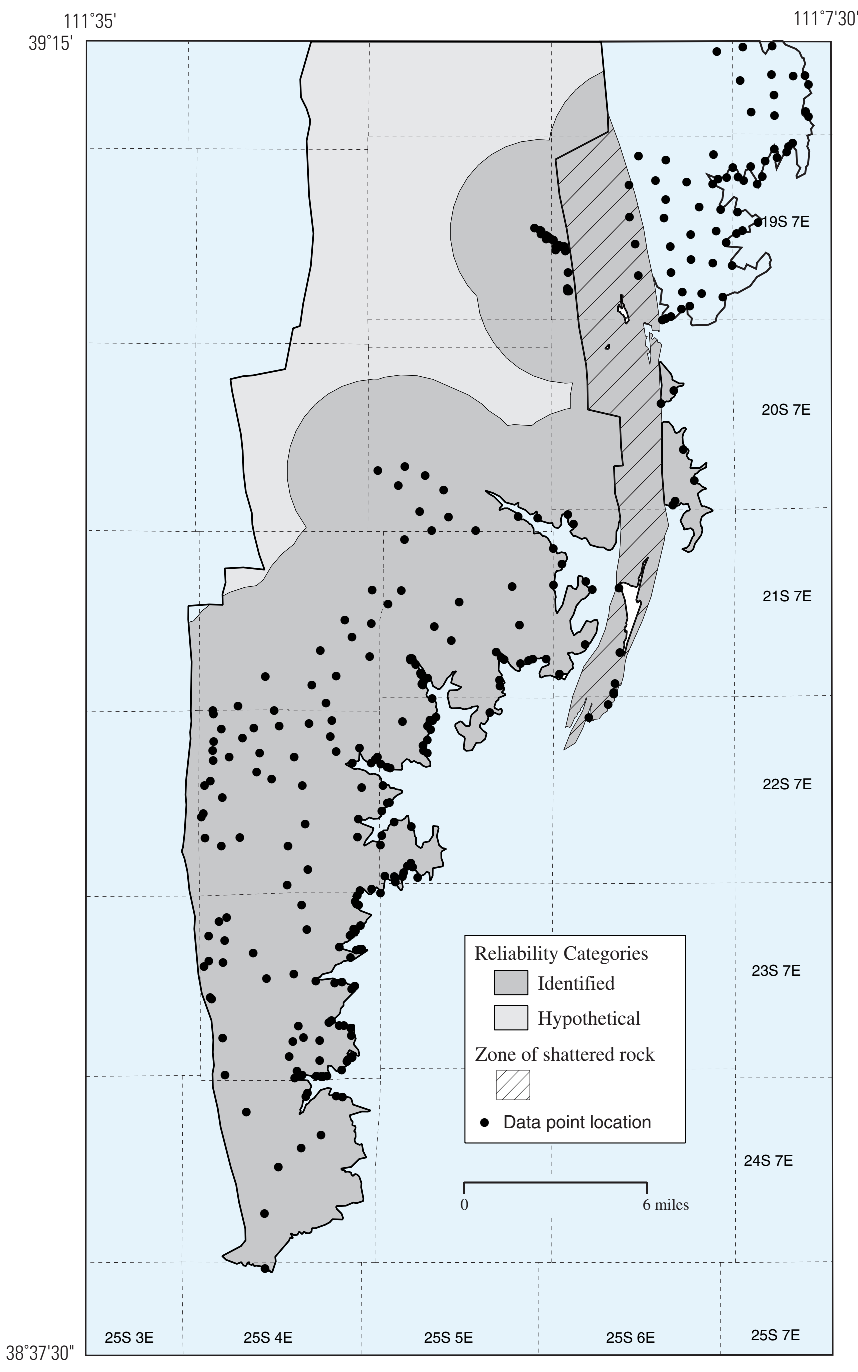


Figure 14. Coal reliability categories in the southern Wasatch Plateau.

Coal Resources in the Southern Wasatch Plateau

The coal quantities reported for this study are entirely "resources" and represent, as accurately as possible, all of the coal in beds greater than 1.2 feet thick within the lower Blackhawk coal zone. The resources are subdivided into categories of total coal thickness and of overburden categories (depth to the coal in the subsurface).

Within the southern Wasatch Plateau, original in-place resources for the overburden category 0 to 500 ft and the net-coal thickness category of 7 to 14 ft are 160 million short tons of coal; for the overburden category 0 to 500 ft and the net-coal thickness category of greater than 14 ft there are 140 million short tons of coal. For the overburden category 500 to 1,000 ft and net-coal thickness category 7 to 14 ft there are 420 million short tons of coal; for that overburden category and net-coal thickness category of greater than 14 ft there are 460 million short tons of coal. For overburden category 1,000 to 2,000 ft and net-coal thickness category 7 to 14 ft there are 310 million short tons of coal; for that overburden category and net-coal thickness category greater than 14 ft there are 2,100 million short tons of coal. For the overburden category 2,000 to 3,000 ft and net-coal thickness category 7 to 14 ft there are 1.4 million short tons of coal; and for that overburden category and net-coal thickness category greater than 14 ft there are 1,800 million short tons of coal. For the overburden category greater than 3,000 ft there are 1,200 million short tons of coal in the net-coal thickness category greater than 14 ft. Additional coal resources are in the thickness categories 1.2 to 2.3 ft, 2.3 to 3.5 ft, and 3.5 to 7 ft throughout the study area. The southern Wasatch Plateau contains an original in-place resource of 6.8 billion short tons of coal. This total resource figure does not reflect geologic, technologic, land-use, and environmental restrictions that may affect the availability and recoverability of the coal.

Photograph. Soldier Creek mine in the northern Wasatch Plateau.

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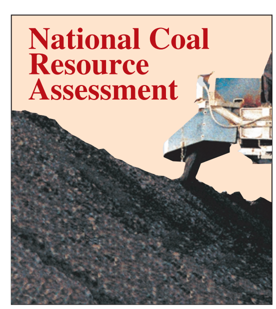

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