INTRODUCTION

This report is one of a series of reports whose main purpose is to show the stratigraphic framework and coal zone correlations for the Blackhawk Formation in the Wasatch Plateau coal field, which approximates the area of the Wasatch Plateau itself. Figure 1 shows the study area of this report as well as that of the other reports in this series. This study, as well as the other studies in this series, was part of the U.S. Geological Survey's coal folio mapping program of 30′×60′ quadrangles. From these 30′×60′ quadrangles, selected areas were mapped at a scale of 1:24,000 and reports were prepared detailing the stratigraphy and coal occurrences. The area investigated is adjacent to the western edge of the Book Cliffs and on the northern part of the Wasatch Plateau (fig. 2). The Wasatch Plateau has been uplifted and eroded and is now marked by steep, highly dissected escarpments with some heavily vegetated areas.

GENERALIZED GEOLOGY

In the study area the Upper Cretaceous Star Point Sandstone and Blackhawk Formation dip 2°–6° W. into the subsurface. The Star Point comprises three prominent sandstone beds, in ascending order: Panther, Storrs, and Spring Canyon Tongues. The overlying Blackhawk includes the Aberdeen Sandstone Member. Westward these sandstone beds wedge out in the subsurface; eastward they merge with each other and then pinch out into the Mancos Shale. The Star Point underlies and intertongues with the continental coal-bearing Blackhawk. The Blackhawk consists of sandstone, siltstone, shale, coal, carbonaceous shale, and limestone.

DEPOSITIONAL ENVIRONMENT AND INTERTONGUING

The depositional environment of the Star Point Sandstone and Blackhawk Formation in the Wasatch Plateau was a northwest-trending barrier island–delta plain adjacent to the epeiric Late Cretaceous seaway. Each eastward progradation of the shoreline and adjacent environments resulted in sedimentation characteristic of barrier island and delta plain facies.

A series of delta front–barrier island deposits have been mapped south of the study area of this report in the Convulsion Canyon, Muddy Canyon, and Rock Canyon areas of the Wasatch Plateau. Several of these deposits have been interpreted by Flores and others (1984), Marley and others (1979), and Muldoon (1980) to be accretion ridges (barrier islands and recurved spits). These authors postulated that many contemporaneous short-headed delta-front point sources discharged sediment into the Late Cretaceous seaway, which was then reworked into these accretion ridges in the direction of longshore drift. These accretion ridges are represented as tongues of the Star Point Sandstone and "consist of 15- to 30-m-thick, fine- to medium-grained sandstone underlain by distal bar–prodelta deposits of interbedded silty shale, siltstone, and silty sandstone" (Flores and others, 1984, p. 542).

North and east of the study area, in the Book Cliffs area, Balsley (1980) described a wave-dominated delta system. This system is represented by fluvial coastal plain, deltaic, and barrier island facies. The Aberdeen Sandstone Member of the Blackhawk Formation and the Spring Canyon Tongue of the Star Point Sandstone were described by him as being "composed of a seaward-imbricated series of shoreface deposits that have the general geometric form of a sheet sandstone. * * * Blackhawk sandstone bodies reflecting a single uninterrupted regressive episode and containing fluvial channel and river mouth bar facies are similar to the deposits of modern and ancient wave-dominated delta systems. * * * On the basis of the similarities between the major features of the Blackhawk regressive sandstone and the deposits of wave-dominated deltas, the Blackhawk units are interpreted to be deltaic in origin" (Balsley, 1980, p. 9–13). Although he recognized barrier island environments and other related facies, he contended that the major deposit in the Book Cliffs area was a wave-dominated delta system.

The intertonguing in the central and southern parts of the Wasatch Plateau has aided in the interpretation of paleoshorelines and their associated environments of deposition. The sedimentary rocks that constitute the coal-bearing Blackhawk Formation were deposited in a barrier island–delta plain setting that trended northwest to southeast along the epeiric Cretaceous seaway. Regressive deposits accumulated as the shoreline and adjacent environments prograded to the east. Newly delineated intertonguing north of this study area has been identified by Blanchard (1981). His detailed cross sections demonstrated that the Aberdeen Sandstone Member of the Blackhawk Formation is a genetically related facies (tongue) of the Star Point Sandstone. The Aberdeen Sandstone Member pinches out to a feather edge in the Jump Creek–Beaver Creek areas and merges with the Spring Canyon Tongue of the Star Point Sandstone to the east.

Spieker (1931) and Clark (1928) assumed that the Aberdeen Member was a persistent stratigraphic horizon throughout the study area. Consequently, the Aberdeen was mapped as a continuous horizontal sandstone datum on which correlations of coal beds were made. These authors' assumption contributed to the miscorrelation of coal beds west of the intertongue zone.

Probably the greatest difference between the intertonguing in the northern part of the Wasatch Plateau–Book Cliffs area and that in the central and southern parts of the Wasatch Plateau is the lateral and vertical extent of the regressively deposited sandstone tongues. The tongues in the central and southern parts of the Wasatch Plateau represent barrier island–deltaic facies, are thin (30 ft thick), and pinch out within several miles. Yet the Aberdeen Member in the northern part of the Wasatch Plateau probably reflects a general westward transgression for 5–25 mi and then subsequent progradation seaward, with these sandstones being deposited during the regressive phase. This type of deposition could possibly reflect a change in the depositional environment from prograding short-headed stream deltas and barrier islands to a large wave-dominated deltaic facies in the study area. These large deltaic lobes of sediment (sand, shale, coal, and so on) were deposited and then abandoned. After abandonment came subsidence and transgression of the seaway. Deposition of the large sheets of sandstone such as the Aberdeen represent a regressively deposited sand reworked after delta lobe abandonment and subsequent progradation of the shoreline.

Flores and others (1984) also pointed out the difference in the depositional environments of the Blackhawk Formation in the Book Cliffs and Wasatch Plateau areas. They concluded that the Blackhawk Formation in the Book Cliffs probably represents a wave-dominated deltaic system, whereas the Blackhawk in the central and southern parts of the Wasatch Plateau represents a delta plain–barrier island deposit (fig. 3).

The model presented in figure 3 attempts to diagrammatically depict and integrate the work of Balsley (1980), Flores and others (1984), Marley and others (1979), and Muldoon (1980). Note that the model depicts deposition of the Blackhawk Formation and Star Point Sandstone during two different chronologic periods.

COAL ZONES

There are five coal zones in the Blackhawk Formation in the study area. From bottom to top they are the Flat Canyon, lower O'Connor, Cottonwood, Castlegate A, and Bob Wright coal zones. Figure 4 diagrammatically depicts the coal zones and their relationship to locally named coal beds. The Panther, Storrs, and Spring Canyon Tongues of the Star Point Sandstone and the Aberdeen Sandstone Member of the Blackhawk Formation are also illustrated in figure 4 to depict the lateral and vertical relationships between the various tongues and the coal zones in the study area.

The Flat Canyon coal zone of Blanchard (1981) occurs sporadically throughout the study area. The Flat Canyon either rests conformably on the Panther Tongue of the Star Point Sandstone or is a short distance stratigraphically above it.

The lower O'Connor coal zone of Blanchard (1981) is possibly equivalent to the Columbine coal bed of Blanchard (1981) (fig. 4). The lower O'Connor is a fairly persistent coal zone, but it is not present in the Beaver Creek area because of intertonguing. This coal zone either rests conformably on the Storrs Tongue of the Star Point Sandstone or is a short distance stratigraphically above it. The coal beds in the zone range in thickness from 1 ft 5 in. in drill hole USGS–5, sec. 9, T. 13 S., R. 7 E. to a cumulative thickness of 16 ft 2 in. in drill hole VC–6, sec. 25, T. 13 S., R. 6 E. The lower O'Connor is currently being mined west of Beaver Creek and in the Scofield area.

The Cottonwood coal zone of Brown and others (1986) is stratigraphically equivalent to the Castlegate A, Hiawatha, and Spring Canyon coal beds (Spieker, 1931) in the Scofield area, and to the upper O'Connor, Spring Canyon, and Hiawatha (Spieker, 1931) in the Jump Creek area. The Cottonwood is laterally continuous throughout the study area. In the Scofield area the coal zone is 120–180 ft above the Storrs Tongue of the Star Point Sandstone. In the Jump Creek and Beaver Creek areas the coal zone either rests conformably on the Spring Canyon Tongue of the Star Point Sandstone or is a short distance stratigraphically above it. The coal beds range in thickness from 2 ft in measured section JC–7, sec. 17, T. 13 S., R. 8 E. to as much as 17 ft in drill hole VC–3, sec. 25, T. 13 S., R. 6 E. The Valley Camp Coal Company and the Southern Utah Fuels Company are currently mining the Cottonwood in the study area.

The Castlegate A coal zone (Spieker, 1931) is stratigraphically equivalent to the Wattis and Hiawatha (Spieker, 1931) coal beds in the Scofield area (fig. 4). The coal zone, which includes the Castlegate A, is laterally continuous throughout the study area. In the Scofield area the coal zone rests 60–120 ft above the top of the Spring Canyon Tongue. In the Jump Creek and Beaver Creek areas the coal zone either rests conformably on the Aberdeen (Spieker, 1931) or is a short distance stratigraphically above it. The coal beds in the zone range in thickness from 16 in. in measured section S63, sec. 16, T. 13 S., R. 8 E. to as much as 9 ft in measured section JC–8, sec. 17, T. 13 S., R. 8 E. The Castlegate A coal zone is currently being mined by the Valley Camp Coal Comapny and the Southern Utah Fuels Company in the study area and warrants further exploration.

The Bob Wright coal group of Spieker (1931), or Bob Wright coal zone, is only present in the Pleasant Valley area and is approximately 330–350 ft above the Spring Canyon Tongue of the Star Point Sandstone. The coal beds in the group range in thickness from 2 ft 6 in. in measured section S101, sec. 35, T. 13 S., R. 7 E. to as much as 11 ft 6 in. in measured section S100, sec. 35, T. 13 S., R. 7 E.

COAL QUALITY

Table 1 shows analyses of 48 coal samples (Doelling, 1972) from two different coal zones in the Clear Creek mines. The rank of the coal samples is high-volatile B bituminous.

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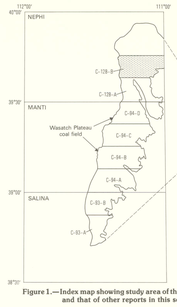

Figure 1.—Index map showing study area of the report (shaded) and that of other reports in this series.

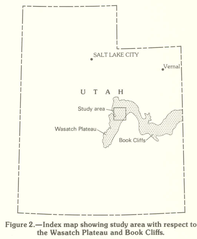

Figure 2.—Index map showing study area with respect to the Wasatch Plateau and Book Cliffs.

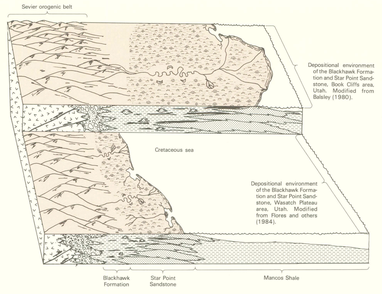

Figure 3.—Paleodepositional environment of the Upper Cretaceous Blackhawk Formation and Star Point Sandstone, Wasatch Plateau, Utah.

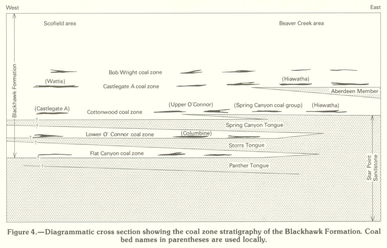

Figure 4.—Diagrammatic cross section showing the coal zone stratigraphy of the Blackhawk Formation. Coal bed names in parentheses are used locally.

TABLE 1.—*Analyses of 48 as-received coal samples, Jump Creek 7 1/2-minute quadrangle*

[Values in percent, except heating values in BTU/lb]

Analysis	Number of analyses	Average	Range
Cottonwood coal zone (Hiawatha bed)			
Moisture	40	7.2	3.2–12.6
Volatile matter	35	41.3	37.3–44.4
Fixed carbon	35	44.6	39.7–49.1
Ash	38	6.5	2.9–11.5
Sulfur	28	0.56	0.4–0.87
Heating value	38	12,114	10,550–13,078
Castlegate A coal zone			
Moisture	7	5.4	4.1–6.1
Volatile matter	5	43.7	42.2–44.2
Fixed carbon	5	44.9	43.9–45.9
Ash	7	5.9	4.7–7.0
Sulfur	7	0.45	0.39–0.60
Heating value	5	12,686	12,330–12,840

STRATIGRAPHIC FRAMEWORK, COAL ZONE CORRELATIONS, AND DEPOSITIONAL ENVIRONMENT OF THE UPPER CRETACEOUS BLACKHAWK FORMATION AND STAR POINT SANDSTONE IN THE SCOFIELD AND BEAVER CREEK AREAS, NEPHI 30′×60′ QUADRANGLE, WASATCH PLATEAU COAL FIELD, CARBON COUNTY, UTAH

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1990

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