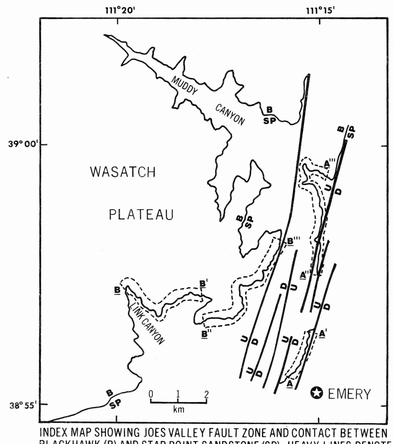
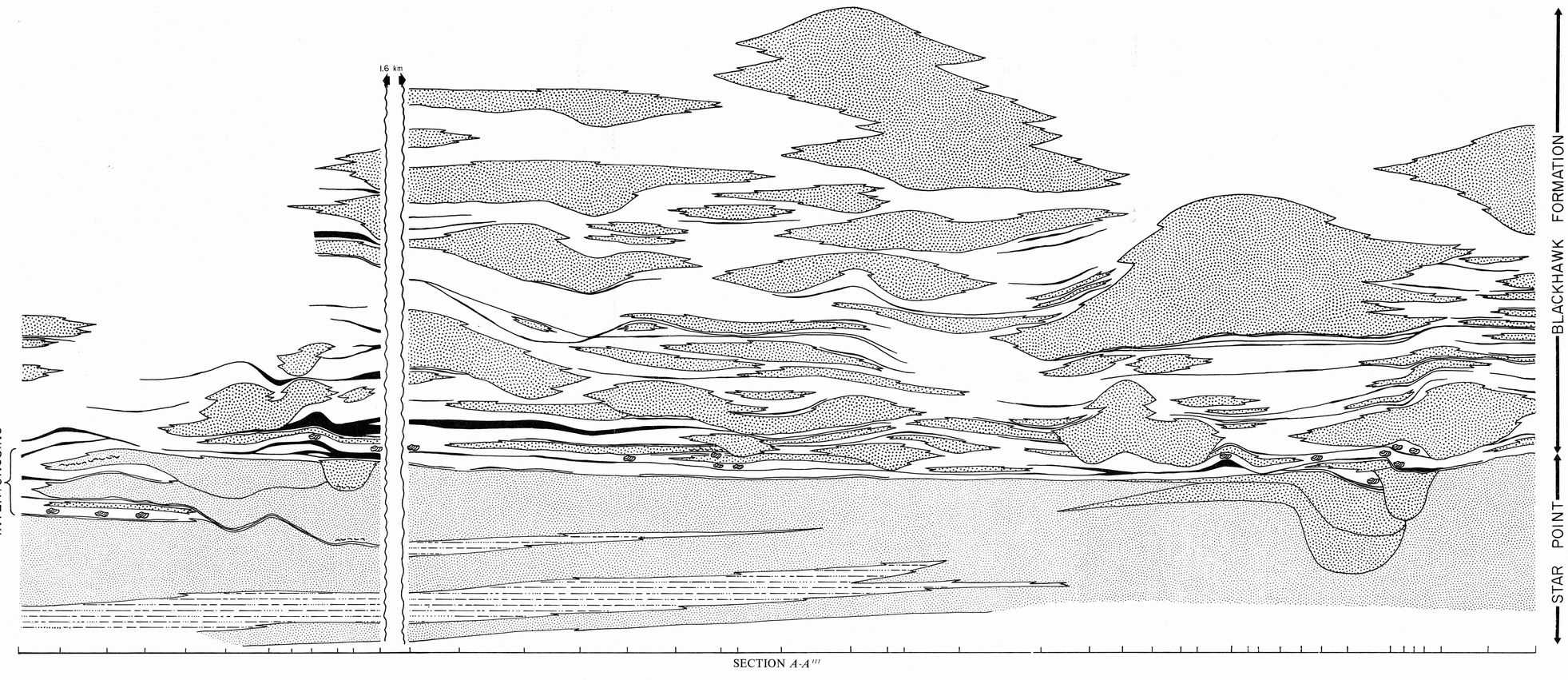
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

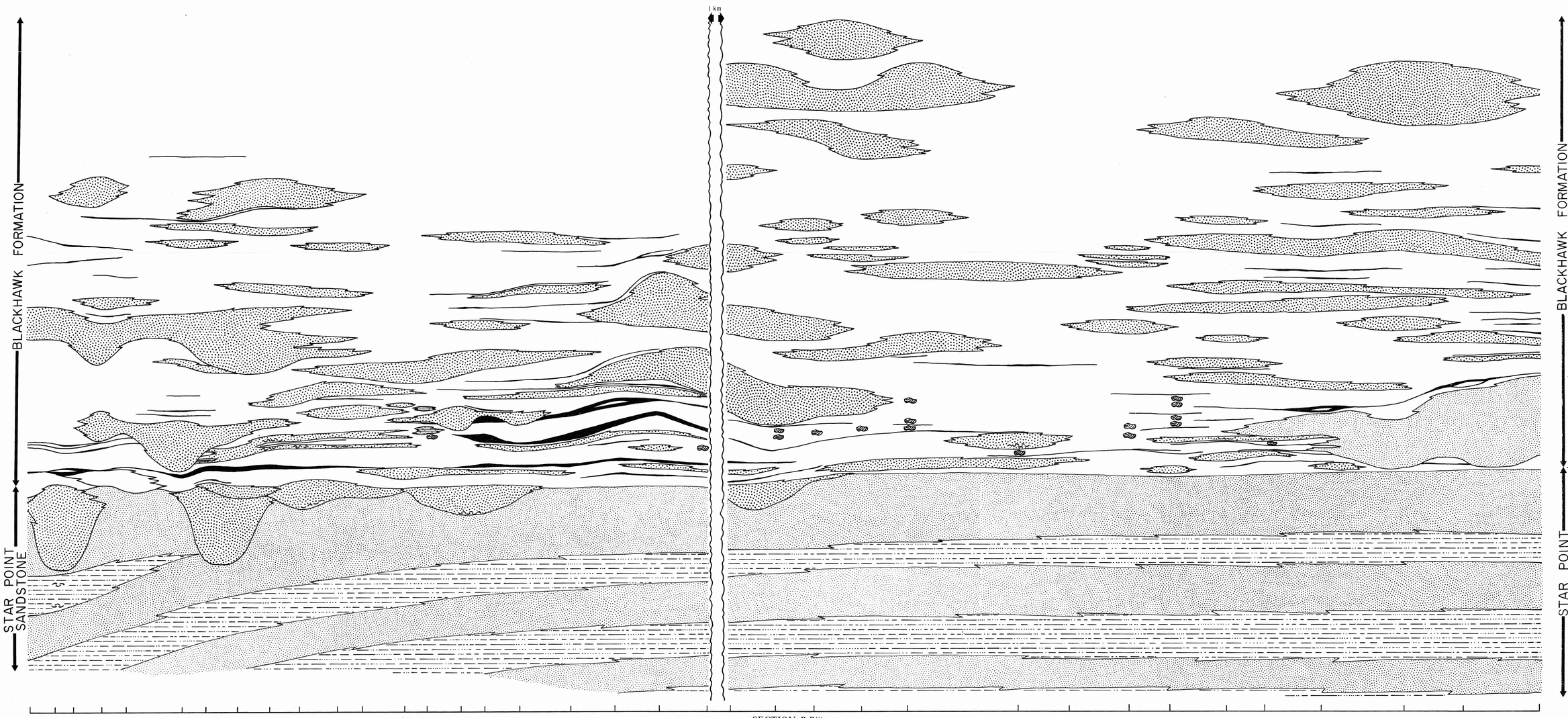
MISCELLANEOUS FIELD STUDIES
MAP MF-1068



INDEX MAP SHOWING JOES VALLEY FAULT ZONE AND CONTACT BETWEEN BLACKHAWK (B) AND STAR POINT SANDSTONE (SP). HEAVY LINES DENOTE FAULTS; U, UPTHROWN; D, DOWNTHROWN. AREAS OUTLINED BY DASHED LINES (A-A', A''-A''', B-B', B''-B''') ARE LOCALITIES OF MEASURED SECTIONS.



SECTION *A-A'''*



SECTION *B-B'''*

EXPLANATION

SANDSTONES

COAL

SILTSTONE, SHALE, AND CARBONACEOUS SHALE

SILTY SANDSTONE, SILTSTONE, AND SHALE

LIMESTONE

BRACKISH-WATER BIVALVES

TICK MARKS INDICATE WHERE STRATIGRAPHIC SECTIONS WERE MEASURED

10M
0
200M
SCALE

INTRODUCTION

The Upper Cretaceous Blackhawk Formation represents the major coal-bearing unit and contains coal beds that are being mined in the southern Wasatch Plateau, Utah. Assessment of the coal resource potential of the Blackhawk Formation hinges in part on the thickness and lateral continuity of the coal beds. Thus, in support of the coal resource assessment program (Blanchard and others, 1977), detailed stratigraphic work was performed on the Blackhawk Formation and underlying Star Point Sandstone west of Emery, Utah.

The regional stratigraphic framework of the Blackhawk Formation and Star Point Sandstone was established by Spieker and Reeside (1925), and Spieker (1931). In addition, the coals in the Blackhawk Formation were named, described, and traced for many kilometers by Spieker (1931). Some of the coal beds in the formation were subsequently renamed and redescribed by Doelling (1972). Coal correlation in the Blackhawk Formation particularly for the lowermost coal zone, 0 to 5 m above the Star Point Sandstone, is critical in that this coal zone contains the most actively mined coal bed in the Wasatch Plateau coal field. Furthermore, an understanding of the lateral variation and distribution of the lowermost coal zone and associated coal beds may contribute to site-specific exploration and development of coal reserves.

METHODS

The basic data for this study are 125 stratigraphic sections published as U.S. Geological Survey Open-File Report 77-833 (Marley and Flores, 1977). Description of rock types primarily included grain size, mineral composition, color, sedimentary structures, bed thickness, nature of contact, trace fossil, and macrofossil content. Each measured section contained key units that are traceable to adjoining sections. Lateral spacing of sections was determined by the degree of exposure and continuity of beds. Preliminary investigations showed that beds were laterally continuous from 100 to 2000 m. Thus, the spacing of sections was established at 50 to 500 m depending on availability of exposures. All stratigraphic sections were assembled into a net of stratigraphic cross sections. Two cross sections which show representative stratigraphic relationship and facies variation of the Blackhawk Formation and Star Point Sandstone are shown in sections A-A''' and B-B'''. Section A-A''' represents a north-south cross section along the downdropped fault block from the mouth of the Muddy Canyon to immediately west of Emery, Utah. Section B-B''' represents a cross section along the plateau escarpment southeast of Muddy Canyon to Link Canyon.

LITHOLOGIC CHARACTERISTICS

In a broad sense, the Blackhawk Formation is composed of limestone, shale, siltstone, carbonaceous shale, coal, and sandstone; the sandstone being the most dominant rock type. The limestone represents the least common rock type in the lower part of the Blackhawk Formation (section B-B''') and ranges from 0.5 to 2.5 m thick. The shale and siltstone occur in interbedded units a few cm to 8.5 m thick and are most common in the lower part of the interval. The carbonaceous shale ranges from a few cm to 1.5 m thick and occurs either as interbeds of coal beds or as a bed that laterally grades into a coal bed. The carnaceous shale is very common in the upper part of the Blackhawk Formation. The coal, which represents the most economically important unit in the Blackhawk Formation, ranges from a few cm to 4.3 m thick. The coal beds are thicker in the lowermost part of the Blackhawk Formation. The sandstones, which vary from very fine to coarse grained, occur in units that are a few cm to 40 m thick. The thick, coarse-grained sandstone beds are well developed in the upper part of the formation in contrast to the thin, fine-grained sandstone beds, which are mainly formed in the lower part of the interval.

The Star Point Sandstone, as the name implies, is composed mainly of sandstone interbedded with shale and siltstone. The Star Point Sandstone is a coarsening-upward sequence. The sandstone beds range from a few cm to 15.5 m thick and vary from very fine to medium grained. The shale and siltstone occur in interbedded units that range from 15 to 18 m thick, and usually separate the sandstone beds. The shale-siltstone interbeds are commonly formed in the lower part of the formation. Some carbonaceous shale and coal beds, a few cm thick, are developed locally below the uppermost sandstone bed. The uppermost Star Point Sandstone also contains localized swarms of channel sandstones. The Star Point Sandstone contains marine trace fossils that are most common in the lower part of the formation.

STRATIGRAPHIC RELATIONSHIP AND COAL CORRELATION

The stratigraphic relationship and coal correlation of the Blackhawk Formation and Star Point Sandstone are shown in sections A-A''' and B-B'''. Although the cross sections are 1.5 to 7 km apart, both cross sections display a similarity in stratigraphic variations, which mainly include: (1) offset contact between the Blackhawk Formation and Star Point Sandstone, (2) marked development of coal deposits in the lower part of the Blackhawk Formation, (3) vertical distribution and offset arrangement of the sandstone beds in the Blackhawk Formation, and (4) concentration of brackish-water bivalves in the lowermost part of the Blackhawk Formation.

The offset nature of the contact between the Blackhawk Formation and Star Point Sandstone is well displayed in both sections. In section A-A''', the offset contact resulted from the intertonguing of the uppermost Star Point Sandstone bed with the lowermost Blackhawk Formation at the southwest end of the cross section. The intertonguing includes a 18-m-thick zone of lithology common to both formations. As a result of the intertonguing the contact between the two formations is offset such that the contact is 18 m higher to the east than it is to the west of the zone. In section B-B''', the offset contact between the two formations includes a 23-m-thick zone. Thus, the formational contact is 23 m higher to the east than to the west of the intertonguing zone. Mapping of the intertonguing zone in both cross sections indicates a northwest-southeast orientation of the zone. The genetic significance of the intertonguing between the Blackhawk Formation and Star Point Sandstone is discussed by Marley, Flores, and Cavaroc (1979).

Perhaps the most significant effect of the offset nature of the contact between the Blackhawk Formation and Star Point Sandstone is the correlation of the coal beds. That is, the difference in elevation of the formational contact on either side of the intertonguing zone affects the lateral continuity of the lowermost coal zone of the Blackhawk Formation. As a result of the offset contact, the lowermost coal zone west of the intertonguing zone correlates with the uppermost Star Point Sandstone bed to the east. Furthermore, the uppermost coal zone west of the intertonguing zone correlated with the lowermost coal zone to the east. The limited lateral continuity of coal beds imposed by the intertonguing, therefore, directly affects the nomenclature given to coal beds of the lower part of the Blackhawk Formation. The correlation and nomenclature problems of the coals as a result of the intertonguing are treated in a separate report by Flores, Hayes, Marley, and Sanchez (1979).

The sections show marked development of thick (greater than 0.3 m) coal beds primarily in the lowermost 25 to 30 m of the Blackhawk Formation. In section A-A''', the thick, laterally extensive (600 to 1600 m) coal beds are well developed above the intertonguing zone in the southern half of the cross section. The lateral continuity of the coal beds is controlled by splitting and partial to complete erosion by channel sandstones. Splitting of coal beds occurs moderately rapidly from 400 to 550 m along their lateral extent. In section B-B''', the thick, laterally extensive (600 to 1200 m) coal beds are well developed west of the Blackhawk-Star Point Sandstone intertonguing zone at the west-southwest end of the cross section. The coal beds merge with the uppermost bed of the Star Point Sandstone to the east; thus, the coal beds are not equivalent to the thick coal beds described for cross section A-A'''. However, like the coal beds in cross section A-A''', the lateral continuity of coal beds in cross section B-B''' is determined by splitting and erosion by channel sandstone. However, splitting of coal beds occurs more rapidly from 200 to 300 m along their lateral extent. The development of thick, laterally extensive coal beds of the lower part of the Blackhawk Formation west and above the intertonguing zone is directly related to their depositional environment (Flores, 1978; Marley, Flores, and Cavaroc, 1979). Coals formed west of the intertonguing zone represent marginal delta deposits. Progradation of the marginal delta formed the coal deposits above the intertonguing zone. The upper Blackhawk detritus represents fluvial facies of the marginal delta.

The vertical distribution and offset arrangement of the sandstone beds, perhaps represent the most significant aspects of the physical stratigraphy of the Blackhawk Formation. These characteristics of the sandstone beds, to some degree, indicate the general mode of deposition at the Blackhawk sequence. In section A-A''', the thick, laterally extensive (as much as 2000 m) sandstone is mainly distributed 30 m above the Blackhawk-Star Point contact. In contrast, in section B-B''', the thick, laterally extensive (greater than 2000 m) sandstone is primarily distributed 25 m above the formational contact. In addition, both cross sections illustrate offset arrangement of the sandstone beds and finer detritus. The offset arrangement is particularly well defined in section A-A'''. The vertical en-echelon arrangement of the sandstone beds suggests that the position of each subsequent sandstone is controlled by topographic expression of preceding sandstones; this characteristic is enhanced by compaction and is typical of fluvio-deltaic sediments (Fern and Cavaroc, 1968). The development of thick, laterally extensive sandstone beds in the upper part of the Blackhawk Formation also indicates that through time the fluvio-deltaic channels have established characteristic lateral migration.

The distribution of brackish-water bivalves in the lowermost part of the Blackhawk Formation is shown in both cross sections. In section A-A''', the bivalves are mainly distributed as small concentrates above and within the intertonguing zone. In contrast, in section B-B''', the bivalves are concentrated in the area between the intertonguing zone to the east and the area of coal deposition to the west. The bivalves and associated fine detritus were interpreted as bay or lagoon deposits (Marley, Flores, and Cavaroc, 1978). The restricted distribution of these deposits in section A-A''' suggests haphazard occurrence of bay environment, which locally marks a small area of brackish-water influx in the marginal delta. The preferential distribution of bay deposits in section B-B''' suggests occurrence of a well developed lagoon between the areas of intertonguing and coal deposition. That this lagoon was maintained as a partly land-locked body of water is indicated by sparse coal deposits associated with the bay facies.

PHYSICAL STRATIGRAPHY AND COAL CORRELATION OF THE BLACKHAWK FORMATION AND STAR POINT SANDSTONE, SECTIONS *A-A'''* AND *B-B'''*, NEAR EMERY, UTAH

By

R. M. Flores and W. E. Marley III

1979

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