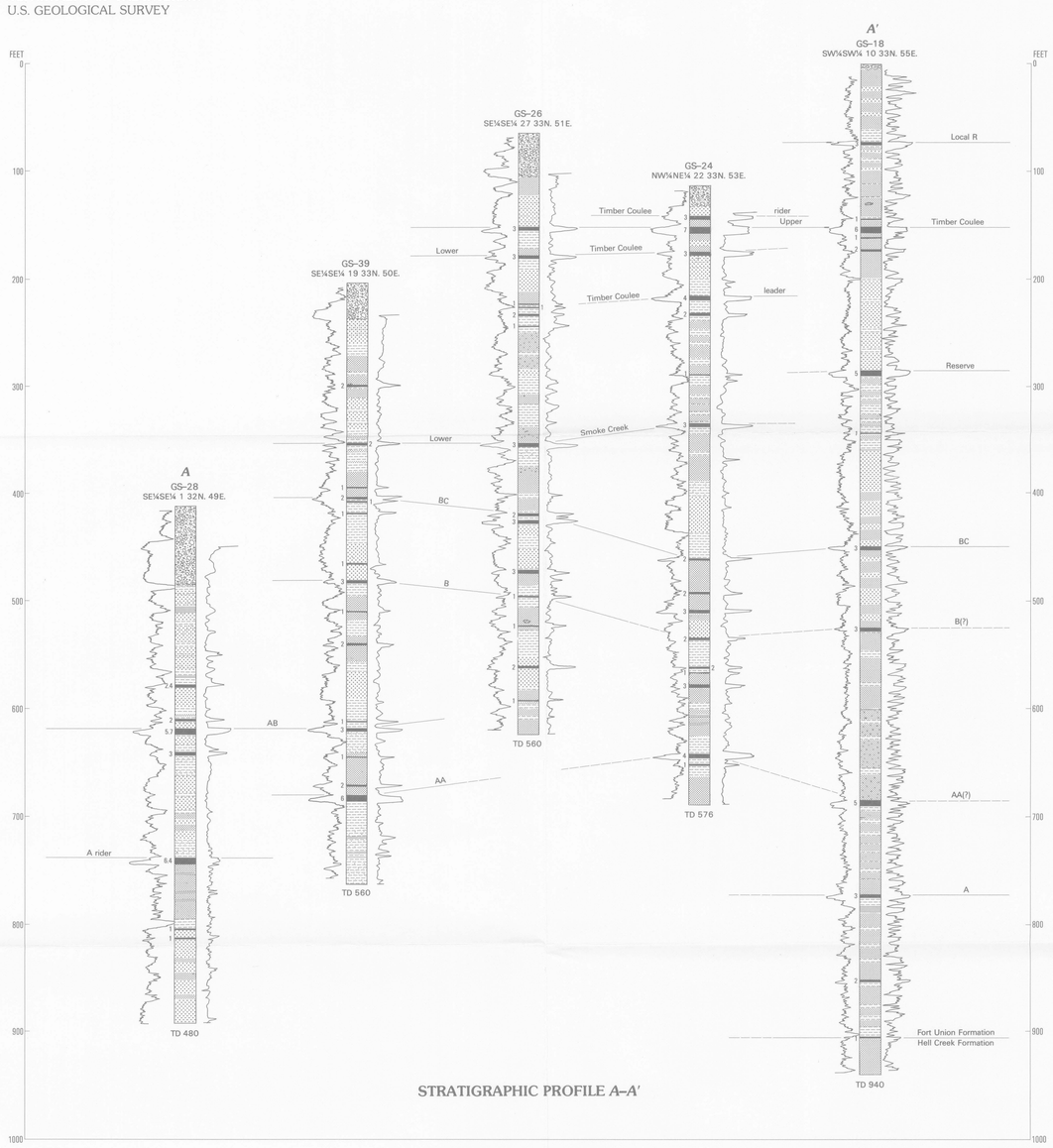
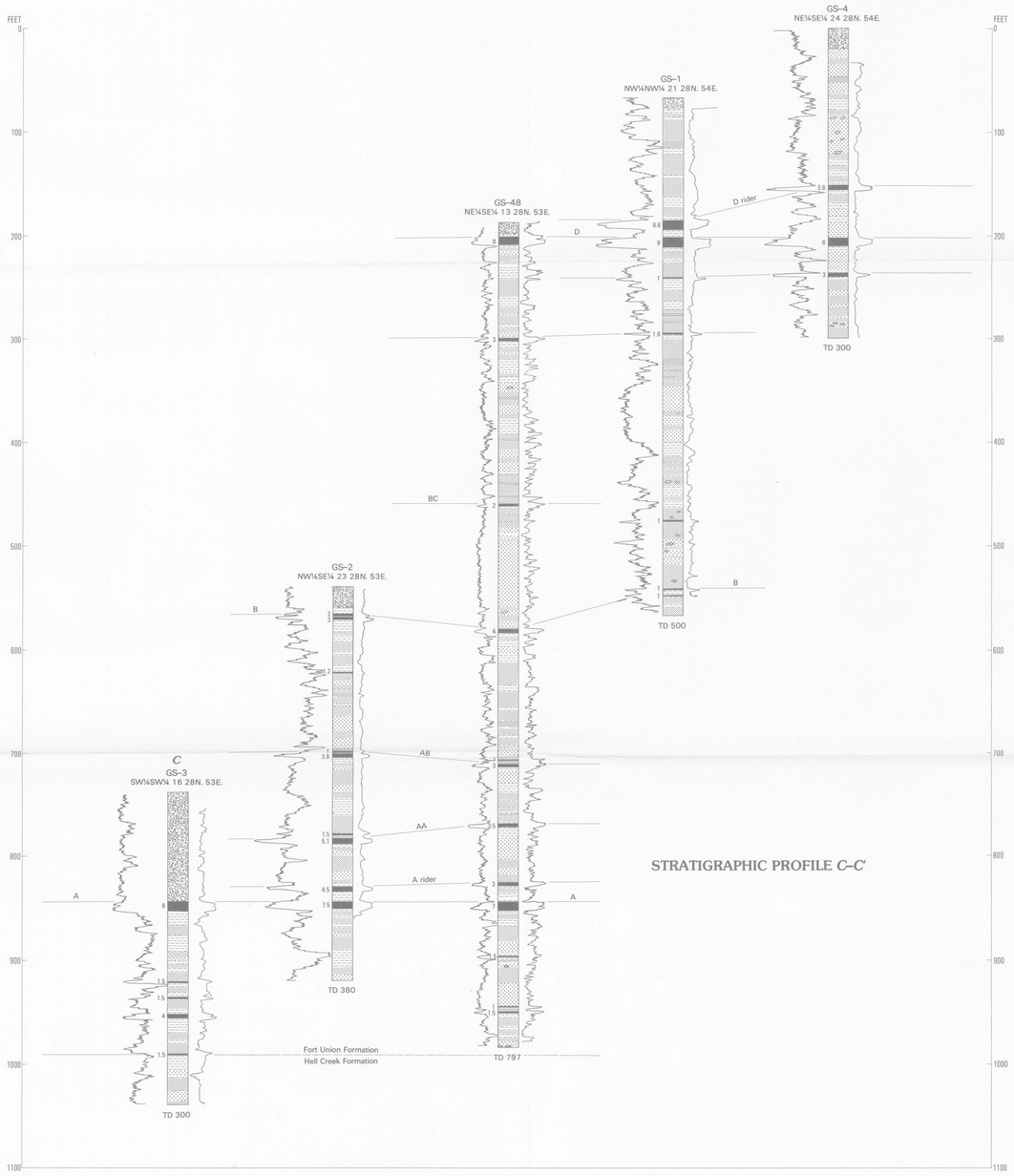
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
U.S. BUREAU OF INDIAN AFFAIRS

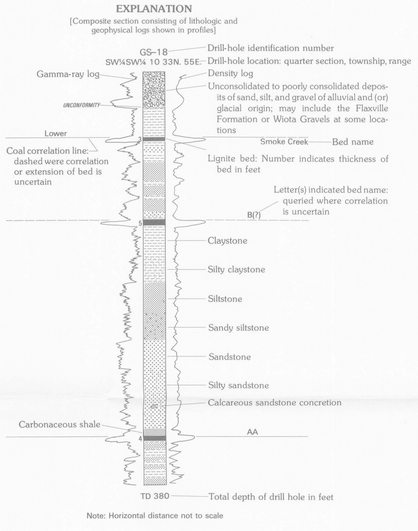
COAL INVESTIGATIONS
MAP C–122–B



STRATIGRAPHIC PROFILE *A–A′*



STRATIGRAPHIC PROFILE *C–C′*



STRATIGRAPHIC PROFILE *B–B′*

Figure 1.—Map showing locations of selected drill holes and profiles in the eastern part of the Fort Peck Indian Reservation, Daniels, Sheridan, and Roosevelt Counties, Montana.

INDEX SHOWING LOCATION OF THE FORT PECK INDIAN RESERVATION AND STUDY AREA (PATTERNED), MONTANA

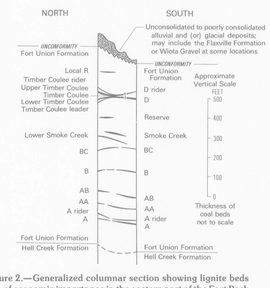


Figure 2.—Generalized columnar section showing lignite beds of economic importance in the eastern part of the Fort Peck Indian Reservation, Montana.

Table 1.—*Stratigraphic units in the eastern part of the Fort Peck Indian Reservation, Montana*

Alluvium and colluvium	Holocene	QUATERNARY
Glacial deposits	Pleistocene	
Wiota Gravel		
Flaxville Formation	Upper Miocene or Pliocene	TERTIARY
UNCONFORMITY		
Fort Union Formation	Paleocene	
Hell Creek Formation	Upper Cretaceous	CRETACEOUS
Fox Hills Sandstone		
Bearpaw Shale		

INTRODUCTION

The Fort Peck Indian Reservation occupies about 3,000 square miles in parts of Daniels, Roosevelt, Sheridan, and Valley Counties, northeast Montana. This report covers the easternmost part of the reservation, an area containing about 1,000 square miles underlain by the coal-bearing Paleocene Fort Union Formation, the focus of this study. The study area is bound on the west by the Poplar River, on the south by the Missouri River, on the east by Big Muddy Creek, and on the north by the reservation boundary. The physiographic character of the area is flat to rolling with scattered glacial surface features. Grasslands, cultivated fields, and glaciofluvial surficial deposits all but conceal much of the bedrock exposures which are at best few and poor.

Eighty-three coal exploratory holes were drilled by the U.S. Geological Survey between 1978 and 1980 (Hardie and Arndt, 1981; Arndt and others, 1982a, b) as part of the data collection phase of a comprehensive coal resource assessment project which was completed in 1985 (Biewick and others, in press; Hardie and Arndt, in press c). An additional 622 supplemental data points, consisting of measured sections, logged water wells, and logged seismograph shot holes were used to support correlation of the coal exploratory holes. Sixteen of the exploratory holes are included in this report which is one of a series of reports that resulted from that investigation. Other reports in this series include U.S. Geological Survey Coal Investigations Maps C–122–A and C–122–C showing the geology and structure of the Fort Union Formation (Hardie and Arndt, 1988) and series of cross sections showing the stratigraphic framework of coal beds in the Fort Union Formation (Hardie and Arndt, in press).

GEOLOGIC SETTING

The study area is located on the western flank of the Williston Basin where gentle easterly dips of less than 1° are present. Surface exposures of bedrock range from Upper Cretaceous marine shales and deltaic rocks to Tertiary and Quaternary continental deposits (table 1). Upper Cretaceous rocks are exposed in the extreme western part of the study area in a narrow margin along the Poplar River and in the south, between the communities of Brockton and Poplar (fig. 1). The remainder of the study area is underlain by rocks of the Fort Union Formation which are mantled by poorly consolidated surficial deposits.

The Fort Union Formation is gradational and conformable with the underlying Upper Cretaceous Hell Creek Formation; the contact between the two units is arbitrarily placed at the base of the lowest mappable coal bed, above which thick extensive coal beds are common (Colton and Bateman, 1956). Fort Union strata are more than 1,300 feet thick in the northeast part of the study area, thinning to a feather edge along the western margin. The formation consists of bright-yellow, thick- to thinly interbedded sandstone, siltstone, claystone, mudstone, and lignite. Much of the Fort Union is buried under upper Tertiary and Quaternary surficial deposits. The oldest of these, the Flaxville Formation (upper Miocene or Pliocene), lies unconformably on Fort Union Formation strata and locally consists of poorly consolidated fluvial deposits of clay, sand, silt, and quartzitic gravel. The Flaxville, a reddish-brown gravel-supported unit, caps the highland areas, where it commonly exceeds thicknesses of 100 feet. The overlying Pleistocene Wiota Gravel is gradational with the Flaxville Formation and the two units are similar in lithology, mode of transport, and area of occurrence. The Wiota Gravel, however, lacks the thickness and lateral extent of the gravel in the Flaxville Formation and has a larger mean clast size. Unconsolidated to poorly consolidated glacial deposits of mostly Wisconsin age are commonly present along slopes and bottoms of lowland areas. Delineation of surficial deposits was not part of this study.

STRATIGRAPHIC PROFILES

The 16 drill holes shown in this report were selected in such a way as to construct three east-west-trending stratigraphic profiles subparallel to the easterly regional dip, in the north, central, and southern parts of the study area (fig. 1). Composite logs for each of the 16 drill holes were prepared to show both the bore-hole lithologies and geophysical log signatures.

Lithologies shown in the composite logs were determined by combining the results of drill cutting examinations with geophysical log interpretations. The tops and bottoms of lithologic units shown in the composite logs were determined from geophysical logs. Drill cuttings were collected at 5-foot intervals and described in detail at the well site. More detailed examinations of the cuttings were later conducted with the aid of a binocular microscope. Natural gamma-ray and focused density logs were recorded in the drill holes and are shown along the left and right sides of the composite logs, respectively. Single-point resistance and caliper logs were recorded but are not shown in this study.

Correlation of the composite logs was made largely on the basis of coal beds and (or) families of coal beds which are laterally continuous. The coal beds in the study area were first described and named by Smith (1910). From scattered exposures, he constructed a generalized section with coal beds designated alphabetically. Subsequent investigations (this report; Arndt and Hardie, 1985; Hardie and Arndt, 1987, 1988, in press; Hardie and Van Gosen, 1986) significantly modified Smith's generalized section and coal-bed nomenclature to that shown in figure 2.

DISCUSSION

The Fort Union Formation consists of thin to thickly interbedded sandstone, siltstone, claystone, and coal beds. Siltstone, the most abundant lithology, is generally light to medium gray and often contains plant fragments and ironstone nodules which have impressions of leaves and rootlets. Freshwater mollusk fossils have been found in association with siltstones that occupy the upper 200 to 300 feet of Fort Union strata (profile *C–C′*, log GS–4). Sandstone, the second most abundant lithology, has a gray to yellowish hue, is fine to very fine grained, and often contains thin hard calcareous concretionary zones. Claystone, the third most abundant lithology, ranges from light- to dark-gray colored hues, is blocky, commonly carbonaceous, and frequently contains plant debris. Lignite beds are common in the Fort Union, thickening to more than 13 feet in the northeast part of the study area. Lignite beds are laterally persistant, with beds only a few feet thick extending over wide areas (B coal bed in *A–A′*, *B–B′*, and *C–C′*). A few coal beds contain fossilized tree stumps.

According to depositional environment studies conducted by Flores and Lepp (1983), upper delta-plain deposition during Late Cretaceous Hell Creek time continued into Fort Union time as suggested by the gradational contact between the two units in profile *B–B′* (drill holes GS–54 and GS–55). Delta-plain deposition probably continued through the lower part of the Fort Union Formation represented by the interval below the Reserve and Smoke Creek coal bed, where interdistributary channel sandstones are common. Coal beds A, A rider, AA, AB, B, BC, Lower Smoke Creek, Smoke Creek, and the Reserve coal beds were probably deposited between these upper delta-plain channels.

In this area the D and Timber Coulee coal beds probably represent the first accumulation of peat in swamps of an alluvial-plain environment. The D and Timber Coulee coal zones, and stratigraphically higher coal beds located south of the study area in the Girard coal field (Spencer, 1980), are thicker and more persistant than beds in the lower part of the Fort Union. In general, better developed coal beds are routinely found in association with thick, commonly occurring fluvial channel sandstone beds. Flores and Lepp (1983) reported the occurrence of freshwater mollusk fossils (*Unio*, *Viviparus*, and *Hydrobia*) in this interval which also suggests transition from upper delta-plain to alluvial-plain deposition.

Flores and Lepp (1983) believe that peat accumulated in backswamp areas of broad abandoned meander belts on an alluvial plain. Areas of peat accumulation extended from these centers to slightly lower areas of the flood plain where backswamps formed on crevasse-splay deposits. The splays probably promoted further development of wetlands by creating a damming effect between two or more aggrading splay lobes, thereby establishing isolated marshy lowlands. Coal beds originating in this intersplay subenvironment are of lesser thickness and lateral extent than those which developed on meander belts and aggrading splays. In the study area, the Reserve and local R coal beds shown are believed to have developed in such a subenvironment.

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STRATIGRAPHY OF THE FORT UNION FORMATION IN THE EASTERN PART OF THE FORT PECK INDIAN RESERVATION, DANIELS, ROOSEVELT, AND SHERIDAN COUNTIES, MONTANA

By

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