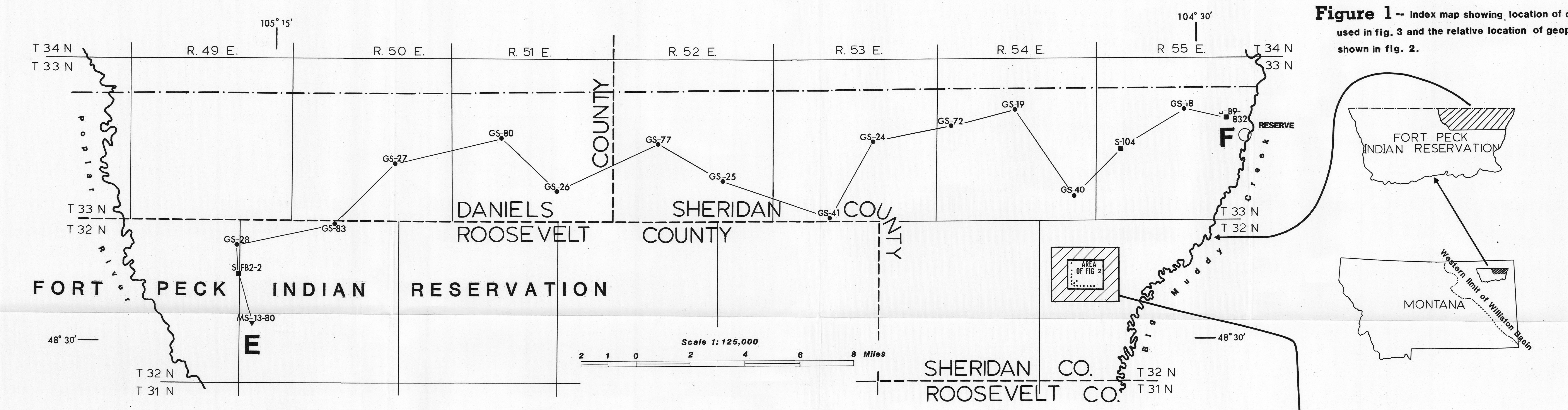


Figure 1-- Index map showing location of coal sections used in fig. 3 and the relative location of geophysical well logs shown in fig. 2.

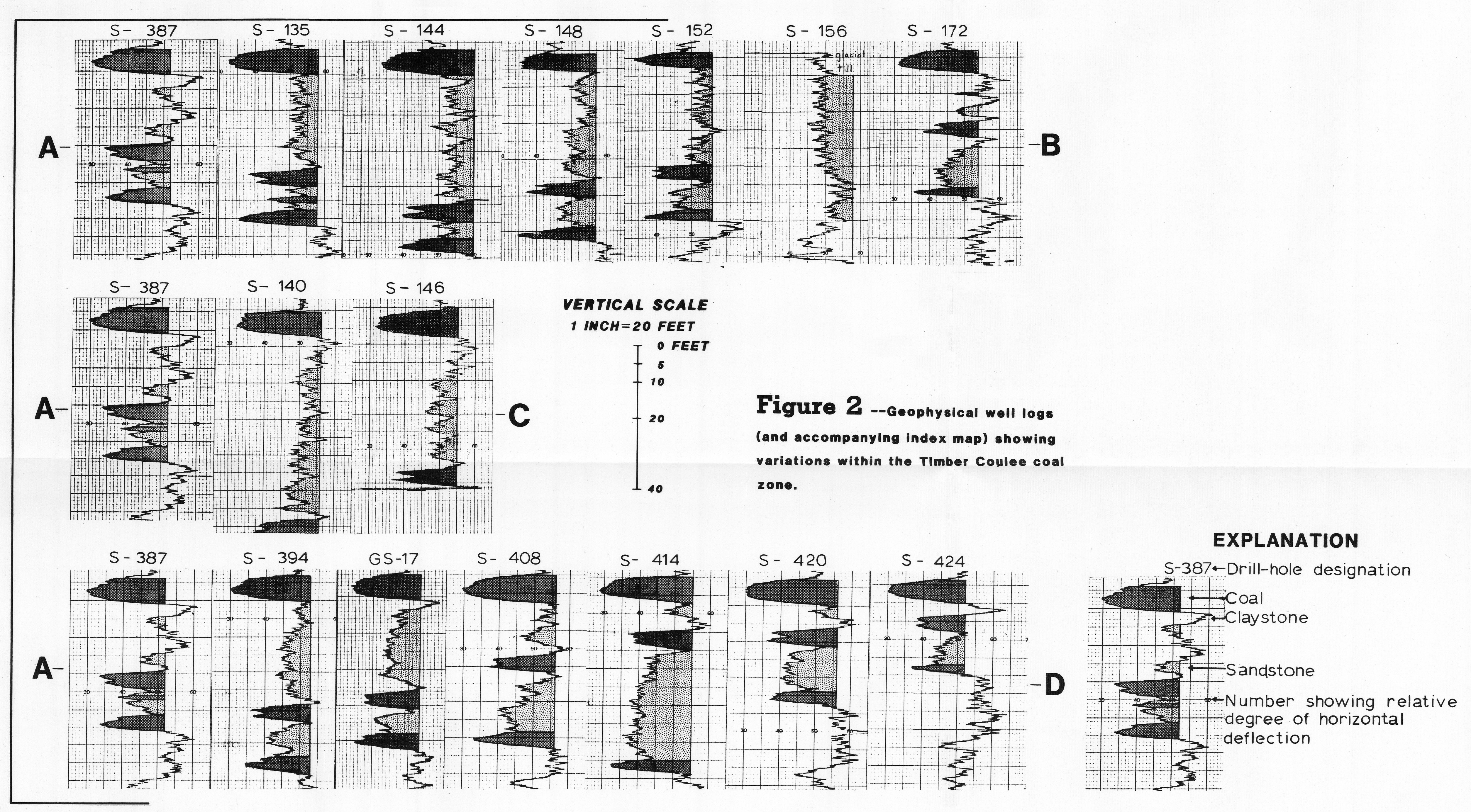
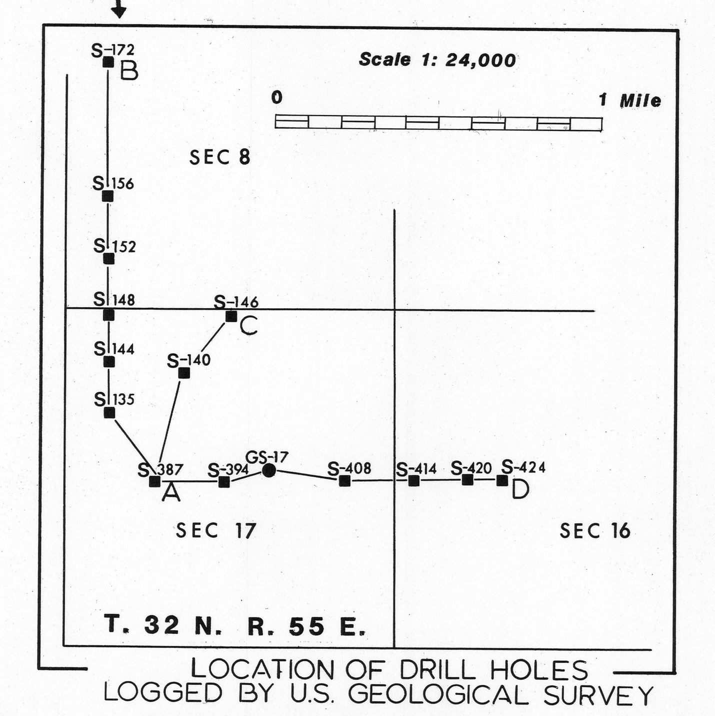


Figure 2 --Geophysical well logs (and accompanying index map) showing variations within the Timber Coulee coal zone.



LOCATION OF DRILL HOLES LOGGED BY U.S. GEOLOGICAL SURVEY

S■-Seismograph drill hole
GS●-U.S. Geological Survey coal exploratory drill hole

EXPLANATION

S-387←Drill-hole designation
Coal
Claystone
Sandstone
Number showing relative degree of horizontal deflection

INTRODUCTION

The area of investigation is located in the northeast part of the Fort Peck Indian Reservation (fig. 1) on the western flank of the Williston Basin. It covers about 450 square miles and is made up of parts of Daniels, Sheridan, and Roosevelt counties. Exploratory drilling for coal and logging of seimograph drill holes in 1978-1981 were done with the support of the Branch of Indian Affairs as part of the U.S. Geological Survey's program to assess coal resources in the reservation (Hardie and Arndt, 1981; Ardnt, Hardie, and Kehn, 1982). From the data generated, selected seismic and coal exploration logs were used in this report to show the stratigraphic framework of lower Fort Union coal beds (fig. 3) and local variations (fig. 2) with particular reference to the Timber Coulee coal zone.

GEOLOGIC SETTING

The Paleocene Fort Union Formation underlying the study area is comprised of about 1,050 ft of interbedded sandstones, siltstones, claystones, limestones, and numerous lignite beds ranging in thickness from a few inches to more than 13 ft. However, for descriptive purposes, only coal beds with thicknesses 1 ft or greater have been used in this report. The rocks of the Fort Union Formation dip gently eastward (averaging less than 1°) toward the deposition center of the Williston Basin.

The Fort Union Formation is mantled by Pleistocene glacial deposits of varying thicknesses and is conformably underlain by the Hell Creek Formation of Late Cretaceous age. The contact between the Fort Union and the Hell Creek is gradational and arbitrarily placed at the base of the lowest mappable coal bed (Colton and Bateman, 1956).

The Hell Creek Formation is about 280 ft thick, consisting of interbedded sandstones, siltstones, claystones, and numerous thin to moderately thick, discontinuous lignite beds. The beds of the Hell Creek Formation have a somber gray hue, which contrasts the lighter yellow-hued beds of the overlying Fort Union Formation.

COAL BED CORRELATION DIAGRAM

The coal sections used in constructing the coal bed correlation diagram (fig. 3) were prepared from three different data sources: (a) 13 geophysical well logs from U.S. Geological Survey coal exploration holes that were drilled in 1979 (Ardnt, Hardie, and Kehn, 1982) with depths ranging from 300 to 940 ft; (b) three seismograph holes with depths ranging from 168 to 227 ft that were drilled by private seismograph companies and logged by the U.S. Geological Survey in 1979-1981; and (c) one U.S. Geological Survey measured section.

The correlations of coal beds in figure 3 were supported by geophysical logs of seismograph and coal exploratory drill holes to the immediate south of the study area. Coal beds without correlation lines indicate that correlations were too uncertain to be shown.

GEOPHYSICAL WELL LOGS

Of the 16 drill holes shown on line E-F in figure 1, 13 are U.S. Geological Survey coal exploratory holes drilled and logged by private contractors; single conductor and multi-conductor geophysical logging systems were used depending on the contractor. The suite of logs run in these drill holes consisted of natural gamma, gamma density, caliper, and resistance. The three seismograph drill holes were logged by the U.S. Geological Survey using a single-conductor geophysical logging unit. Only natural gamma logs were run in these three seismograph holes owing to the lack of drill-hole conditioning and the risk that unexploded seismograph charges could be detonated by stray voltage from logging tools other than natural gamma.

Fifteen natural gamma geophysical well logs are shown in figure 2. Fourteen of these well logs were recorded by the U.S. Geological Survey from closely spaced seismograph drill holes drilled by private seismograph companies. The one remaining geophysical log (GS-17) was recorded from a U.S. Geological Survey coal exploratory hole drilled and logged by a private contractor.

The horizontal deflection of the natural gamma log signatures in figure 2 is in response to the spontaneous natural radioactive decay of the rocks surrounding the natural gamma sensing probe in the drill hole. When the sensing probe, traveling up the drill hole, passes a coal bed that characteristically has very little natural radioactivity, a corresponding signature deflection to the extreme left results. The rocks between coal beds, interpreted using only the natural gamma log, are sandstone, siltstone, claystone, or some combination of these. In general, claystone is more radioactive than siltstone, which in turn is usually more radioactive than sandstone. A large deflection to the left, approaching that of a coal bed (low radiation), indicates a relatively pure sandstone. A moderate deflection to the left is probably a siltstone or argillaceous sandstone. A very slight deflection, indicating relatively high radiation, is probably a claystone or shale.

DISCUSSION

The coal bed correlation diagram in figure 3 oversimplifies the spatial behavior of coal beds from one data point to another; this is a result of the wide spacing of data points (averaging about 3 miles). From this data alone, one may infer the spatial behavior of coal beds between data points is relatively predictable and uniform. However in figure 2 the close spacing of natural gamma logs recorded in seismograph drill holes combined with the radiating trend of the three lines of drill holes, demonstrates intense variation of coal beds and associated sandstone units over short distances.

The relationship between the coal beds and sandstone units shown in figure 2 is a product of a fluvial-dominated depositional environment. The interplay between coal beds and sandstone units is produced through deposition and differential compaction. Geophysical logs S-414 through GS-17 show a thinning trend of the lower sandstone unit, while the upper sandstone unit shows a thickening trend. Adjustments in the stratigraphic position of the coal beds are made in response to changes in the sandstone interval as seen in logs S-414 and S-394. Where the sandstone interval thickens, the coal beds immediately above and below it bifurcate. Where the sandstone interval thins, the confining coal beds begin to coalesce.

There is no reason to believe coal zone variations are isolated occurrences in the Fort Peck area. When correlating widely spaced coal sections as in figure 3, this variability cannot be seen but is likely to be present.

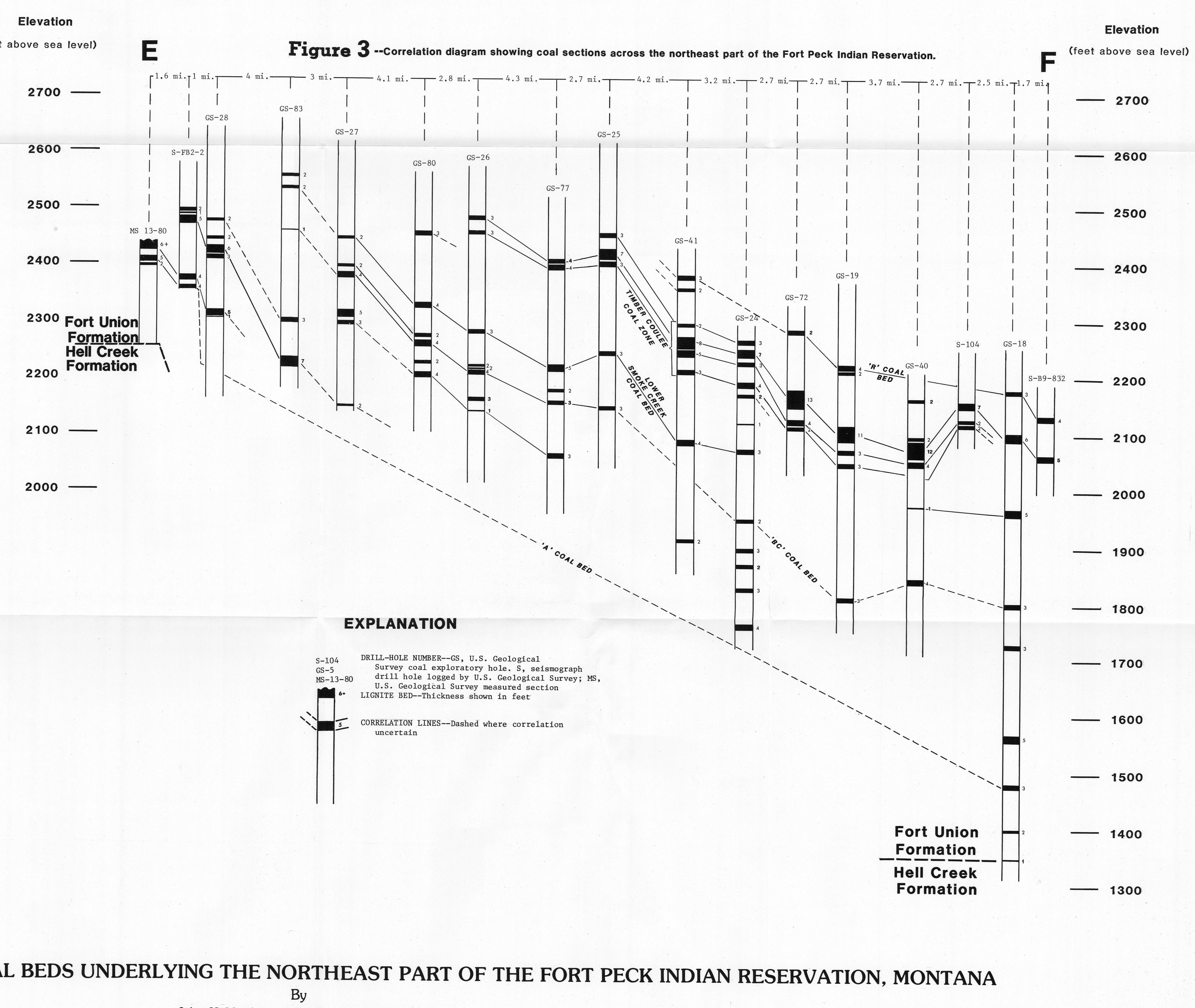
REFERENCES CITED

Ardnt, H. H., Hardie, J. K., and Kehn, T. M., 1982, Results of exploratory drilling for lignite in 1979, Fort Peck Indian Reservation, Daniels, Roosevelt, and Sheridan Counties, Montana: U.S. Geological Survey Open-File Report 82-480, 152 p.
Colton, R. B., and Bateman, A. F., Jr., 1956, Geologic and structure contour map of the Fort Peck Indian Reservation and vicinity, Montana: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-225, scale 1:125,000.
Hardie, J. K., and Arndt, H. H., 1981, Results of exploratory drilling for lignite in 1978, Fort Peck Indian Reservation, Roosevelt County, Montana: U.S. Geological Survey Open-File Report 81-786, 66 p.

Table 1.--Control points used in correlating coal beds across the northeast part of the Fort Peck Indian Reservation, Montana

Number on figure 3	Elevation (in feet)	Depth (in feet)	Location (section)	Township (north)	Range (west)
S-B9-832	2190	193	NE NE 14	33	55
GS-18	2255	940	SW SW 10	33	55
S-104	2150	168	NE NE 14	33	55
GS-40	2210	500	NW NW 36	33	54
GS-19	2370	620	SE SE 9	33	54
GS-72	2330	300	SE SW 18	33	54
GS-24	2295	575	NW NE 22	33	53
GS-41	2430	575	NW SW 33	33	53
GS-25	2615	575	NW SW 26	33	53
GS-77	2520	560	NE NE 20	33	51
GS-26	2575	560	SE SE 27	33	51
GS-80	2565	460	SE SE 17	33	51
GS-27	2620	480	SE SE 22	33	50
GS-83	2660	480	NE NE 3	32	50
GS-28	2645	480	SE SE 1	32	49
S-FB2-2	2580	227	SW SW 7	32	50
MS-13-80	2440	185	NW SE 19	32	50

Figure 3 --Correlation diagram showing coal sections across the northeast part of the Fort Peck Indian Reservation.



STRATIGRAPHIC FRAMEWORK OF COAL BEDS UNDERLYING THE NORTHEAST PART OF THE FORT PECK INDIAN RESERVATION, MONTANA

By
John K. Hardie and Bradley S. Van Gosen
1986

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1986
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