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PRELIMINARY GEOLOGIC INVESTIGATION OF THE WEST GLENDIVE LIGNITE DEPOSITS, DAWSON COUNTY, MONTANA

By

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CONVERSION TABLE

To convert	Multiply by	To obtain
feet	0.3048	meters (m)
miles	1.609	kilometers (km)
feet/mile	.1894	meters/kilometer (m/km)
tons (short)	.907	metric ton (t)
Btu/lb	2.326	kilojoule/kilogram (kJ/kg)
acre-foot	1.233×10^{-3}	hectometer^3 (hm^3)

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ABSTRACT

Four major lignite beds, all in the Fort Union Formation (Paleocene), occur in the West Glendive area, Dawson County, Montana. The Newton Ranch and Poverty Flats beds are in the Lebo Member and the Peuse and Kolberg Ranch beds are in the Tongue River Member. Correlation of the lignite beds across the area shows that the Peuse bed is the thickest and most extensive. Field mapping and drill-hole data indicate that folding and faulting are more common than previously reported.

INTRODUCTION

This report describes the West Glendive area's major lignite beds. The area comprises Tps. 14 to 18 N., Rs. 52 to 54 E., and Tps. 16 to 18 N., R. 55 E., P.M., Dawson County, Montana (fig. 1). The four major beds are the Newton Ranch, Poverty Flats, Peuse, and Kolberg Ranch (table 1, fig. 2).

The data were obtained from oil-well geophysical logs, water-well lithologic logs, geophysical logs provided by Charles M. Hauptman, consulting geologist, Billings, Montana, geophysical and lithologic logs from U.S. Geological Survey-Montana Bureau of Mines and Geology coal drill holes (1978), and the author's field mapping in 1977.

All four lignite beds are in the Fort Union Formation (Paleocene); the Newton Ranch and Poverty Flats are in the Lebo Member and the Peuse and Kolberg Ranch are in the overlying Tongue River Member. The Fort Union and older formations underwent considerable deformation during evolution of the Cedar Creek anticline (fig. 1). The folding and faulting, probably the most intense in the Tertiary of the Williston basin, led earlier workers to interpretations that later more detailed studies suggest as incorrect.

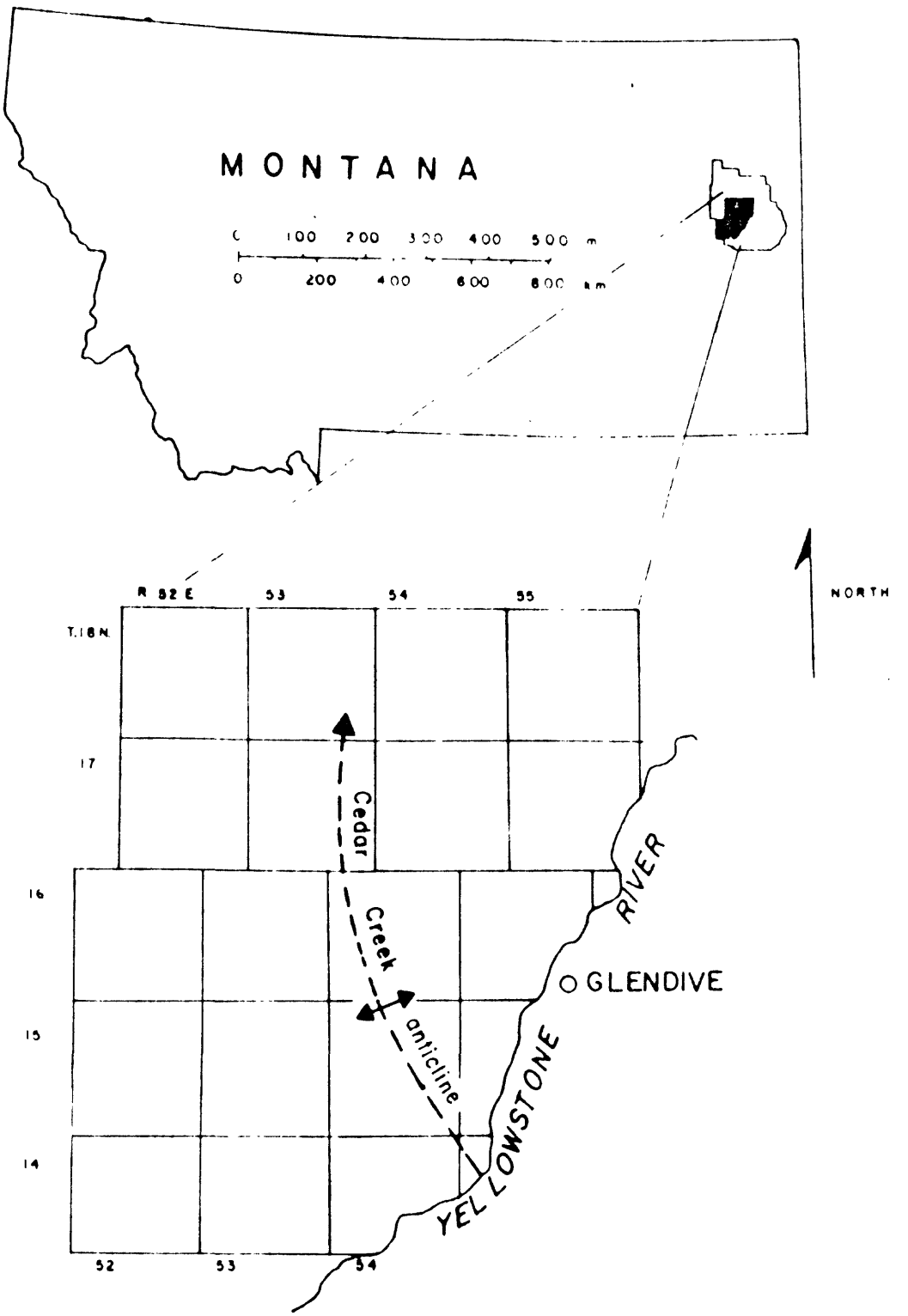

Figure 1. Index map of West Glendive area, Dawson County, Montana, showing approximate location of the Cedar Creek anticline.

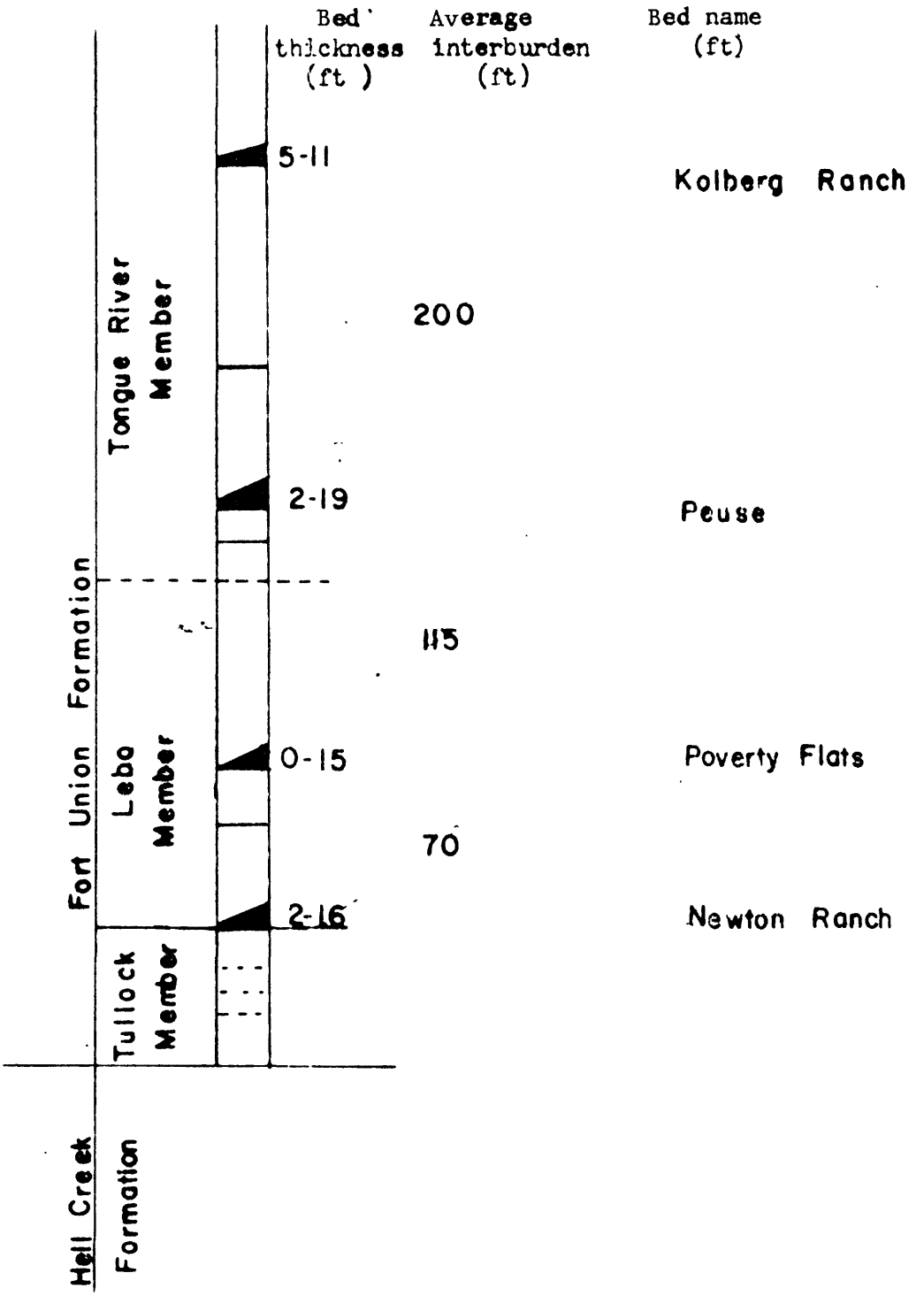

Figure 2. Composite section showing the lignite beds and nomenclature used in this report.

Currently, there is no commercial mining in the area but inactive mine sites attest to early small-scale mining.

Table 1.--Nomenclature of lignite beds in West Glendive area

This report	G. D. Mowat (oral commun., 1977)	C. M. Hauptman (written commun., 1977)	J. L. Stewart (written commun., 1927)	Hance (1912)
Kolberg Ranch	--	Kolberg Ranch	--	--
Peuse	--	Reynolds	C and E	--
Poverty Flats	--	--	B	Upper
Newton Ranch	Big Dirty	Newton Ranch	A	Lower

PREVIOUS WORK

Hance (1912) mapped and studied the lignite beds exposed in small strip pits and widely scattered outcrops. He described two lignite beds (table 1) having great areal extent that were rarely less than 4 feet thick. Poor exposures necessitated his mapping the two beds as one outcrop.

J. L. Stewart (written commun., 1927) mapped the Glendive part of the Northern Pacific Land Grant, north of T. 10 N., and east of R. 52 E. This map shows the outcrop and inferred outcrop of lignite beds (table 1) and where the lignite burned, baking and fusing the overlying rock (clinker or scoria).

Charles M. Hauptman (written commun., 1977) described three lignite beds in the West Glendive area (table 1). Southwest of Glendive, he described the Reynolds bed in the basal 30 to 50 feet of the Tongue River Member. Along Deer Creek he described the Newton Ranch bed and tentatively correlated it to be 40 to 60 feet above the Reynolds (Peuse) bed. He also tentatively correlated the Kolberg Ranch bed in the northeast part of the area to be approximately 250 feet above the Newton Ranch bed.

Hauptman (written commun., 1977) calculated the tonnages of recoverable lignite in the Reynolds (Peuse) and Newton Ranch beds:

Newton Ranch bed	125×10^6 tons
Reynolds (Peuse) bed	333×10^6 tons

These tonnage calculations were based on 1,700 tons of lignite per acre-foot, overburden to lignite ratio of less than 10:1, and areas where the lignite was greater than 5 feet thick.

GEOMORPHOLOGY

The West Glendive area is located on the northwest side of the Yellowstone River (pl. 1). Maximum relief between the river and the western boundary of the area is approximately 700 feet. Several southeastward-flowing streams drain the area.

Local topography reflects both structure and stratigraphy. Formations composed mainly of claystone, gravel, sandstone, shale, or siltstone are exposed along the flanks and over the axis of the Cedar Creek anticline (fig. 1). Badlands topography is prevalent in areas composed mainly of claystone and siltstone. In areas where the amount of sandstone in the beds increases, the land surface becomes gently rolling prairies with scattered hills. Gravel-topped tablelands are common between the drainages.

STRATIGRAPHY

The Pierre Shale, Fox Hills Sandstone and Hell Creek Formation (Cretaceous) and the Fort Union Formation (Paleocene) are exposed in the West Glendive area. Locally, the Fort Union is divided into the Tullock, Lebo, and Tongue River Members. Only the Lebo and Tongue River Members were studied for this report. The Lebo-Tongue River contact (fig. 2) is approximately located because of local intertonguing.

The Lebo Member consists of dark-gray and tan siltstone, poorly consolidated, white to gray, very fine-grained sandstone, carbonaceous shale, and lignite beds. It is approximately 200 feet thick and thickens to the west (J. D. Stoner, oral commun., 1978).

The Tongue River Member consists of light-gray, calcareous, fine-grained, poorly consolidated sandstone, tan to gray siltstone and claystone, and lignite beds. The claystone and siltstone are generally lighter in color than the claystone and siltstone in the Lebo and weather to a tan to buff color. Loglike concretions are common in the Tongue River (Howard, 1960, p. 16). Drilling penetrated 490 feet of the Tongue River in T. 17 N., R. 53 E., but this probably does not represent the entire member.

The Flaxville (Pliocene or Miocene), Cartwright, and Crane Creek Gravels (Pleistocene) are mostly unconsolidated, flat lying, and unconformably overlie the bedrock in the area. The gravels are as much as 100 feet thick and are found along the Yellowstone River between the drainages and in the western part of the area. Howard (1960, p. 17, 19) described their mineralogy and geologic history.

Holocene alluvium is in the stream valleys and along the Yellowstone River. It is composed of bedrock fragments, gravel, and lignite.

STRUCTURE

The West Glendive area is in the western part of the Williston basin. Regionally, the Fort Union and older formations dip less than 1° E. Locally, the northwest-trending Cedar Creek anticline interrupts the structural pattern.

Structural deformation along the Cedar Creek anticline has taken place intermittently since the Cambrian (McCabe, 1954). Oil-well drill-hole data confirms several periods of extensive Paleozoic and Mesozoic folding and faulting (McCabe, 1954; Strickland, 1954; Davis and Hunt, 1956). Data compiled by Frye (1969, p. 22-24) suggests erosional unconformities at the base of the Hell Creek Formation (Cretaceous) over the axis of the anticline. Gilles (1952, p. 24) mapped several small domes but reported no faulting.

Most surficial structure around the northern nose of the anticline has been concealed by gravels (Pliocene or Miocene and Pleistocene), slumping of poorly consolidated sediments, and the intertonguing of the Fort Union Members. The combination of coal

exploration drill-hole data from Charles M. Hauptman (written commun., 1977) and the U.S. Geological Survey-Montana Bureau of Mines and Geology (1978) and field mapping by the author in 1977 indicates that considerable post-Fort Union pre-Flaxville deformation has occurred (pls. 2, 3). Dips as steep as 19° were measured and fault traces were recognized for the first time in the area. North-trending normal faults, upthrown to the west, were mapped in sec. 23, T. 17 N., R. 53 E., and in sec. 7, 8, 17, and 18, T. 16 N., R. 54 E. (pl. 2). Northwest-trending normal faults, upthrown to the southwest, were mapped in sec. 29, T. 16 N., R. 54 E. These faults extend approximately N. 40° W. along the Upper Sevenmile Creek drainage and southeast past the Glendive oil field (pl. 2). All the faults displace the lignite beds, but lack of good exposure made it impossible to measure the amount of displacement (pls. 2, 4).

Folding is illustrated by the deep trough in Tps. 17 and 18 N., R. 53 E., and by the knobs and depressions shown on plate 2. Both the folding and faulting appear to decrease in intensity away from the axis of the anticline (pl. 2, fig. 1).

COAL

The four major lignite beds in the West Glendive area are in the Fort Union Formation (table 1, figs. 2, 3). Additional stratigraphic and structural data obtained from coal exploration drilling and field mapping have resulted in revised correlations. The correlation sections (pl. 4) and the idealized section (fig. 2) illustrate the structural and stratigraphic relationships of the lignite beds across the area.

The Newton Ranch bed, named for the ranch in sec. 3, T. 16 N., R. 55 E., is exposed along Deer Creek and Upper Sevenmile Creek. It was identified by G. D. Mowat (oral commun., 1977) as the Big Dirty bed at the base of the Lebo Member (table 1, fig. 2). The lignite is 2-16 feet thick (pl. 5), splits preferentially along the bedding plane and has a dull luster and widely spaced siltstone partings. Table 2 lists the analyses of this lignite. Outcrop measurements and drill-hole data provide very good control on the bed only in the Deer Creek area.

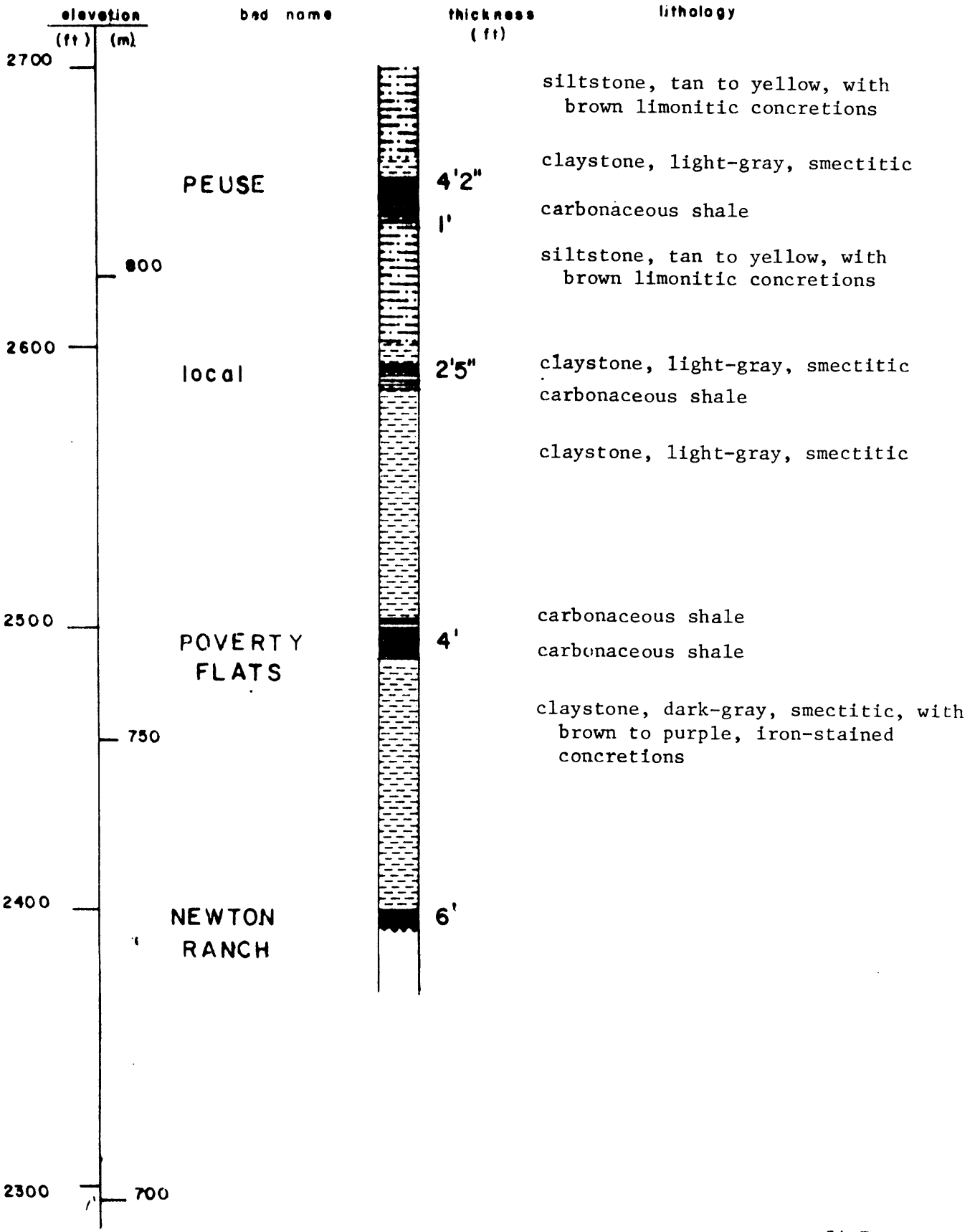

Figure 3. Measured section from sec. 3, T. 16 N., R. 54 E.

Table 2.--Chemical and physical analyses of coals in the West Glendive area

[Values in percent, except heat value. A, as received; B, moisture free; ---, no data. Data supplied by C. M. Hauptman (written commun., 1977)]

Drill-hole No.	Location T. N., R. E., section			Form of analysis	Proximate Moisture	Volatile matter	Fixed carbon	Ash	Ultimate Sulfur	Heat value Btu/lb
Newton Ranch bed										
HFC-114	16	53	35	A	28.77	24.82	29.89	16.52	0.34	6,396
				B	---	34.85	41.96	23.19	.48	8,874
HFC-116	16	53	35	A	29.07	24.72	31.69	14.52	.48	6,729
				B	___	34.58	44.68	20.47	.68	9,487
HFC-113	17	54	35	A	31.42	24.88	32.51	11.19	.25	6,372
				B	---	36.28	47.40	16.32	.36	9,816
HFC-119	17	54	36	A	30.13	24.49	27.81	17.57	.60	6,278
				B	---	35.05	39.80	25.18	.86	8,985
HFC- 94	16	55	7	A	35.12	24.88	32.54	7.46	.17	6,762
				B	---	38.85	50.15	11.50	.27	10,423
Peuse bed										
HFC- 85	16	53	35	A	35.91	26.34	30.13	7.76	0.43	6,698
				B	---	41.11	46.99	11.90	.65	10,451
HFC- 48	15	53	17	A	35.06	27.12	28.25	7.65	.34	6,652
				B	---	41.77	43.98	11.77	.54	10,354
HFC- 57	15	53	33	A	35.19	28.01	31.20	5.60	.28	7,005
				B	---	43.21	48.15	8.64	.44	10,809
HFC- 68	15	54	17	A	36.16	26.25	30.60	6.99	.27	6,768
				B	---	41.12	47.94	10.94	.42	10,602
HFC- 8	14	53	5	A	36.09	26.56	28.17	9.18	.28	6,492
				B	---	41.56	44.08	14.36	.44	10,158

The Poverty Flats bed is also in the Lebo Member and is approximately 70 feet above the Newton Ranch bed (table 1, fig. 2). It is named for the Poverty Flats area where it is well exposed. The lignite is 0-15 feet thick (pl. 6). It was mapped along Upper Sevenmile Creek and only the south side of Deer Creek because it pinches out to the north. Like the Newton Ranch bed, the Poverty Flats splits preferentially along the bedding plane but it has fewer siltstone partings.

The Peuse lignite bed, named for the Peuse coal mine in sec. 13, T. 16 N., R. 54 E., is the lowest major lignite bed in the Tongue River Member. It is the thickest and most extensive lignite bed in the area. The maximum thickness of this bed is 19 feet in T. 15 N., R. 54 E., and it is greater than 5 feet thick throughout most of the area (pl. 7). The channel in T. 15 N., R. 53 E., is inferred from drill-hole data and discussion with Ivan Hoitland (oral commun., 1977) (pls. 2, 7). The 150-foot overburden line is drawn for areas where 1:24,000 topographic map coverage is available.

The Peuse bed was mapped along Deer Creek and its burned outcrop was mapped along Upper Sevenmile Creek. At the outcrop the Peuse lignite is distinctively different from lignite in the underlying Lebo Member. The Peuse lignite does not split preferentially along the bedding plane and lacks the siltstone partings of those lower beds. Analyses of the lignite are listed in table 2.

The hand-specimen character, the Tongue River appearance of the overlying and underlying sediments, and the rock interval down to the Newton Ranch bed are the criteria used to correlate the Peuse bed in the northern part of the area (pls. 2, 7). Owing to its widespread extent, the Peuse bed is a useful marker in showing the structural deformation around the northern nose of the Cedar Creek anticline.

The Kolberg Ranch bed is named for the ranch in sec. 10, T. 18 N., R. 55 E. It is in the Tongue River Member, approximately 200 feet above the Peuse bed. The Kolberg Ranch bed is found in five drill holes in the northeast part of the area (pl. 6) and ranges in thickness from 5 to 11 feet.

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