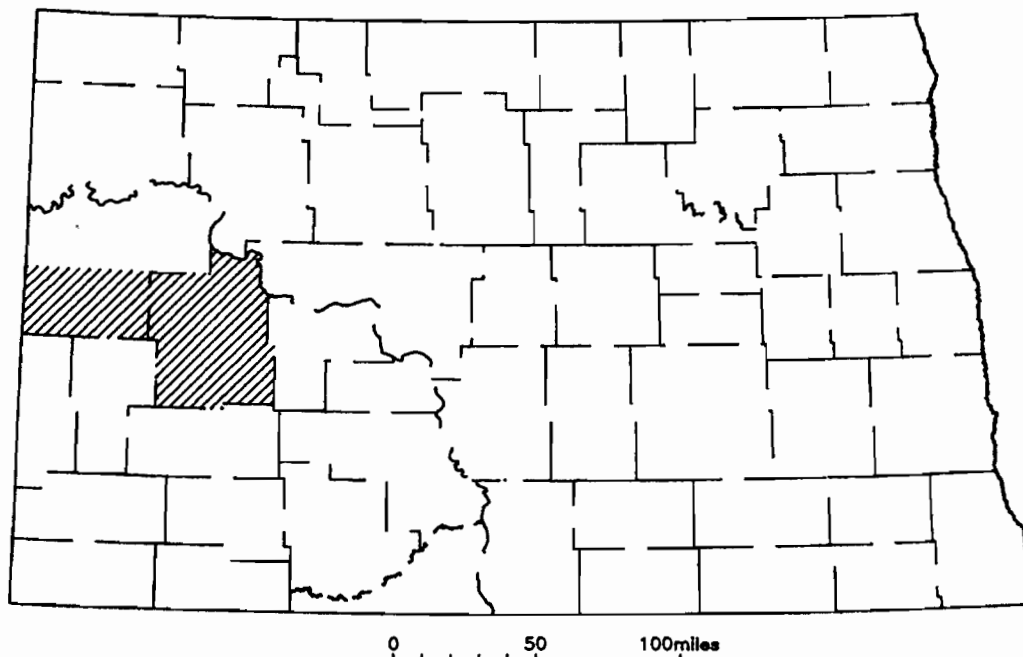


THICK COALS IN DUNN AND SOUTHERN MCKENZIE COUNTIES, NORTH DAKOTA

by

Edward C. Murphy and Gerard E. Goven



Open-File Report No. 98-3
North Dakota Geological Survey
John P. Bluemle, State Geologist
1998

TABLE OF CONTENTS

INTRODUCTION	1
SOUTHERN MCKENZIE COUNTY	2
Harmon (?) Coal	2
Other Coals in Southern McKenzie County	6
DUNN COUNTY	6
Harmon (?) Bed	6
Dunn Center Bed	18
JK Ranch Bed	18
CONCLUSION	18
REFERENCES	18
APPENDICES	22
Appendix A	22
Appendix B	31

LIST OF ILLUSTRATIONS

Figure

1. Well control in the Dunn County and southern McKenzie county study area	1
2. Isopach of the Harmon (?) coal in southern McKenzie County	3
3. Contour map on the top of the Harmon (?) coal in southern McKenzie County	4
4. Depth to the Harmon (?) coal in southern McKenzie County	5
5. A north-south geologic cross-section (A-A') of the Harmon (?) coal in southern McKenzie County	7
6. A north-south geologic cross-section (B-B') of the Harmon (?) coal in southern McKenzie County	8
7. An east-west geologic cross-section (C-C') of the Harmon (?) coal in southern McKenzie County	9
8. An east-west geologic cross-section (D-D') of the Harmon (?) coal in southern McKenzie County	10
9. A cross-section through Fort Union strata in south-central McKenzie County	11
10. The traces of cross-sections A-A' through G-G' in Dunn County	12
11. Cross-section A-A' of Fort Union and Upper Cretaceous strata in northern Dunn County ..	13
12. Cross-section B-B' of Fort Union and Upper Cretaceous strata in central Dunn County ..	14
13. Cross-section C-C' of Fort Union and Upper Cretaceous strata in southern Dunn County ..	15
14. Cross-section D-D' of Fort Union and Upper Cretaceous strata in western Dunn County ..	16
15. Cross-section E-E' of Fort Union and Upper Cretaceous strata in eastern Dunn County ..	17
16. Cross-section F-F' of Sentinel Butte strata in central Dunn County	19
17. Cross-section G-G' of Sentinel Butte strata in central Dunn County	20
18. Cross-sections H-H' and I-I' through Fort Union strata in southern Dunn County	21

INTRODUCTION

Stratigraphic data from all of the available coal logs and oil and gas logs run to the surface or near surface in Dunn and southern McKenzie counties were entered into a computer database (Stratifact). Lithologic data from approximately 2100 holes, in a 3500 square mile area, was entered into this system (Figure 1). Typically, gamma logs run through surface casing were the only electric logs available from oil and gas wells. It is not possible to verify all low gamma traces on the oil logs represent coals without an accompanying density log.

Approximately 1500 to 2000 feet of coal-bearing (Fort Union) strata are present in this portion of the Williston Basin. The base of the Fort Union Group varies between elevations of 800 to 1300 feet above sea level. An oil well in this area will typically encounter 10-20 coal beds, most of which will be less than 5 feet thick. Only a handful of coal beds in this area were found to be more than 10 feet thick, and only a few beds exceeded 20 feet in thickness.

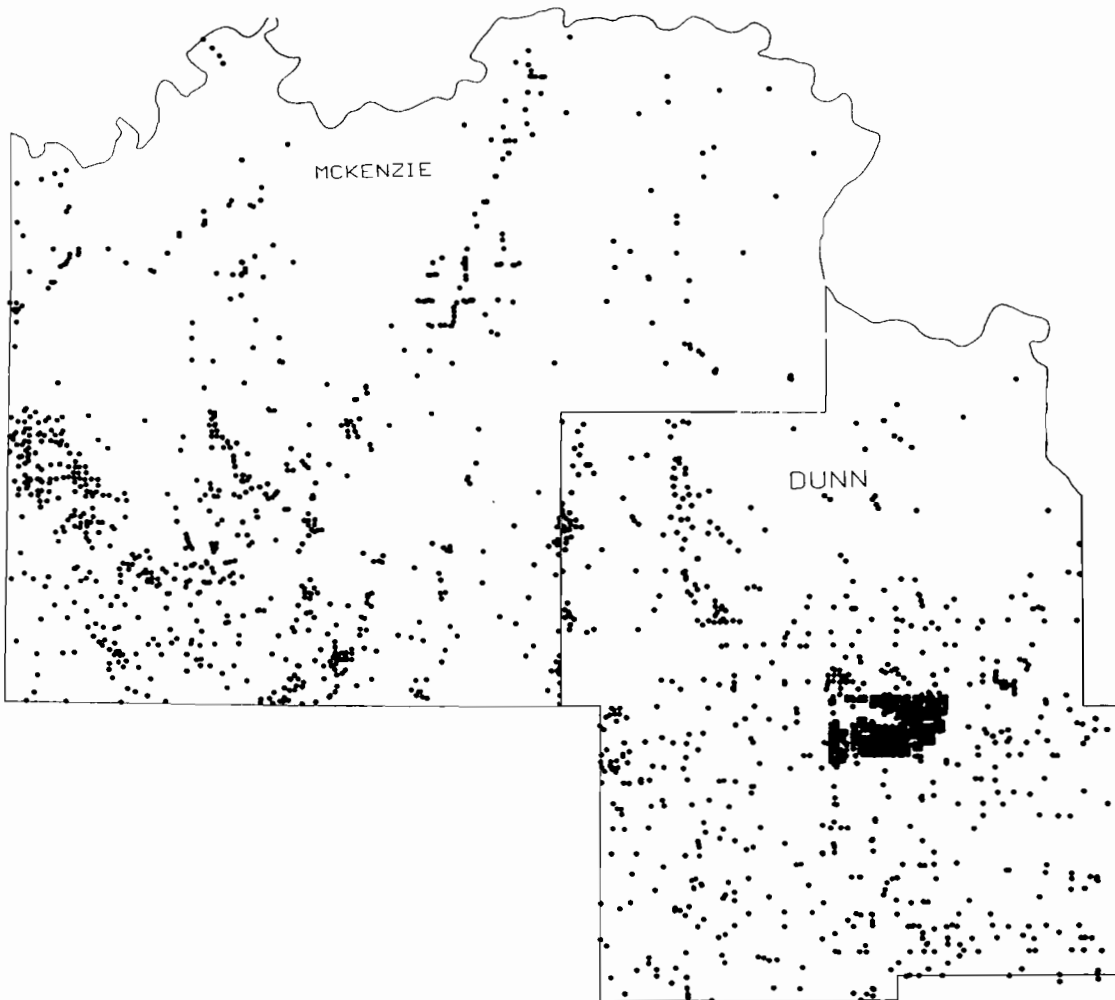


Figure 1. Well control in the Dunn County and southern McKenzie county study area.

SOUTHERN MCKENZIE COUNTY

The thick coal in southern McKenzie County was referred to as the Harmon (?) coal by Murphy and Goven (1998). Carlson (1985) noted that this coal was in the lower Tongue River Formation (Bullion Creek) at the same approximate stratigraphic horizon as the Harmon bed. Recent preliminary stratigraphic correlations by the U.S. Geological Survey question whether this thick coal is correlative to the Harmon (Al Ochs, personal communication, 1998). The oil and gas logs from Billings, Golden Valley, and Slope counties have not yet been entered into the database. As a result, we do not yet have the control needed to definitively determine whether or not this thick coal is correlative with the Harmon bed in Slope and southern Golden Valley counties. In the absence of this data, we have elected to continue the use of the Harmon (?) when referring to the thick coal bed in southern McKenzie County and north-central Dunn County.

The stratigraphic information from 827 holes in McKenzie County has been entered into the computer database. Of these, 487 were oil and gas logs. However, only a fraction of these holes were used to construct the maps and cross-sections in southern McKenzie County. Well control for Figures 2-8 was provided by 143 oil-and-gas gamma logs and 36 coal holes drilled by Burlington Northern in 1979 and 1980. Although the coal logs provide more information (gamma, resistivity, and density) than the oil logs (gamma), a reliable surface elevation is only available for the oil logs. As a result, all wells were used to construct the isopach map (Figure 2) but only the oil logs were used to construct the other maps and cross-sections.

Harmon (?) Coal

The Harmon (?) bed obtains a thickness of 52 feet in south-central McKenzie County, the thickest known coal in North Dakota (Figure 2). Although it may not exceed 50 feet in thickness for more than a few square miles (3 square miles in four separate areas), it is in excess of 40 feet for approximately 89 square miles (57,000 acres) covering most of townships T.147N., R.101W. and R.102W. and at least half of townships T.146N., R.101W. and R.102W. The isopach was constructed using the following criteria: 1) a clay split of less than a few feet was ignored (but not added to the total coal thickness), and 2) if the Harmon (?) was split into two or more beds by five feet or more of clay, the isopach was generated from the thicker of the two or more coal beds (Appendix A). As a result, the cumulative thickness of the Harmon (?) bed maybe much more than is indicated along the periphery of the main deposit (the area encompassed between the 10 and 30 foot contour lines).

The Harmon (?) bed dips to the northeast at an average rate of 15 to 20 feet per mile (Figure 3). Dip is rather uniform except for a topographic high just off the map in T.145N., R.101W. Additional well data from northwestern Billings County may demonstrate that this topographic high is not as pronounced as indicated on this map. The area of thick coal is bisected by the Little Missouri River (Figure 4). Due primarily to badlands topography, the

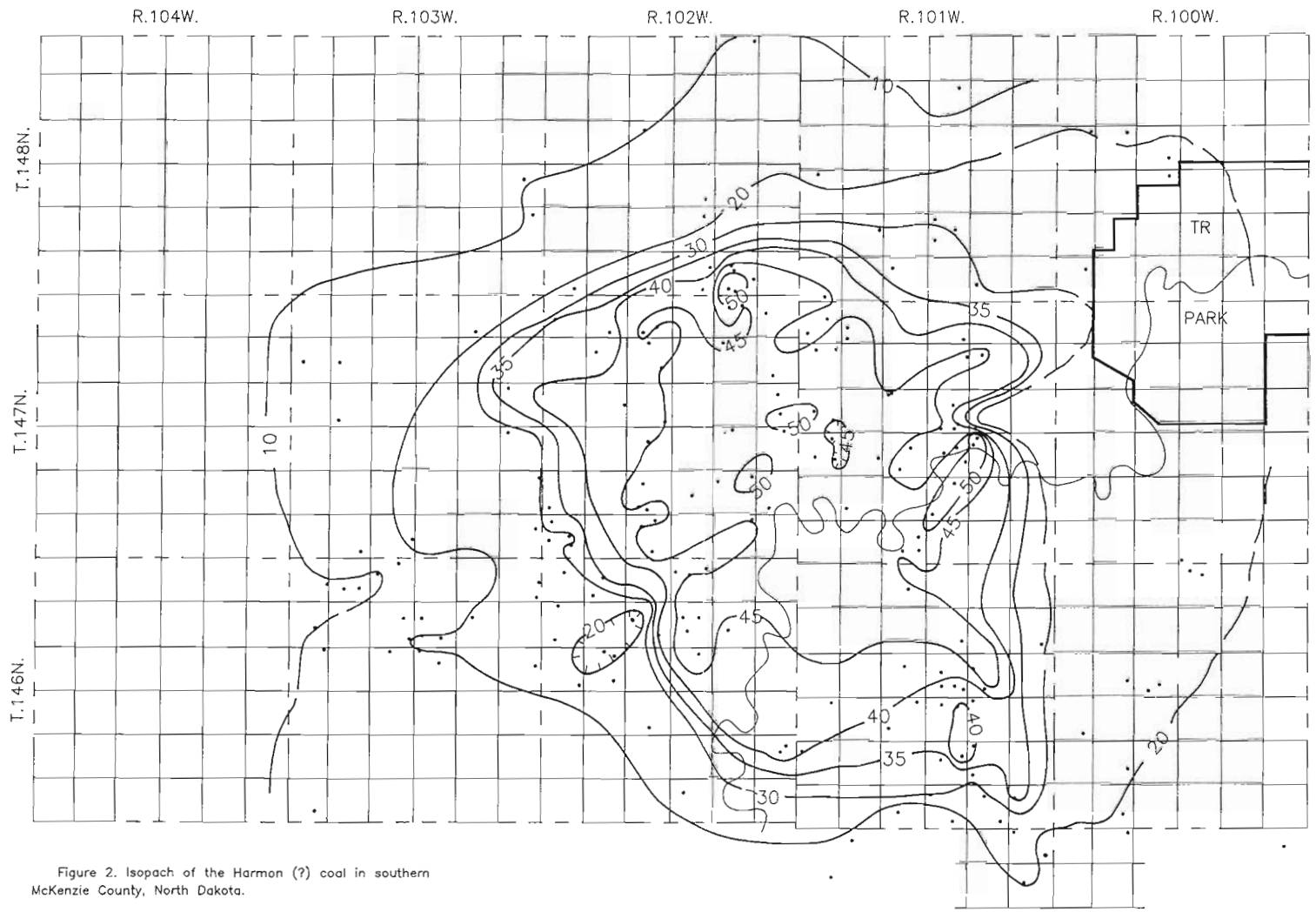


Figure 2. Isopach of the Harmon (?) coal in southern McKenzie County, North Dakota.

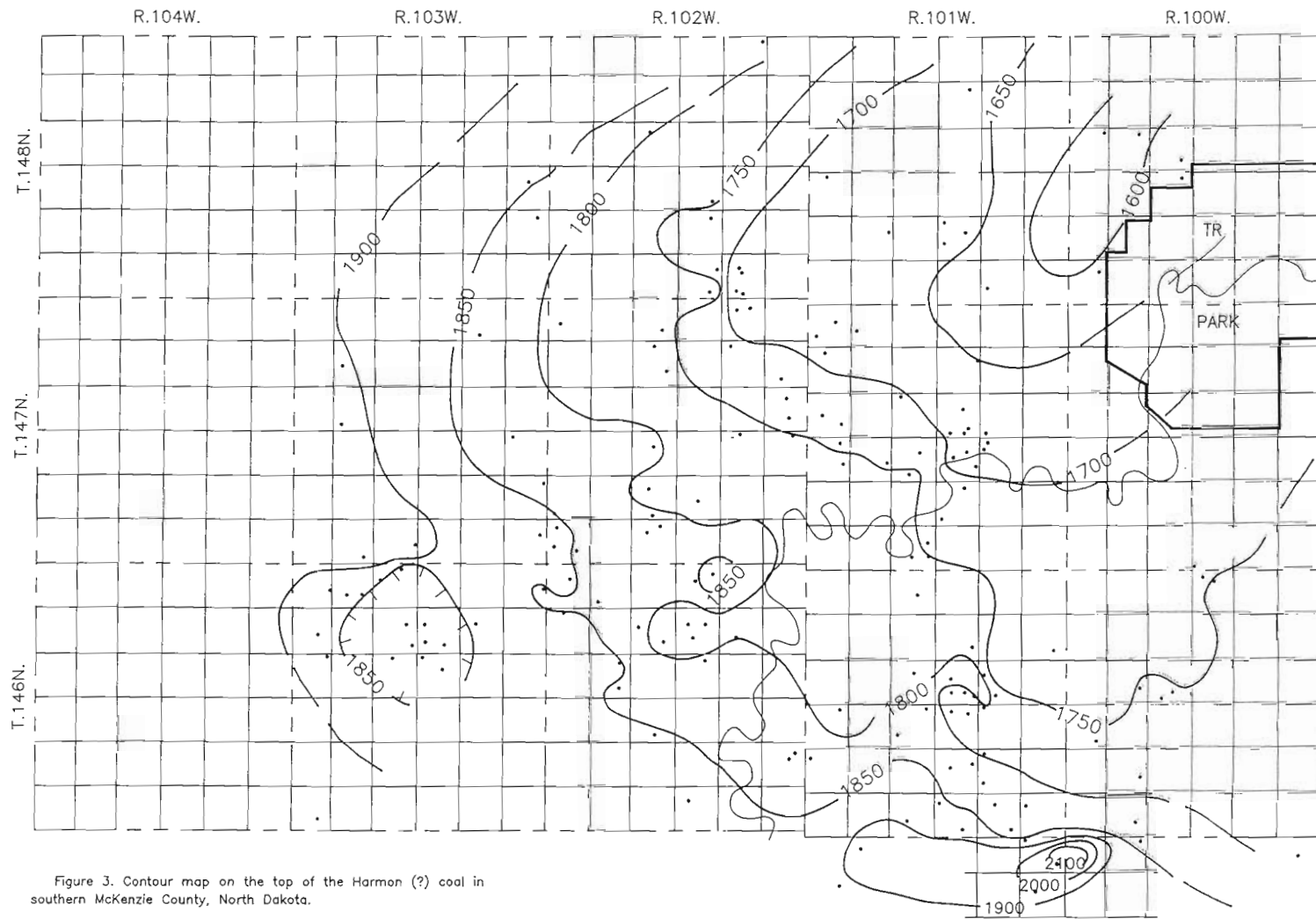


Figure 3. Contour map on the top of the Harmon (?) coal in southern McKenzie County, North Dakota.

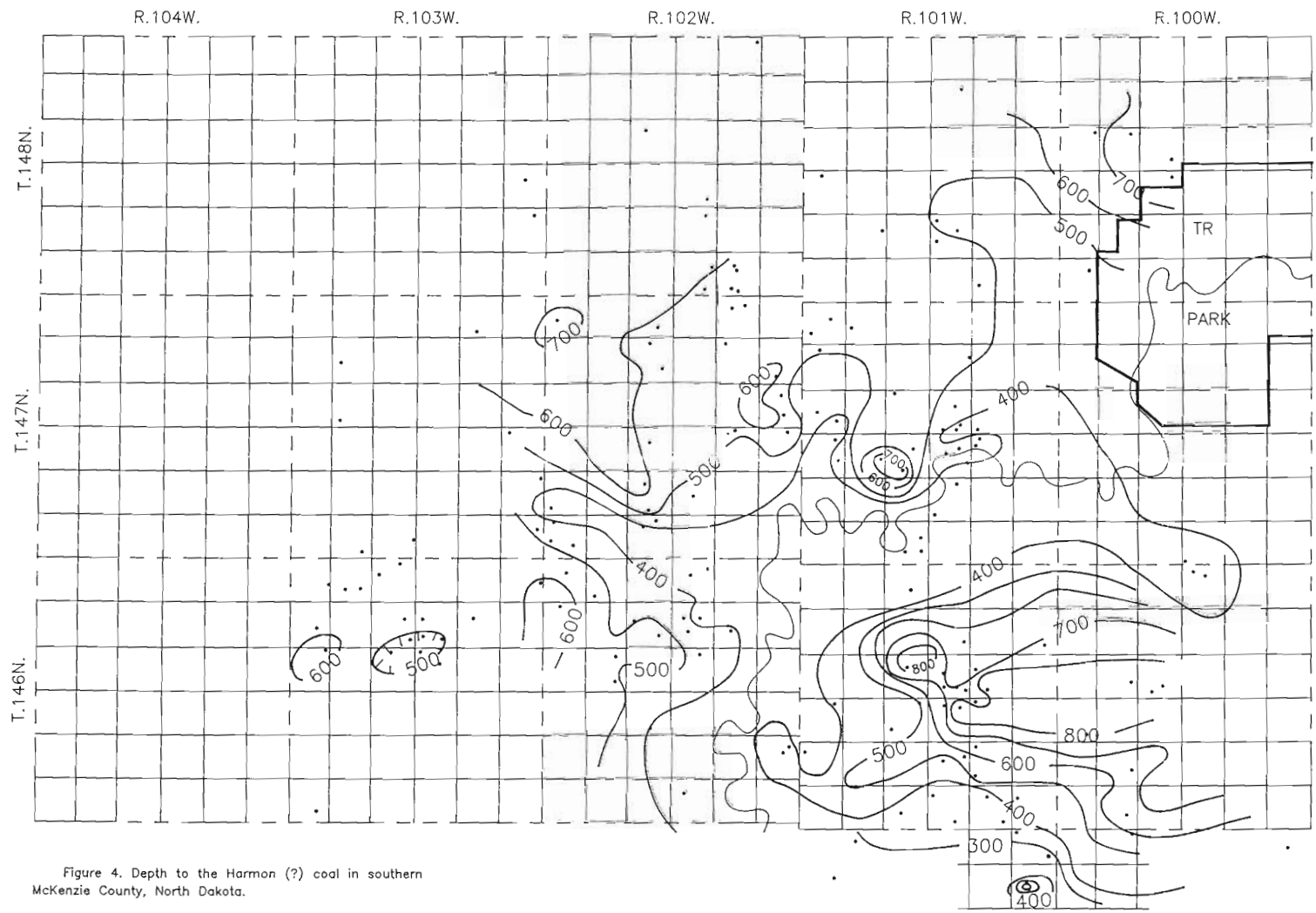


Figure 4. Depth to the Harmon (?) coal in southern McKenzie County, North Dakota.

Harmon (?) coal lies from less than 400 feet to more than 800 feet beneath the surface in southern McKenzie County (Figure 4).

Cross-sections generated across the area demonstrate that the Harmon (?) bed generally persists as a single bed throughout much of the area (Figures 5-8). The coal splits into three or more beds to the north and two beds to the south. The Harmon (?) coal is split into five thin beds at the northern edge of section A-A' but the upper coal bed at the north edge of section B-B' is approximately 30 feet thick. To the south, the thicker of the two coal splits ranges from 16 feet at the terminus of B-B' to 26 feet at A'. To the west and east, the coal splits primarily into two beds. Along the western edge of cross-sections C and D, the coal splits are less than 15 feet thick. But, along the eastern edge the upper coal bed maintains a thickness of approximately 25 feet (Figures 7 and 8).

Other Coals in Southern McKenzie County

The Fort Union Group (Paleocene) in this area consists of approximately 1500 feet of strata, most of which is coal-bearing. Up to fourteen individual beds of coal were detected on the oil-and-gas gamma logs in southern McKenzie County (Figure 9). The majority of these coals were less than five feet thick and only a few were thicker than 10 feet. No thick coals (coals greater than 20 feet), other than the Harmon (?), were detected within the Fort Union Group in southern McKenzie County.

DUNN COUNTY

A total of 1270 holes were entered into the database system for Dunn County, 980 coal logs and 294 oil and gas logs. Seven geologic cross-sections were constructed across the county using the Stratifact database (Figures 10-17). The coal correlations were not verified with electric logs and therefore these sections should only be used as a general guide to the coal stratigraphy of Dunn County.

Harmon (?) Bed

The Harmon (?) bed in can be traced east from the Dunn/McKenzie County line to the approximate mid point of Dunn County (Figures 11, 12, 14). The bed thins eastward from 30 feet (with several splits) along the west edge of the county to 10 feet or less north of Killdeer. The Harmon (?) is present throughout this area (T144N-T147N, R95W-R97W) between the elevations of 1500 to 1600 feet. A coal of variable thickness, tentatively identified as the Harmon (?), can be traced through southern Dunn County between the elevations of 1600 to 1800 feet (Figure 13-15).

NORTH
A

SOUTH
A'

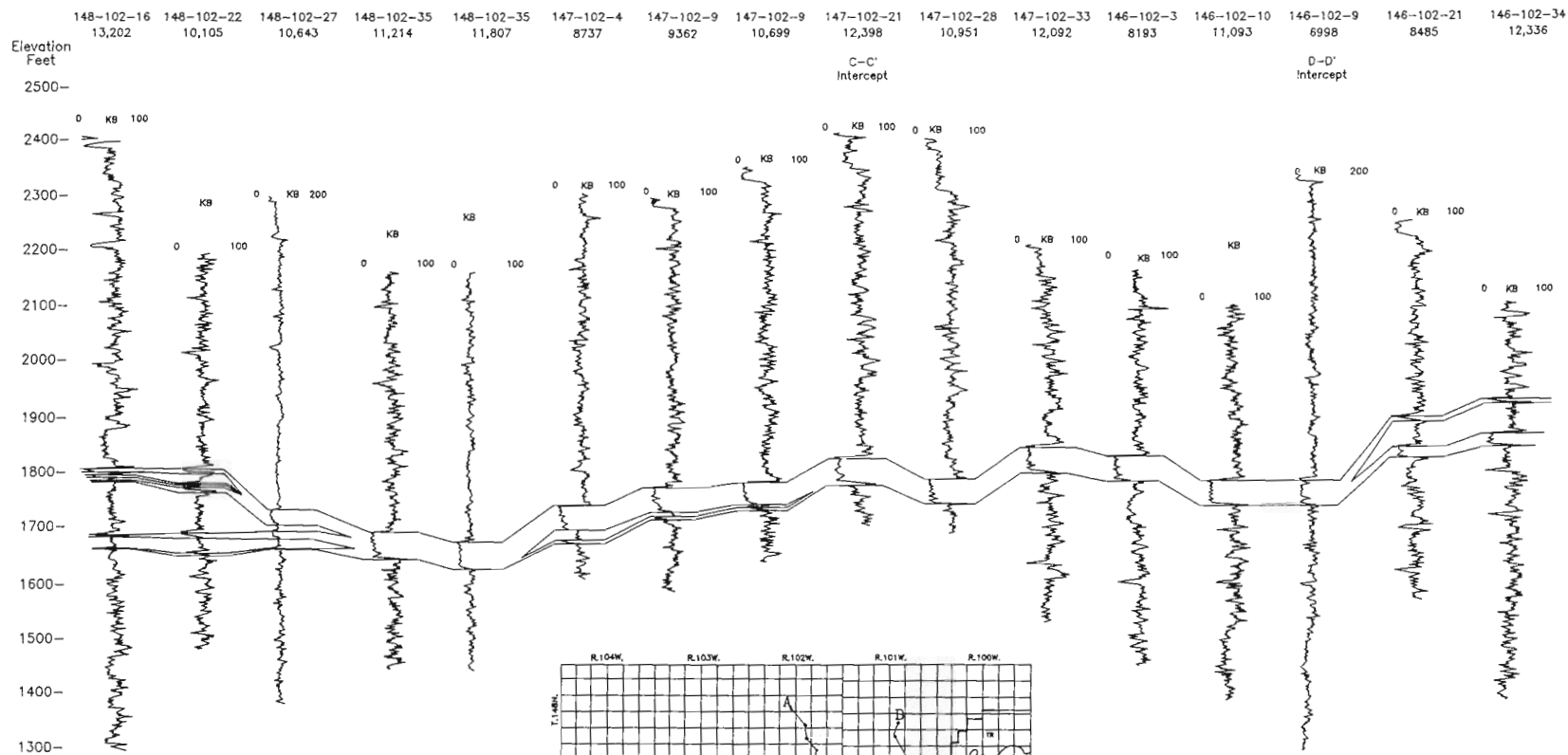


Figure 5. A north-south geologic cross-section (A-A') of the Harmon (?) coal in southern McKenzie County, North Dakota.

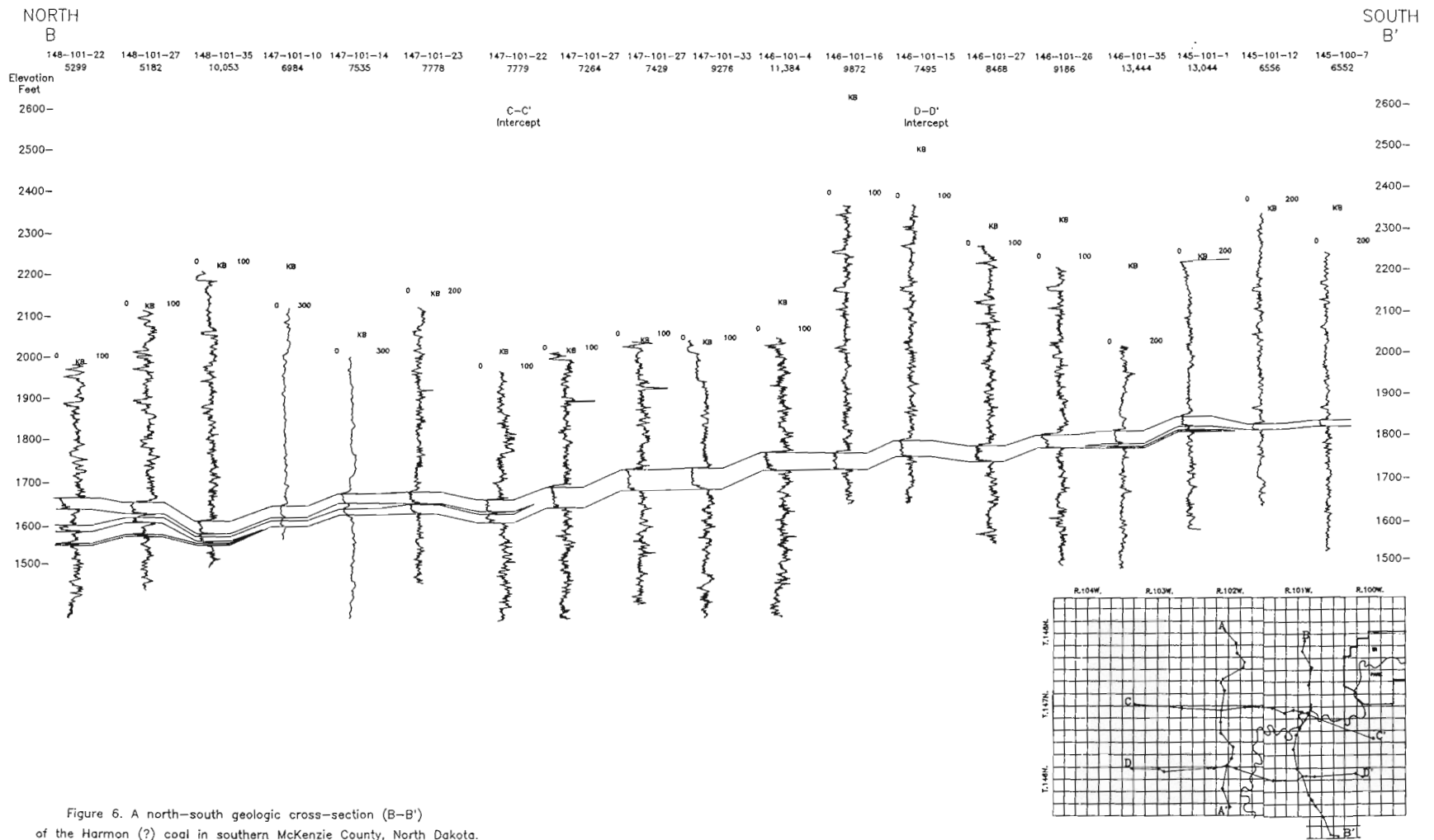


Figure 6. A north-south geologic cross-section (B-B') of the Harmon (?) coal in southern McKenzie County, North Dakota.

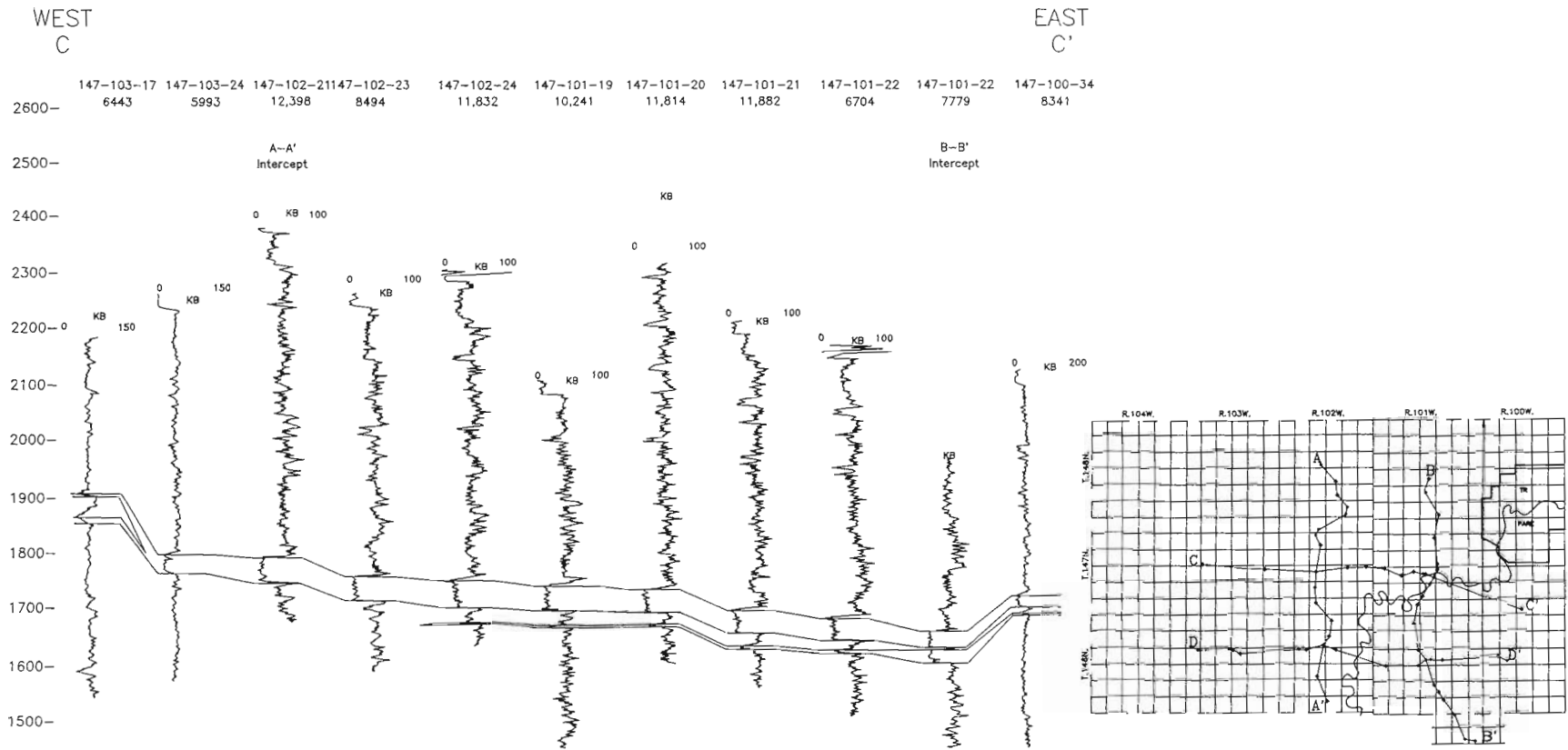


Figure 7. An east-west geologic cross-section (C-C') of the Harmon (?) coal in southern McKenzie County, North Dakota.

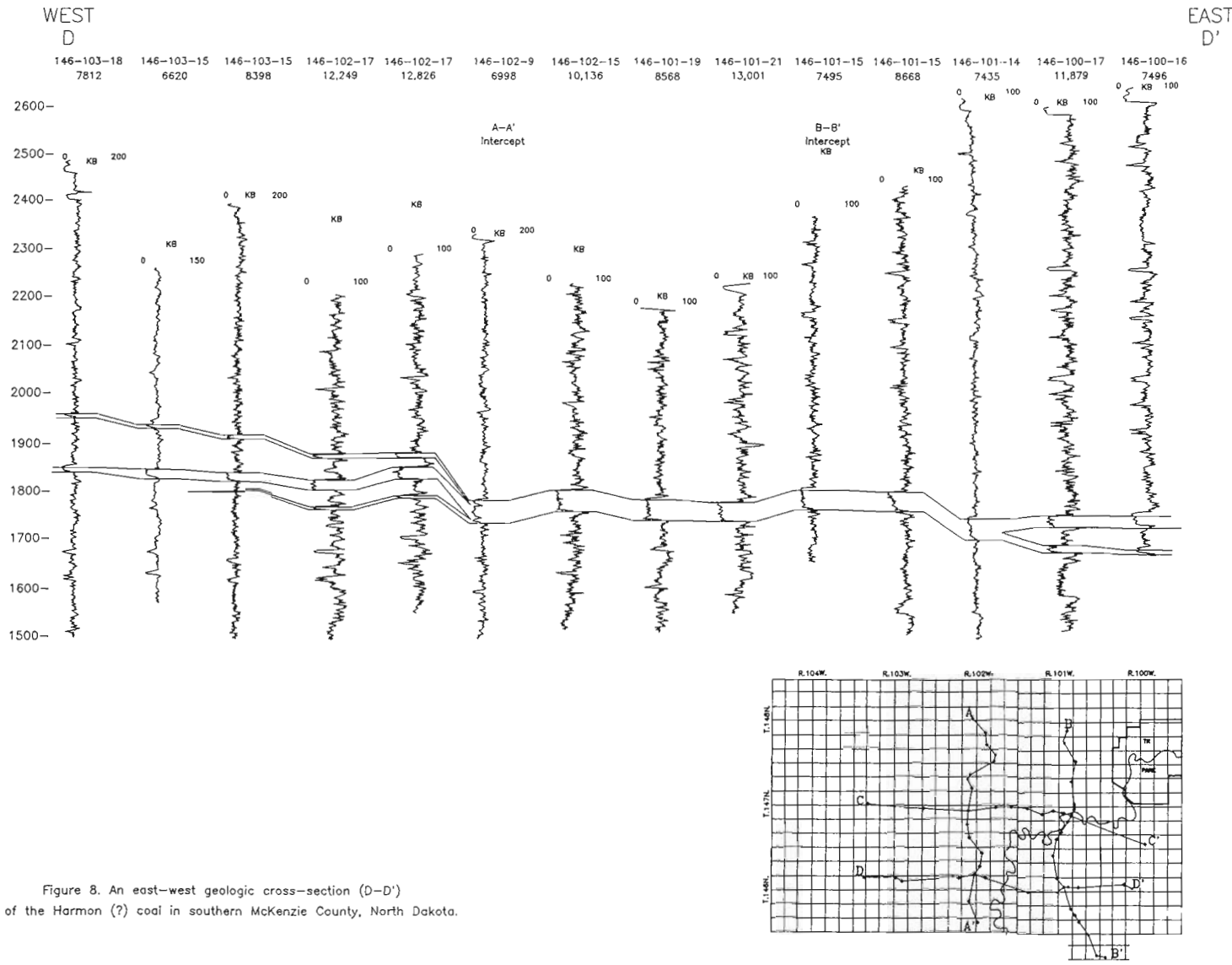


Figure 8. An east-west geologic cross-section (D-D') of the Harmon (?) coal in southern McKenzie County, North Dakota.

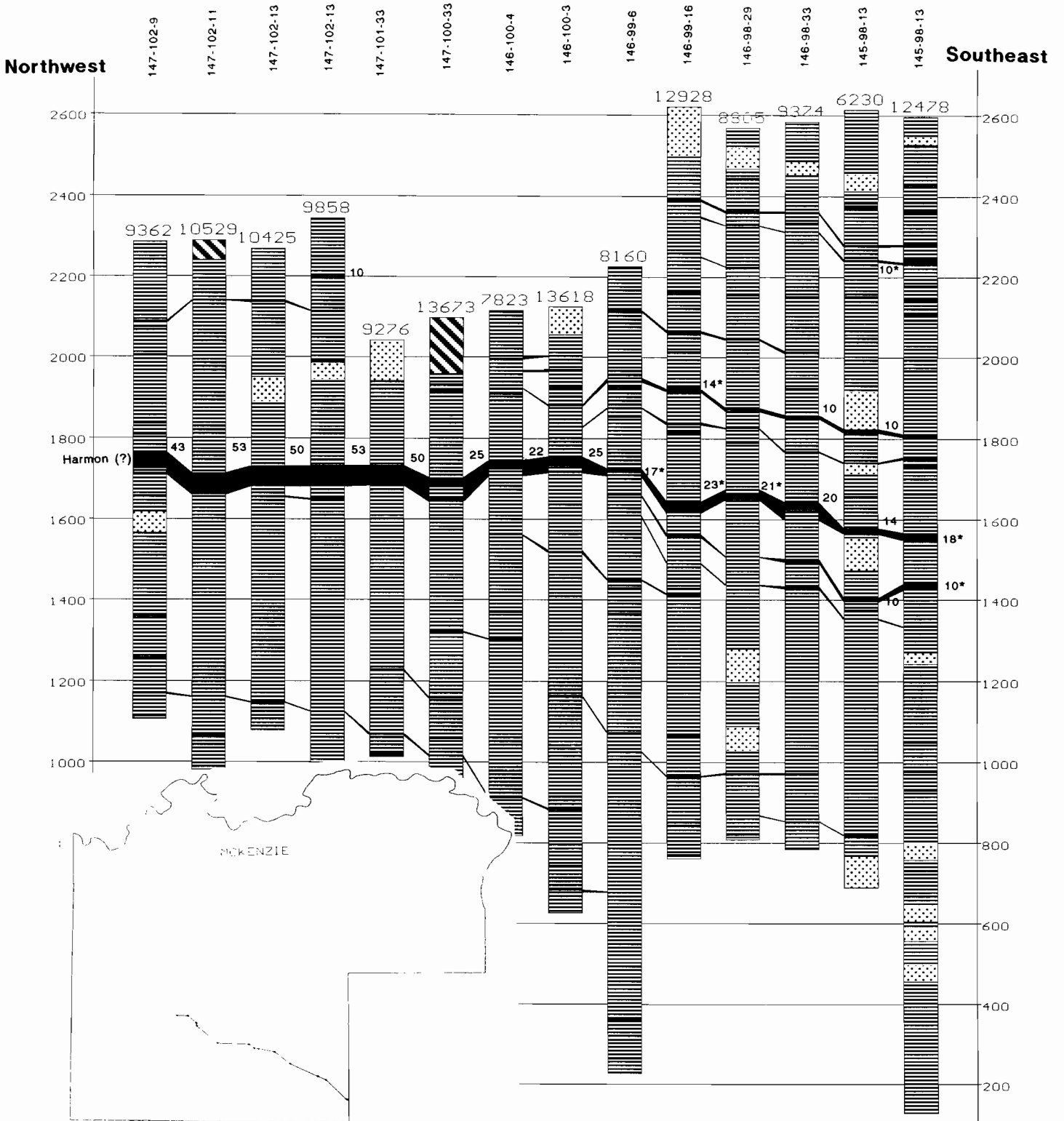


Figure 9. A cross-section through Fort Union strata in south-central McKenzie County. Only one coal was found in excess of 20 feet in this area (Harmon (?)) and only a few were thicker than 10 feet. Coal thickness \geq to 10 feet are noted on the diagram.

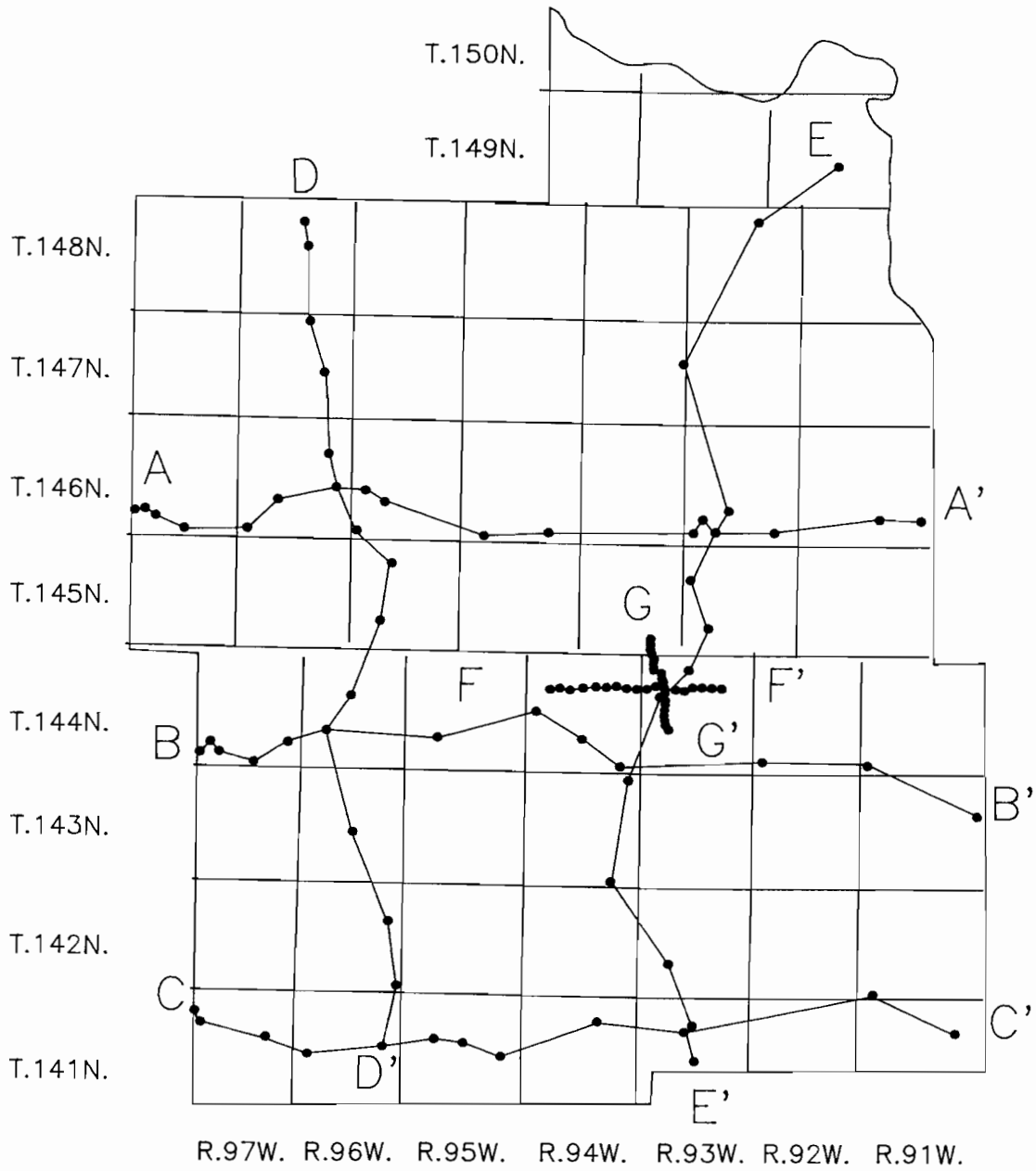


Figure 10. The traces of cross-sections A-A' through G-G' in Dunn County.

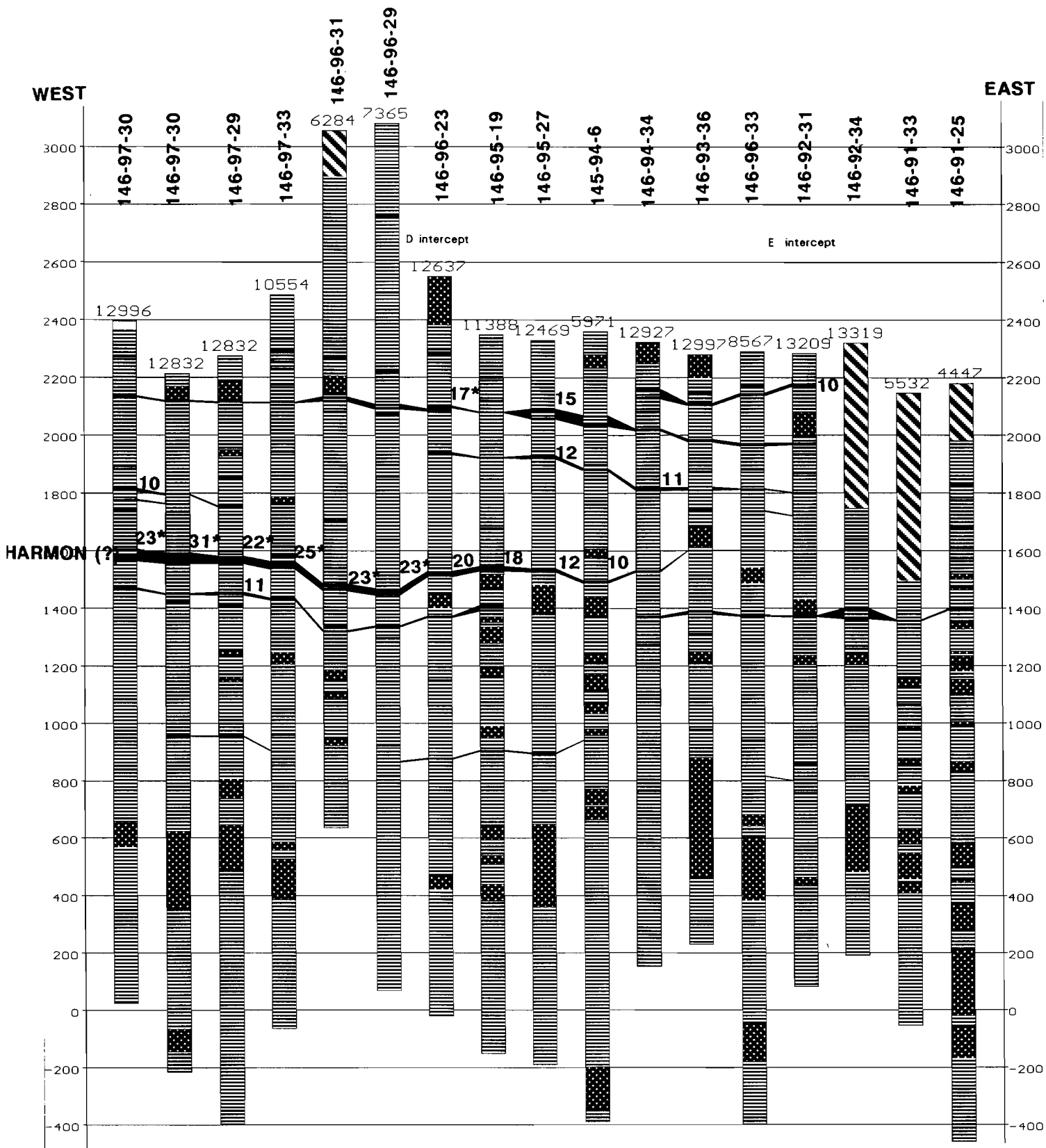


Figure 11. Cross-section A-A' of Fort Union and Upper Cretaceous strata in northern Dunn County.

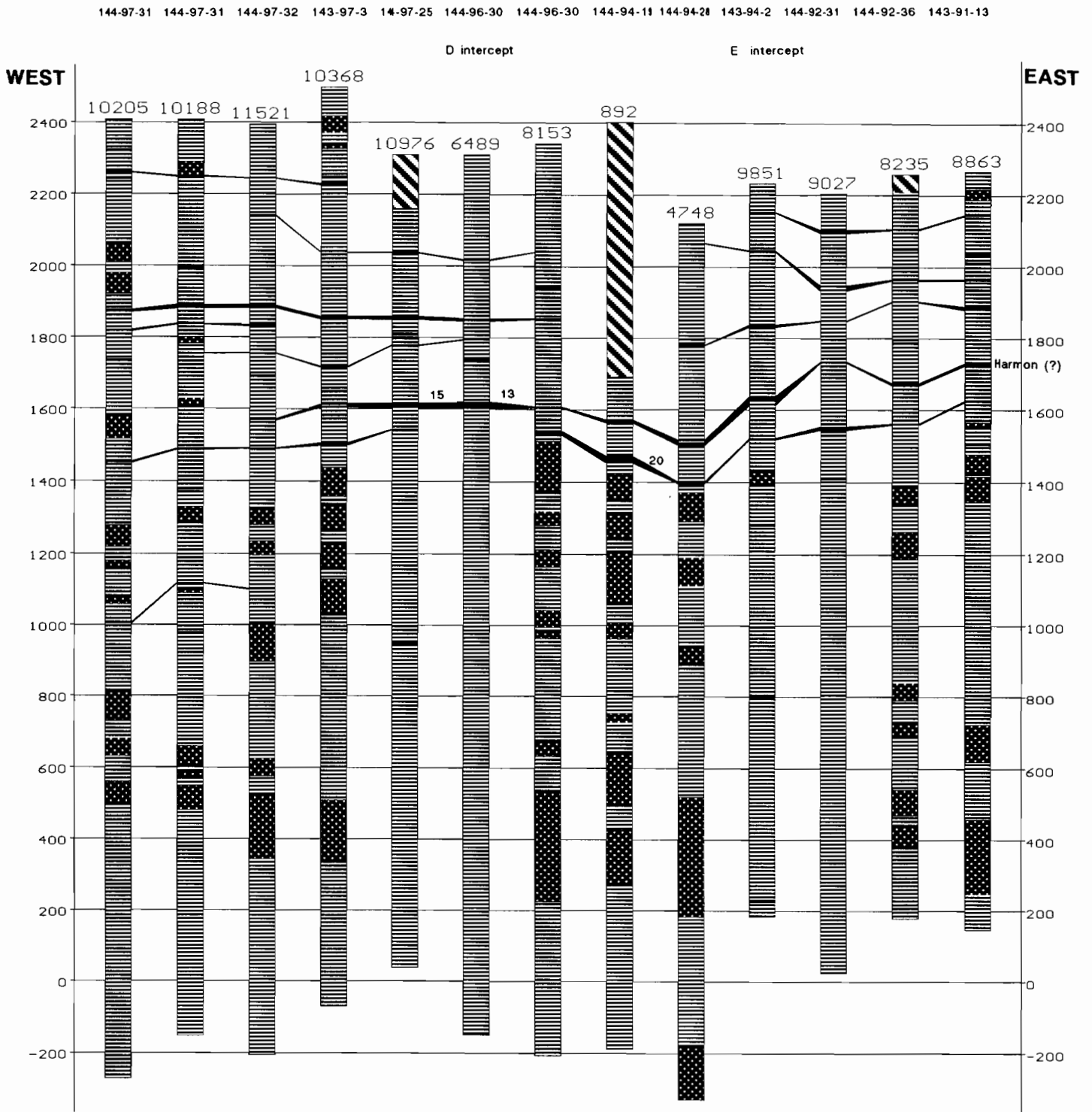


Figure 12. Cross-section B-B' of Fort Union and Upper Cretaceous strata in central Dunn County.

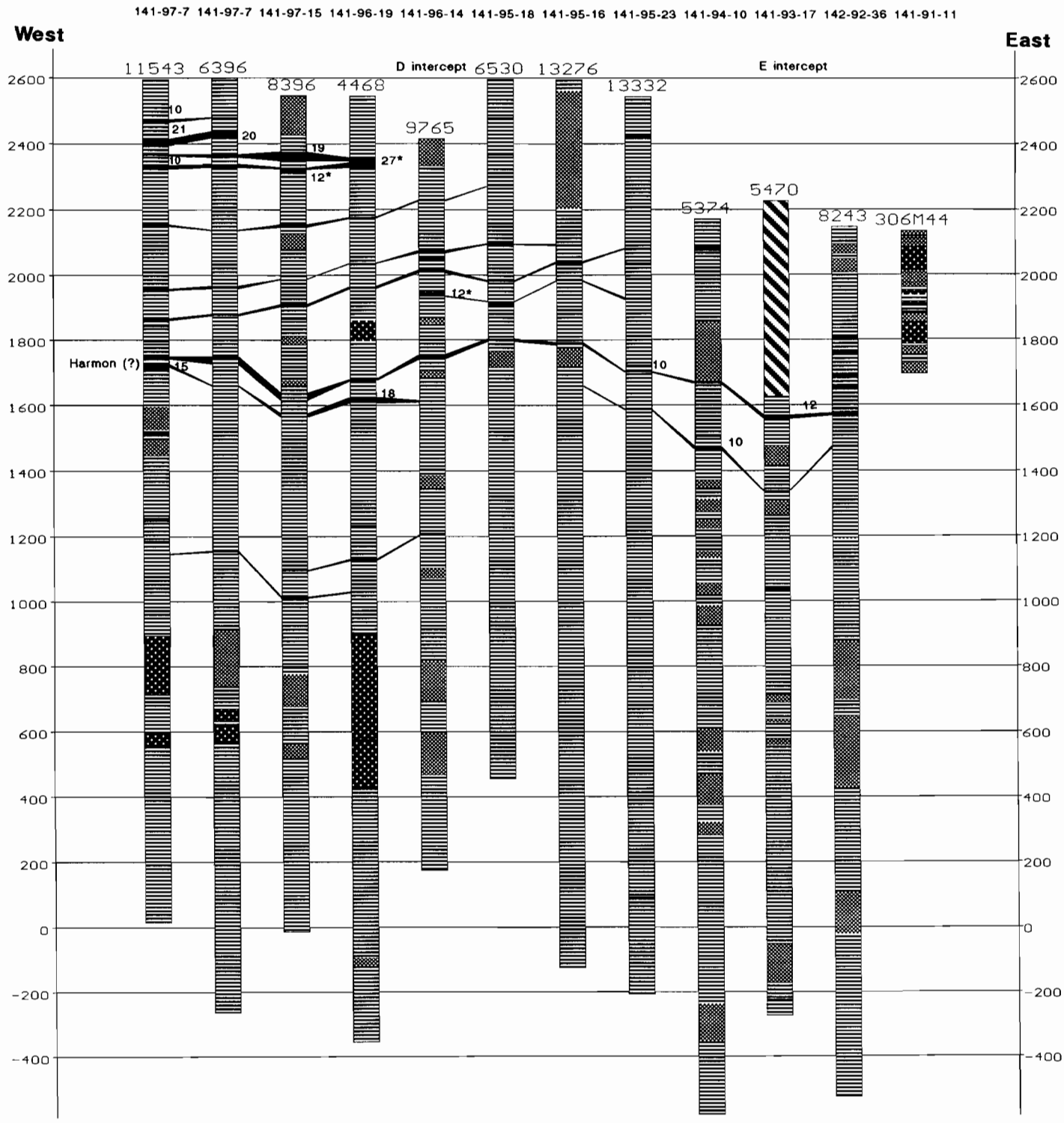


Figure 13. Cross-section C-C' of Fort Union and Upper Cretaceous strata in southern Dunn County.

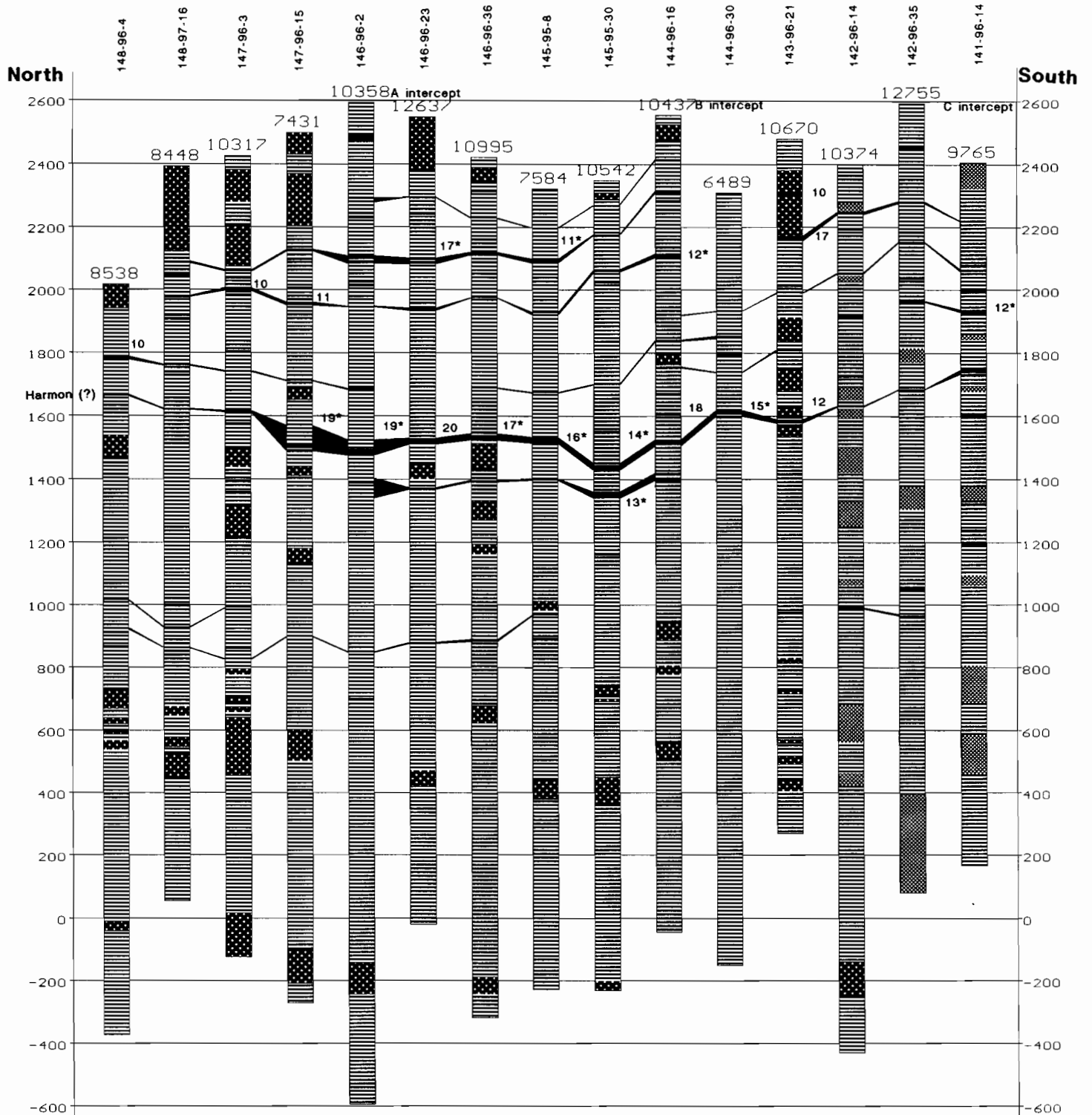


Figure 14. Cross-section D-D' of Fort Union and Upper Cretaceous strata in western Dunn County.

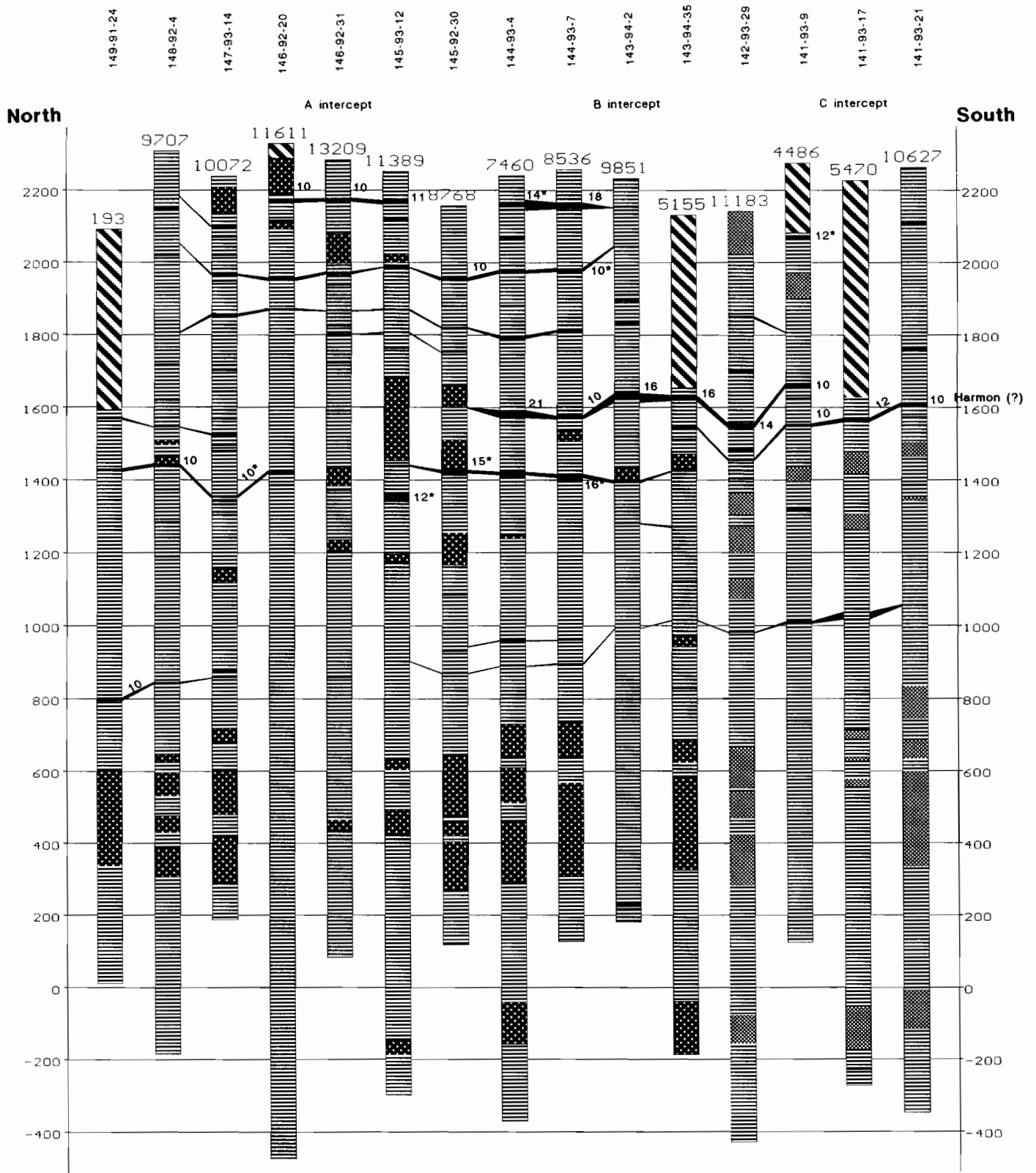


Figure 15. Cross-section E-E' of Fort Union and Upper Cretaceous strata in eastern Dunn County.

Dunn Center Bed

The Dunn Center coal is stratigraphically positioned near the middle of the Sentinel Butte Formation. The coal generally ranges in thickness from 15 to 20 feet at depths from 50 to 250 feet below the surface over a 60 square-mile area in central Dunn County (Figures 16 and 17). The bed has been well delineated by nearly 2000 holes drilled by coal companies in the southern portion of T145N, R93W, the central portion of T144N, R94W, and the west half of T144N, R93W. Additional cross-sections of the Dunn Center bed are presented in North Dakota Geological Survey Open-File Report 98-1.

JK Ranch Bed

The JK Ranch bed is a thick coal that lies in the upper part of the Sentinel Butte Formation. The coal is 15 to 20 feet thick and present at depths of 50 to 175 feet along the Stark/Dunn county line. The bed splits and thins to the north into Dunn County but may be equivalent to two, 15 to 20 foot thick coals at a depth of 300 to 400 feet in T142N, R96W (Figure 18).

CONCLUSIONS

The Harmon (?) bed can be traced from southwestern McKenzie County to the midpoint of Dunn County with a high degree of confidence. A persistent coal can be traced throughout most of Dunn County at this same stratigraphic position that may be equivalent to the Harmon (?). The Harmon (?) obtains a maximum thickness of over 50 feet in southern McKenzie county and is approximately 20 feet thick over a large area of west-central Dunn County. The Dunn Center bed approaches 20 feet in thickness over an area of a few townships in central Dunn County. The JK Ranch bed may be equivalent to two 15 to 20 foot thick beds in southern Dunn County. Other than these three beds, no laterally extensive beds of coal thicker than 20 feet were encountered on the logs from these two counties.

REFERENCES

- Carlson, C.G., 1985, Geology of McKenzie County, North Dakota: North Dakota Geological Survey Bulletin 80, Part 1, 48 p.
- Murphy, E.C. and Goven, G.E., 1998, Coalbed methane potential of North Dakota lignites: North Dakota Geological Survey Open-File Report no. 98-1, 38 p.

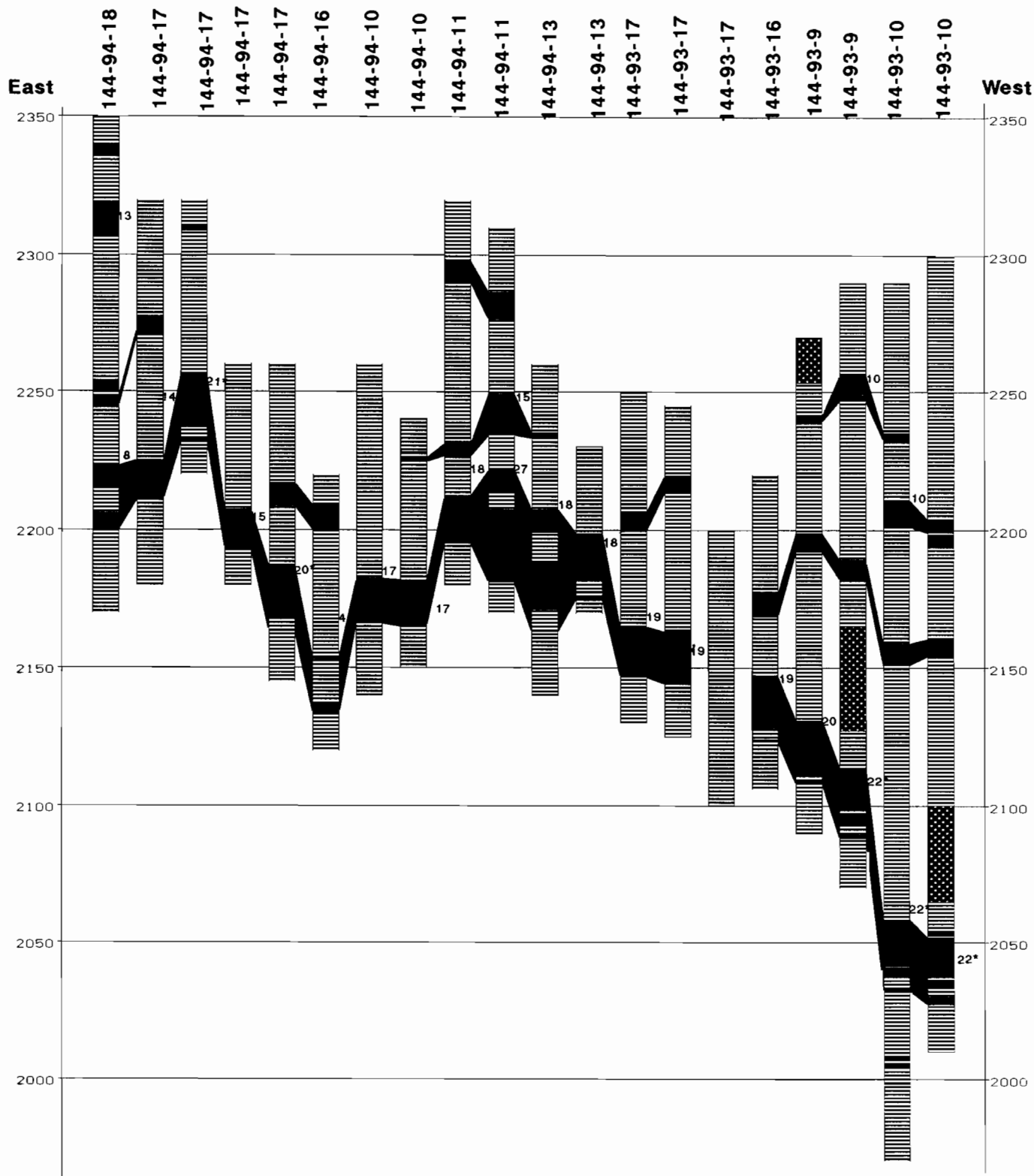


Figure 16. Cross-section F-F' of Sentinel Butte strata in central Dunn County.

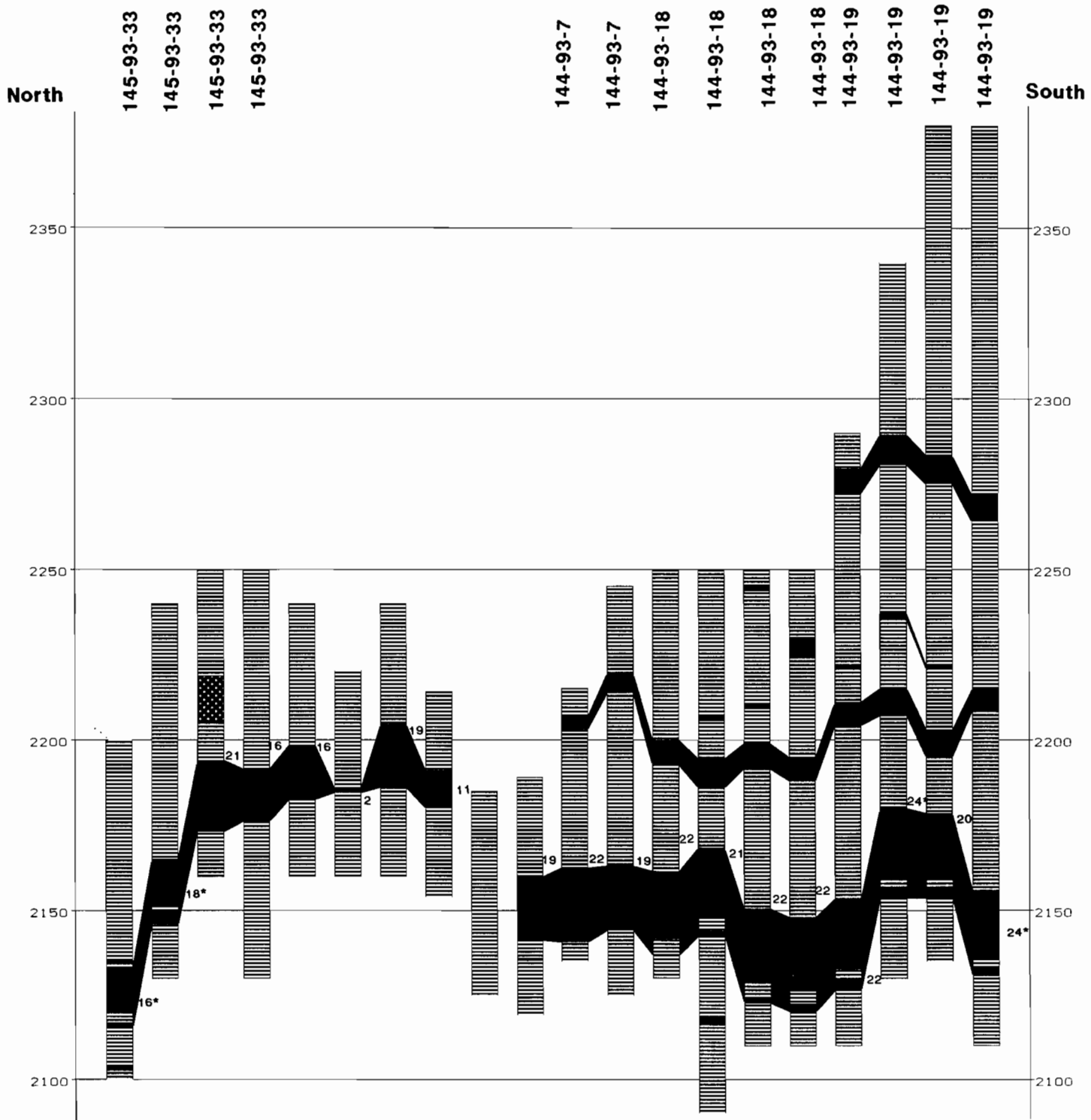


Figure 17. Cross-section G-G' of Sentinel Butte strata in central Dunn County.

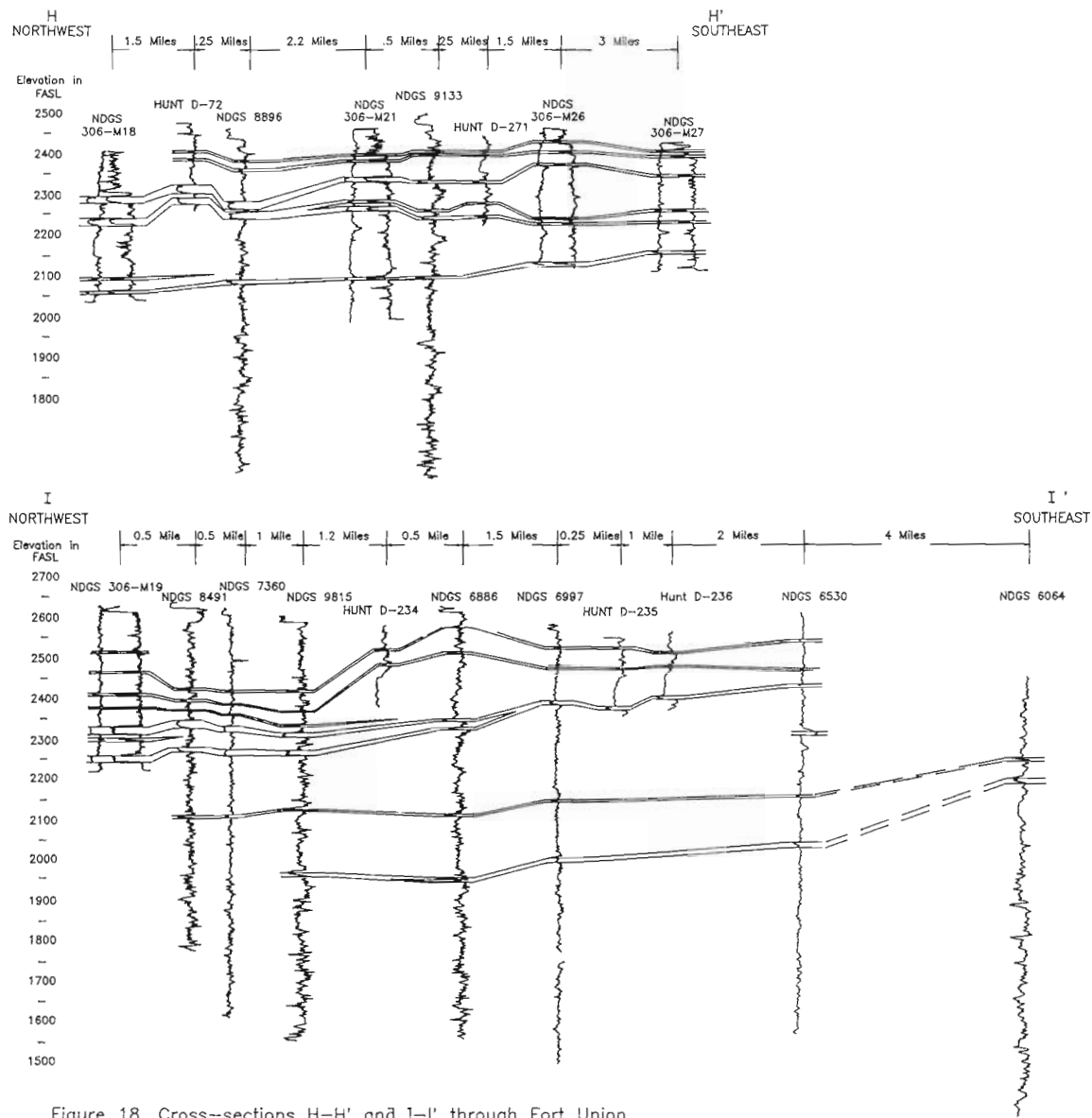


Figure 18. Cross-sections H-H' and I-I' through Fort Union strata in southern Dunn County.

APPENDICES

Appendix A -- Basic Data Used to Generate Figures 2-4.

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
145-100-1 SW/NE	8,013	2442	735	1707	17	
145-100-5 NE/NE	6,791	2588	760	1828	13	
145-100-7 NE/NW	7,555	2312	410	1902	15	5' coal, 8' clay 15' coal
145-100-7 SE/SW	6,552	2346	505	1841	16	
145-100-9 SW/NW	11,727	2255	440	1815	10	3 10' coals over 60' interval
145-100-10 NW/SW	11,275	2282	440	1842	10	3 10' coals over 80' interval
145-100-12 SE/NW	8,064	2545	795	1750	8	4' coal, 2' clay 8' coal
145-101-1 NW/NW	13,044	2231	378	1853	22	
145-101-1 SE/SE	7,525	2443	300	2143	10	
145-101-5 SE/NW	13,071	2214	270	1944+	19	8' coal, 12' clay 19' coal
145-101-7 SE/SE	13,165	2170	297	1873	18	
145-101-7 SE/NW	11,718	2111	230	1881?	16	4 coals
145-101-11 SW/NE	6,077	2324	430	1894?	16	2 coals
145-101-12 SE/NE	6,926	2285	365	1920?	15	5' coal, 6' clay 15' coal
145-101-12 NW/SE	6,556	2351	505	1846	15	5' coal, 30' clay 15' coal
145-101-12 NE/SW	12,091	2500	600	1900?	20	7' coal, 4' clay 20' coal
145-101-12 SE/SE	12,106	2363	517	1846	15	
145-101-17 NE/NE	12,968	2198	345	1853	16	

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
146-100-3 NE/NW	8,064	2123	380	1743	22	22' coal, 8' clay 8' coal
146-100-3 NW/NE	13,618	2126	370	1756	24	24' coal, 10' clay 5' coal
146-100-16 SE/SW	7,496	2621	870	1751	26	
146-100-16 NW/SE	13,672	2628	880	1748	27	
146-100-17 NE/SE	11,879	2596	840	1756	27	27' coal, 30' clay 12' coal
146-100-19 SE/SE	13,091	2579	825	1754	24	24' coal, 15' clay 10 coal
146-100-29 NE/SE	12,070	2424	640	1784	20	20' coal, 30' clay 8' coal
146-100-32 SE/SE	6,985	2527	695	1832	18	18' coal, 40' clay 6' coal
146-101-4 NW/SE	11,384	2141	360	1781	46	
146-101-10 SE/SE	8,219	2443	680	1763	47	
146-101-12 SW/SE	8,199	2412	700	1712	55	30' coal, 8' clay 25' coal
146-101-14 SW/NW	2,667	2392	650	1742	45	
146-101-14 NE/SW	7,435	2612	860	1752	45	
146-101-15 SE/NW	7,494	2557	735	1822	43	
146-101-15 SE/SW	7,495	2492	695	1797	38+	
146-101-15 SW/SE	8,668	2453	655	1798	38	
146-101-15 SE/SE	6,846	2443	660	1783	37	
146-101-16 NE/NE	9,872	2628	850	1778	41	
146-101-19 SE/NE	8,568	2196	410	1786	44	
146-101-21 NE/NE	13,001	2263	455	1808	39	
146-101-22 NE/NW	8,086	2477	685	1792	35	
146-101-22 SW/NE	7,512	2616	830	1786	41	

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
146-101-23 NW/NW	4,520	2449	648	1801	37	
146-101-26 NW/NW	12,049	2417.5	620	1798	40	
146-101-26 SW/SW	9,186	2318	510	1808	32	
146-101-27 SE/NW	12,226	2274	455	1819	34	
146-101-27 SE/NE	8,468	2357	520	1837	40	
146-101-30 SW/NW	13,344	2153	320	1833	38	
146-101-33 NE/SW	12,568	2257	370	1887	24	8' coal, 4' clay 16' coal
146-101-34 W1/2/NW	9,982	2171	322	1849	30	30' coal, 5' clay 3' coal
146-101-34 SW/SE	10,458	2234	360	1874	19	10' coal, 10' clay 19' coal
146-101-35 SE/SE	13,105	2179	355	1824	26	26' coal, 4' clay 5' coal
146-101-35 SE/NW	13,444	2213	385	1828	30	30' coal, 7' clay 4' coal
146-101-36 SW/NW	6,503	2256	450	1806	37	
146-102-3 SE/NW	8,193	2185	370	1815	47	
146-102-3 SW/NE	8,762	2164	360	1804	44	
146-102-5 SW/SW	12,073	2460	610	1850	31	10' coal, 10' clay 21' coal
146-102-6 SW/NE	9,501	2427	570	1857	24	
146-102-7 NW/NW	11,995	2499	630	1869?	33	10' coal, 5' clay 23' coal
146-102-9 SE/SE	6,998	2332	550	1782	44	
146-102-10 SE/NW	11,093	2234	450	1784	46	
146-102-10 SW/NE	10,704	2178	380	1798	46	
146-102-10 NE/SW	9,882	2254	460	1794	46	
146-102-11 NE/SW	6716	2210	410	1800	42	

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
146-102-15 NW/NE	10,136	2292	490	1802	48	
146-102-17 SW/NE	12,826	2391	510	1881?	37	10' coal, 20' clay 22' coal, 35' clay 5' coal
146-102-17 NE/NE	7,585	2391	560	1831	22 + splits	
146-102-17 NE/NW	12,249	2360	530	1830	22 + splits	
146-102-17 SW/SE	11,869	2374	540	1834	22 + splits	
146-102-21 SE/SW	8,485	2255	400	1855	22 + splits	350' to 625'
146-102-25 SW/NE	9,252	2293	460	1833	40	
146-102-25 SE/NE	9,680	2322	495	1827	42	
146-102-34 SW/NW	12,336		340		26 + splits	
146-103-1 SE/SE	11,322	2326	510	1816	34	24' coal, 32 clay 10' coal
146-103-4 SW/NE	8,438	2447	610	1837	17	several splits
146-103-4 SW/NW	6,781	2337			10	5 coal splits 400' to 700'
146-103-5 NW/SE	6,894	2326				5 coal beds 400' to 700'
146-103-5 NE/SW	9,220	2371		1871		4 coal beds 300' to 750' 15' coal @ 500'
146-103-6 NE/SE	8,238	2329		1879		4 coal beds 350' to 700' 13' coal @ 450'
146-103-7 NW/SE	8,481	2414.5				4 coal beds 450' to 760'
146-103-9 SE/NW	5,002	2372		1822		beds from 450'- 750' 18' coal @ 550'
146-103-9 SE/SE	6,527	2278	470	1808	20	
146-103-10 SW/NW	6,747	2270	440	1830	19	

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
146-103-10 SE/SW	6,643	2273	435	1838	17	
146-103-10 SW/SE	7,217	2299	470	1829	20	
146-103-11 SE/NW	7,973	2392	534	1858	20	several beds
146-103-15 NW/NW	6,620	2305	470	1835	17	several beds spread over 300'
146-103-15 SW/NE	8,398	2400	560	1840	17	
146-103-16 NE/NW	6,831	2297	470	1827	18	
146-103-18 NE/NE	7,812	2478	620	1858	15	
146-103-31 SW/SE	13,526	2423	480 680		10 15	
147-100-34 E1/2/SW	8,341	2129	395	1734	24	24' coal, 5' clay 5' coal
147-101-5 NW/SW	5,562	2185.5	528	1657.5	48	w/2' split
147-101-6 SW/NE	8,209	2233	548	1685	42	
147-101-6 NE/SW	10,183	2263	575	1688	43	
147-101-7 NE/NW	9,909	2192	508	1684	46	
147-101-10 NE/NE	6,984	2217	568	1649	46	total 6' split
147-101-14 SW/SW	7,535	2052	375	1677	52	30' coal, 5' clay 22' coal
147-101-15 SW/NE	6,987	2099	435	1664	44	26' coal, 3' clay 18' coal
147-101-15 SE/SW	7,449	2149	470	1679	50	45' coal, 6' clay 5' coal
147-101-15 NW/SW/SE	6,532	2057	365	1692	36	23' coal, 5' clay 13' coal
147-101-15 SW/SE	7,944	2062	370	1692	48	
147-101-18 NW/SE	10,308	2099	370	1729	45	
147-101-18 SE/NW	10,892	2159	420	1739	50	

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
147-101-19 NE/NE	10,241	2114	370	1744	44	
147-101-19 NE/SE	11,719	2182	408	1774	43	
147-101-20 NE/SE	11,814	2442	705	1737	46	
147-101-21 SW/NE	11,882	2226	510	1716	44	
147-101-21 SE/SW	11,664	2456	705	1751	42	
147-101-22 SE/NW	6,704	2178	485	1693	45	
147-101-22 SW/NE	12,470	2174	490	1684	44	
147-101-22 SW/NE	6,718	2196	488	1708	42	
147-101-22 NE/SE	7,779	2014	355	1659	50	22.5' coal, 5'clay 22.5' coal
147-101-23 NW/NW	7,778	2149	470	1679	52	25' coal, 5' clay 22.5' coal
147-101-27 NW/NE	7,264	2029	320	1709	50	
147-101-27 SW/SW	7,429	2034	305	1729	52	
147-101-33 SE/NE	9,276	2042	305	1737	48	
147-101-33	8,484	2099	350	1749	48	
147-101-33 NE/SW	9,311	2051	285	1766	45	
147-102-2 SE/NW	11,840	2257	560	1697	48	
147-102-2 SW/NE	9,955	2257	580	1677	45	
147-102-4 NW/SE	8,737	2335	580	1755	42	
147-102-6 NW/SW	11,276	2488	700	1788	39	
147-102-9 NE/NW	9,362	2286.5	520	1766.5	42	
147-102-9 SW/SE	10,699	2344	580	1764	45	with split
147-102-11 NW/NW	10,529	2290	585	1705	45	
147-102-12 SE/SW	11,073	2336	600	1736	46	
147-102-13 SE/NW	10,425	2269	536	1733	48	
147-102-13 NW/SE	9,858	2344	610	1734	51	

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
147-102-21 SE/NW	12,398	2403	598	1805	45	
147-102-23 NE/NW	8,494	2268	505	1763	46	
147-102-24 NW/NE	11,832	2317	560	1757	49	
147-102-27 NE/SW	7,850	2222	440	1782	46	
147-102-28 SE/NW	10,951	2409	620	1789	46	
147-102-28 SE/SW	12,607	2370	565	1805	43	
147-102-30 SW/SW	12,238	2216	370	1846	44	w/2' split
147-102-31 SE/NW	12,560	2307.5	450	1857.5	35	w/2' split (33' total)
147-102-31 NW/SE	11,848	2270	440	1830	38	w/2' split (36' total)
147-102-31 NE/SW	7,794	2380	505	1875	35	w/5' split (30' total)
147-102-33 NW/NW	12,092	2212	380	1832	46	w/3' split (43' total)
147-102-33 SE/NW	12,068	2160	340	1820	45	
147-103-2 SE/SW	5,302	2263	420	1843	31	10' coal, 3' clay 21' coal
147-103-8 NW/SW	7,183	2185	270	1915	22	10' coal, 60' clay 12' coal
147-103-17 SW/SW	6,443	2216	290	1926	23	8' coal, 20' clay 15' coal
147-103-24 NW/NW	5,993	2262	450	1812	35	8' coal, 3' clay 28' coal
147-103-25 NE/NE	12,806	2237	400	1837	28	w/2' split
147-103-32 SW/SE	8,218	2453	530	1923	27	12' coal, 60' clay 15' coal
147-103-33 NW/NE/SE	8,821	2288	380	1908	30	10' coal, 75' clay 20' coal
147-103-36 NW/SE/NE	7,680	2380	500	1880	34	14' coal, 5' clay 20' coal

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
148-100-16 SW/SE	11,125	2357	750	1607	26	
148-100-17 NE/NE	10,324	2313	720	1593	16	8' coal, 3' clay 16' coal
148-100-18 NE/NE	10,884	2250	660	1590	20	8' coal, 2' clay 20' coal
148-100-21 NW/NE	11,220	2397	777	1620	24	
148-100-31 SW/NE	7,700	2402	810	1592	25	
148-101-10 NW/NE	8,187	2444	770	1674		numerous splits
148-101-19 NE/NW	7,167	2302	620	1682	18	4 splits
148-101-27 SW/NE	13,590	2162	505	1657	29	29' coal, 8' clay 10' coal
148-101-27 NW/NW	5,212	2177	495	1682	24	24' coal, 35' clay 11' coal
148-101-27 SE/NW	5,182	2165	510	1655	30	30' coal, 5' clay 14' coal
148-101-29 SE/NE	5,246	2245	590	1655	48	30' coal, 40' clay 18' coal
148-101-35 NE/SW	10,053	2218	610	1608	60	30' coal, 2' clay 20' coal, 3' clay 10' coal
148-102-2 NE/NE	11,660	2295	595	1700	14	8' coal, 5' clay 6' coal
148-102-16 W/2/NW	5,846	2439	630	1809	10	5' coal, 5' clay 5' coal
148-102-22 SW/SE	10,105	2288	510	1778	23	10' coal, 20' clay 5' coal, 2' clay 8' coal
148-102-27 NW/NE	12,983	2286	560	1726	36	8' coal, 2' clay 5' coal, 3' clay 8' coal, 25' clay 10' coal, 28' clay 5' coal

LOCATION	NDIC#	KB	DEPTH TO COAL	ELEVATION TOP OF COAL	THICKNESS	SPLITS
148-102-27 NW/SE	10,643	2295	570	1725	47	27' coal, 15' clay 15' coal, 20' clay 5' coal
148-102-34 SE/NE	12,555	2345	630	1715	39	
148-102-34 SW/SE	11,856	2268	520	1748	46	41' coal, 10' clay 5' coal
148-102-35 SE/NW	12,550	2251	575	1676	45	
148-102-35 SE/NW	11,214	2250	570	1680	50	
148-102-35 SE/SW	11,807	2295	630	1665	50	
148-102-35 SW/SE	12,962	2227	550	1677	51	
148-102-35 SE/SW	8,883	2263	590	1673	50	
148-103-24 SE/NW	7648	2474	610	1864	17	10' coal, 3' clay 2' coal, 2' clay 3' coal, 2' clay 2' coal
148-103-25 NW/NE	9,901	2439	630	1809	18	10' coal, 10' clay 4' coal, 1' clay 2' coal, 5' clay 2' coal

Appendix B – Legend for Figures 9, 11-17.

5470



Oil and Gas Division Permit Number

No record available

Coal

Sandstone

Claystone and Mudstone.

Siltstone.

20 Thickness of an individual bed.

10* Cumulative thickness of two or more coal beds separated by clay beds less than 5 feet thick.