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METHANE IN CRETACEOUS AND PALEOCENE COALS OF WESTERN COLORADO

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INTRODUCTION

Western Colorado is the site of coal, oil, and natural gas development in three principal areas: the San Juan River, the Uinta, and the Green River Regions (fig. 1). Evidence is accumulating that some of the coals in these regions both act as a source and potential reservoir for natural gas (methane). This paper details some of the evidence and describes work being done by the Colorado Geological Survey (CGS) to estimate the methane resources of these regions.

PROCEDURES

Only areas considered to have a high methane potential are included in this paper. These areas contained thick, high ranking coals at depth (Goolsby and others, 1981).

Net coal thicknesses were determined from the following logs: natural gamma, caliper, sonic or acoustic, neutron, and density. SP-resistivity logs were used only to pick formation tops or verify the presence of coals seen on the other logs or sample logs. The minimum seam thickness used in determining net coal thicknesses is 0.6 m (2 ft) for the San Juan Region, 1 m (3 ft) for the Uinta Region, and 1.2 m (4 ft) for the Green River Region.

SAN JUAN RIVER REGION

The San Juan River Coal Region of southwestern Colorado is that area underlain by the coal-bearing Dakota Formation (Goolsby and others, 1979, p. 38).

Within this region, the San Juan Basin offers the greatest methane potential. The basin, a deep assymetrical syncline, is approximately 160 km in diameter (fig. 1). Its arcuate axis lies just south of the Colorado-New Mexico border. The steeply dipping,

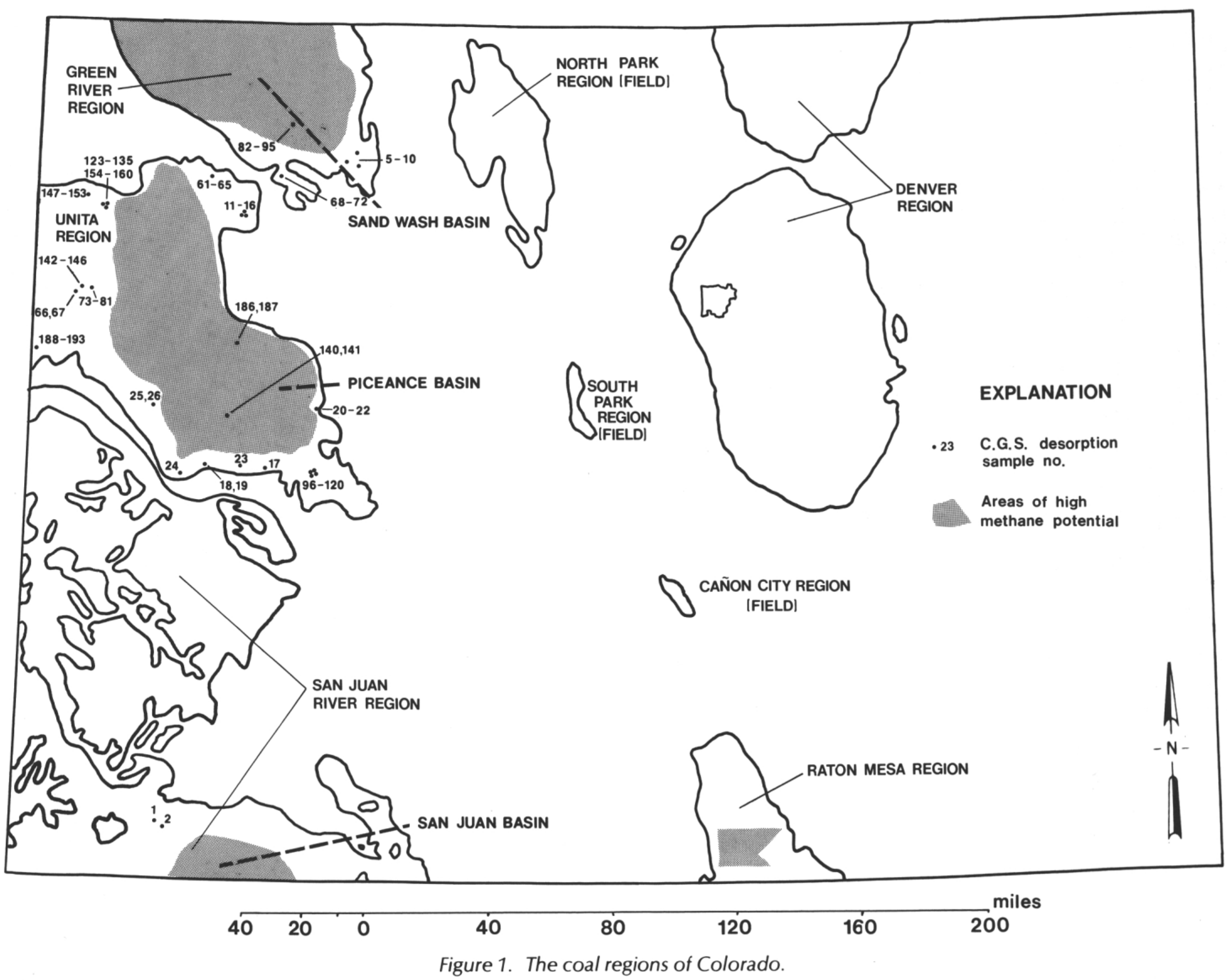

Figure 1. The coal regions of Colorado.

U-shaped Hogback Monocline forms the northern rim of the basin. To the east, the Gallina-Archuleta Arch and the Nacimiento Uplift bound the basin. To the south, the basin grades into the Chaco Slope. The southwestern boundary of the basin is formed by the Defiance Monocline (Woodward and Callender, 1977, p. 210).

En echelon northwesterly trending folds and northeasterly trending high-angle faults occur along the basin's eastern boundary. Around the basin's perimeter are radial folds plunging towards the basin's center and minor folds parallel to the basin's margins. These structures formed principally during Late Cretaceous Laramide times. The entire area was then epeirogenically uplifted. Igneous intrusions were emplaced along the basin's margins during Tertiary times.

The San Juan Basin contains sediments ranging in age from Cambrian to Quaternary. The Precambrian basement is encountered at depths of 1,428 m to 4,276 m below the surface.

The Upper Cretaceous sediments contain all of the coal-bearing formations in the basin (fig. 2). These sediments are a series of intertonguing marine and nonmarine deposits which resulted from three transgressive-regressive cycles of the Cretaceous epicontinental sea (Fassett and Hinds, 1971, p. 4). The final regression of the sea is represented by the Pictured Cliffs Sandstone.

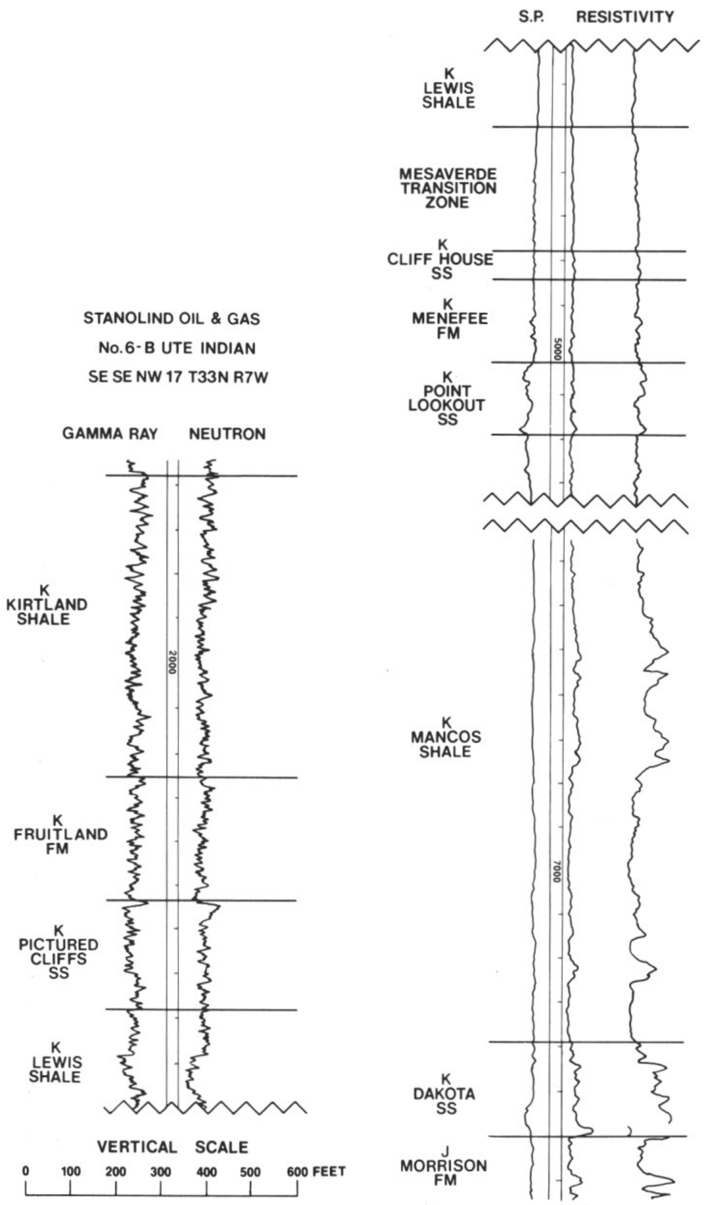

Figure 2. Log showing Cretaceous coal-bearing formations (Dakota, Menefee, and Fruitland) in the San Juan Basin.

The marine sediments are pro-delta and interdeltaic deposits of shoreline marine sands, offshore sandy silts, and deep water muds. The nonmarine deposits are lower delta or coastal-plain deposits, and upper delta or alluvial-plain deposits (Molenaar, 1977, p. 159). It is predominiantly in these nonmarine, coastal-plain and alluvial-plain facies that coal sequences are found.

The coal-bearing formations of the San Juan Basin, in ascending order, are the Dakota, the Menefee (Mesaverde Group), and the Fruitland formations (fig. 2). The Dakota has coal seams ranging in thickness from 0.6 m to 2.4 m. All seams are discontinuous and grade laterally into carbonaceous shales. The coals were probably deposited in a flood-plain/braided stream environment. The Menefee coals, like the Dakota coals, are extremely lenticular and also range from 0.6 m to 2.4 m thick. It appears these coals were deposited on a delta plain between distributary channels.

The Fruitland Formation, which averages 122 m in thickness, has the thickest and most continuous coal seams in the region. Coals throughout the formation range from less than 0.3 m to 22 m. Thickest and most continuous seams in the Fruitland are found in the lowermost 21 m. These seams formed from peat deposited in brackish to fresh-water lagoons and marshes, behind a barrier coastline. The thinner seams in the Fruitland probably formed on upper coastal plains (alluvial plains).

Historically, the Fruitland Formation has been broken into three coal zones (Boreck and Murray, 1979, p. 56). The upper zone (Shamrock zone) may reach 6 m in thickness and is found near the middle of the formation. The middle zone (commonly called the Carbonera or Peacock zone) is located in the basal 21 m of the formation. The third zone (Fruitland tongue) is a shale and coal deposit which intertongues with the Pictured Cliffs Sandstone. This zone is not continuous throughout the basin and is difficult to locate on geophysical logs.

The Fruitland coals in the San Juan River Region vary in rank from subbituminous B (sub B) at the basin's perimeter, to medium volatile (mv) in the deeper parts of the basin. The medium volatile ranking coals may be due to local upgrading. The deepest Fruitland coals in the basin have overburdens of up to 1,200 m.

Methane

Evidence from mine data, oil and gas exploration, and desorption of coal cores and cuttings samples indicates that gas is present in the coals of the San Juan Basin.

Fender and Murray (1978, p. 8) reported three gassy mines in the San Juan region. The Burnwel I No. 1 and the Hesperus (old) mines were sites of mine fires. The Champion was the site of a gas explosion.

A large number of wells had gas shows in coal zones or were tested and/or producing from Fruitland coal intervals. One well, T.32N., R.7W., recorded a gas "kick" over a 6.4 m interval, containing a 1.5 m coal at its base. A second well (T.33N, R.6W.) was drill-stem tested over a 49 m Fruitland interval containing three coal beds totaling 17 m. The interval tested 5,664 m^3 per day (200 MCFD) with a flow pressure of 96 pounds in a 1 hour test. Well completion included 2.4 m of coal (Goolsby and others, 1981, Appendix B).

Lent (1980) gives the results of 10 desorption measurements (using the U.S. Bureau of Mines "direct method") from the San Juan River Coal Region of Colorado and New Mexico. The gas contents

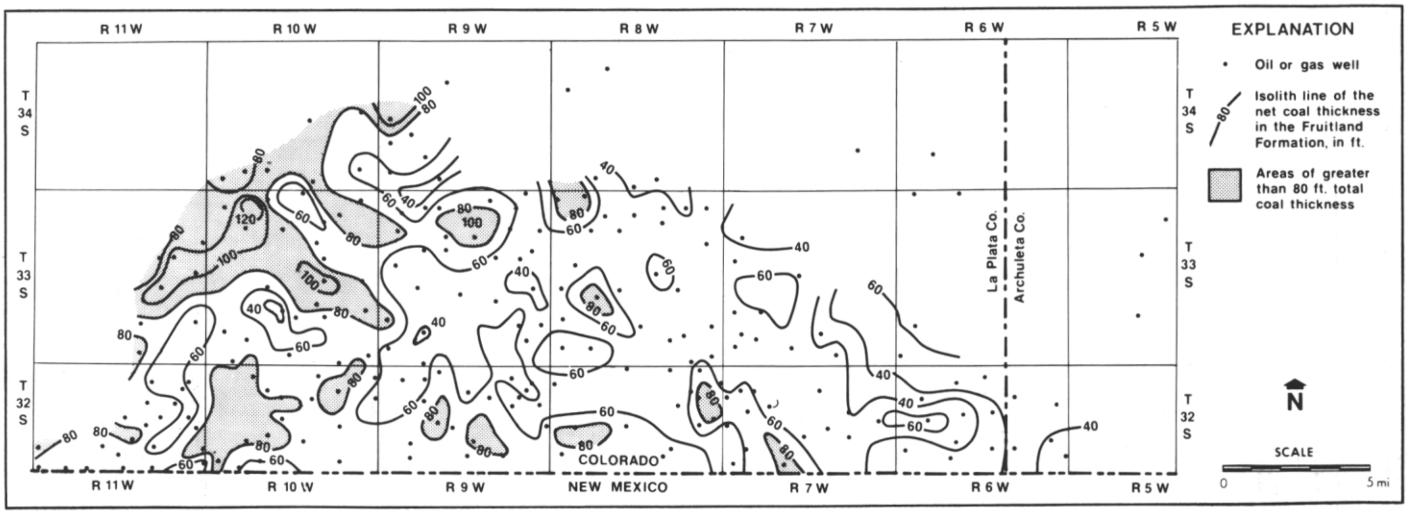

Figure 3. Net coal thickness map of the coal-bearing Fruitland Formation, San Juan Basin (from Goolsby and others, 1981).

range from 0.16 cubic centimeters per gram (cm^3/g) [5.3 cubic feet per ton (ft^3/0] of coal to 4.2 crn'ig (134 ft^3/t). The coals rank from high volatile C bituminous (hvC) to high volatile A bituminous (hvA). However, these data do not reflect the high methane potential of the region, since the samples were not from the highest ranking Fruitland seams.

Goolsby and others (1981) reported on an area in the Colorado part of the San Juan Basin characterized by thick, continuous, and high ranking Fruitland coals under sufficient overburden to prevent gas loss. This area covers 1,528 km' in T.32N.-T.34N. and R.5W.-R.11 W. Figure 3 is a net coal thickness map and Figure 4 is a structure map of this area.

The authors believe the gas contents of the coals in the study area are similar to those of coals in the Raton Mesa Coal Region. This belief is based on similarities in rank, overburden depths, stratigraphic position, and localized upgrading (Goolsby and others, 1981, p. 25; and Tremain, 1981, p. 34). The gas contents of the Raton Mesa region ranged from 2.25 cm^3/g (72 ft^3/t) in a high volatile B bituminous (hvB) sample to 16.0 cm^3/g (514 ft^3/t) in a medium volatile bitumunous (my) sample.

A coal resource estimate of 19.7 billion short tons was obtained for the study area by planimetering the net coal thickness isopach (fig. 3). Multiplying this tonnage by the low and high gas contents stated above, gives a total coal bed methane resource estimate ranging from 40 billion m^3 (1.4 trillion ft') to 283 billion m^3 (10.0 trillion ft^3).

UINTA REGION

The Unita Coal Region (fig. 1) is the area in west-central Colorado and eastern Utah bordered by the base of the Mesaverde Group. The Colorado portion of the region covers 18,648 km' (Murray, 1980, p. 214).

The Piceance Basin, in the Colorado portion of the Uinta Region, has excellent methane potential. This basin is defined by the Cretaceous-Tertiary outcrop and covers approximately 10,360 km^2 (Dunn, 1974, p. 217). The basin is bounded by: the Axial Basin Uplift in the north; the Grand Hogback Monocline in the east; the Elk and West Elk mountains and the Gunnison Uplift in the south; the Uncompahgre Uplift in the southwest; and the Douglas Creek Arch in the west.

The basin itself is assymetrical with a steeply-dipping eastern and northeastern flank and a gentle western and southwestern flank.

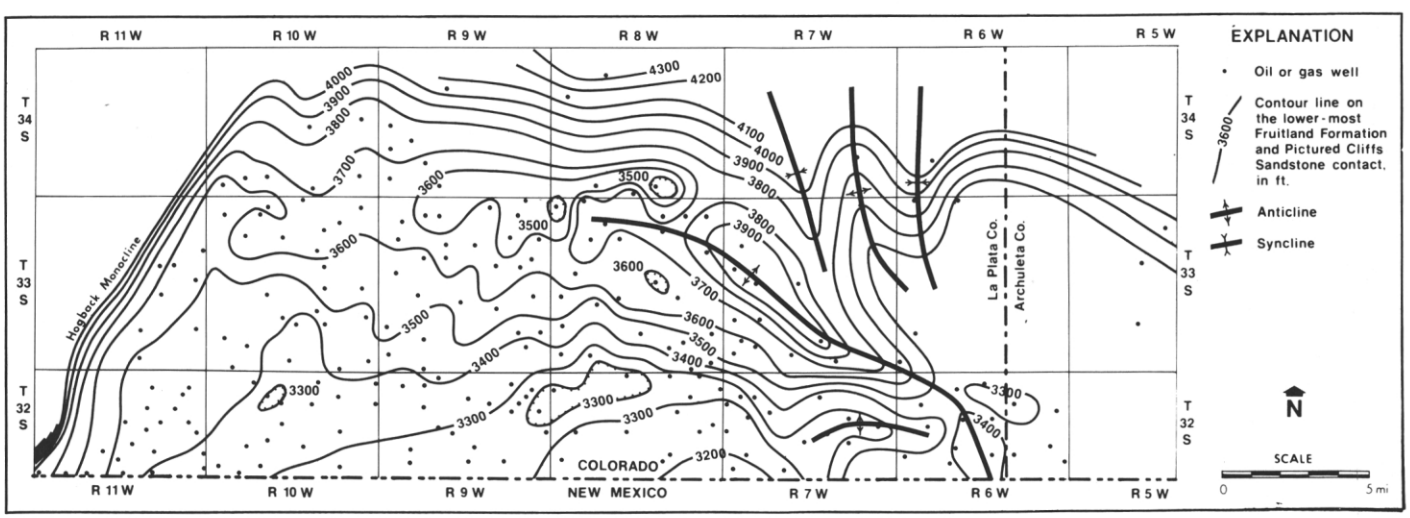

Figure 4. Structure map of the lower Pictured-Cliffs Sandstone–Fruitland Formation contact, San Juan Basin (from Goolsby and others, 1981).

The axis of the basin trends northwesterly and parallels the Grand Hogback Monocline on the eastern side of the basin. This axis is split by basinward plunging anticlines on its north and south ends (Dunn, 1974, p. 217). Other northwest-southwest trending anticlines dot the interior of the basin. Gas and locally oil is produced from a number of these anticlines and from structures in the adjoining Douglas Creek Arch.

The Precambrian basement is 5,500 m below sea level at the deepest point in the basin. There are over 7,620 m of Cambrian through Quaternary sediments at this point (Murray, 1980, p. 214). Cretaceous sediments constitute over 3,000 m of this sequence (Murray and Haun, 1974, p. 31). These sediments were deposited as the Cretaceous sea slowly and episodically regressed to the east. The marine Mancos Shale comprises the major portion of the lower Cretaceous sediments. Upper Cretaceous sediments are predominantly the non-marine sandstones, shales, and coals of the Mesavede Group (see fig. 5).

The Mesaverde coals occur as discontinuous beds throughout the formation. They show great variations in thickness and rank. In an outcrop at Newcastle, the total coal thickness reaches 33 m; an individual bed is reported as 15 m (Gale, 1910, p. 111). Subsurface data in the south central part of the basin show a maximum of 24 m of coal present in beds up to 9 m thick. The coals range from subbituminous B (sub B to anthracite (anth) in rank. Figure 6 is an isopach and rank map of Mesaverde coals. Figure 7 is a structure map of the Cozette Sandstone near the base of the Mesaverde Group.

Methane

Fender and Murray (1978) listed 47 coal mines in the region that reported gas occurrences. The gassiest mines are in the Car

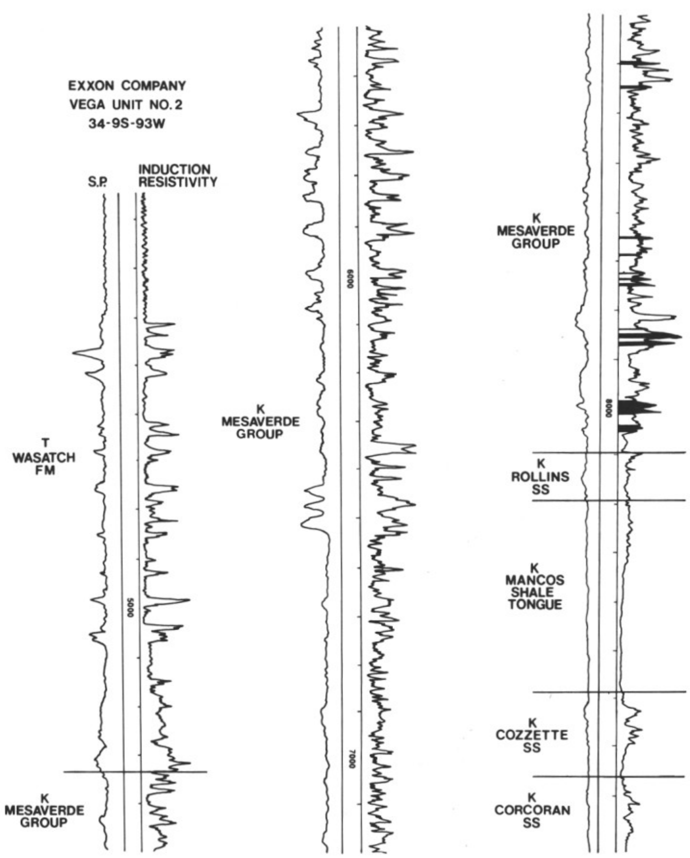

Figure 5. Type log for the southern Piceance Basin. Coals are shown in black.

bondale coal field (T.7-10S., R.89W.) where the coal ranks medium volatile (mv). In this field, the L. S. Wood mine emitted 61,454 m' per day (2,170 MCFD); the Dutch Creek #1 mine emitted 37,892 WA (1,338 MCFD); and the Dutch Creek #2 mine emitted 40,384 m^3/d (1,426 MCFD) for the period 1974 through 1976.

At least two wells have produced methane from coal in the Piceance Basin area. A well on the Douglas Creek Arch produced an average of 283 m'id (10 MCFD) for several months from a shallow coal bed. A well in the south-central part of the basin had an initial production of 12,461 m^3/c1 (440 MCFD) and 17 m^3/c1 (109 barrels) of water from perforations in three deep, medium volatile coals.

The gas contents of the 80 samples collected by the CGS from the region have ranged from 0 to 13.7 cm^3/g (0 to 438 Wit) (Table 1). The quality of the gas of seven of these samples has ranged from 3,583 to 8,534 kcal/m' (403 to 960 BTU/ft^3). These and other samples taken by the U.S. Bureau of Mines and the CGS show an increase in gas contents with increasing rank and depth. Therefore, those areas with thick, high ranking coals at depths sufficient to prevent gas loss would be likely methane prospects. Study of coal rank, isopach, structure, and topographic maps should reveal such areas.

By planimetering the coal isopach map (fig. 6) and using gas contents averaged from Table 1, the CGS has estimated a coal bed methane resource of 878 billion m' (31 trillion ft') in the southern half of the Piceance Basin. The CGS is currently revising this map in order to estimate the methane resources for the entire basin.

GREEN RIVER COAL REGION

The Green River Coal Region in northwestern Colorado (fig. 1) is defined as the area bounded by the basal contact of the Upper Cretaceous Mesaverde Group (Murray, 1980, p. 211).

The main structure within the region is the Sand Wash Basin. The basin is bordered by the Cherokee Ridge to the north, the Sierra Madre Uplift to the east, the Axial Basin Arch to the south, and the Uinta Uplift to the west and southwest.

The basin's axis trends west-northwest. Depth to the top of the Precambrian rocks in the deepest part of the basin is approximately 5,300 m below sea level (Haun, 1962, p. 11). Folding and faulting is common in the basin. The major structures are usually found along the periphery. Upper Triassic intrusives occur in the eastern part of the basin.

Sedimentary rocks in the Sand Wash Basin-Green River Region range from Upper Cambrian to Tertiary in age. Coal-bearing rocks in the Green River Region are: the Upper Cretaceous Iles and Williams Fork formations (or Rock Springs and Almond formations) of the Mesaverde Group, the Upper Cretaceous Lance Formation, the Upper Cretaceous-Paleocene Fort Union Formation, and the Paleocene-Eocene Wasatch Formation (fig. 8).

The Iles and Williams Fork formations (Mesaverde Group) were deposited in a marginal marine environment bordering the Late Cretaceous epeirogenic sea. The formations are predominantly white to light brown sandstones, gray shales, and coals. The coals are found throughout the Mesaverde Group. Most individual coal beds are less than 3 m thick, although coals up to 7 m have been recorded. Net coal thicknesses for the Iles and Williams Fork formations range from 6 to 41 m.

The Lance Formation was deposited in a marginal marine to fluvial environment. The formation is made up of gray shales, light brown sandstones and coals. Lance coals are not as thick and well

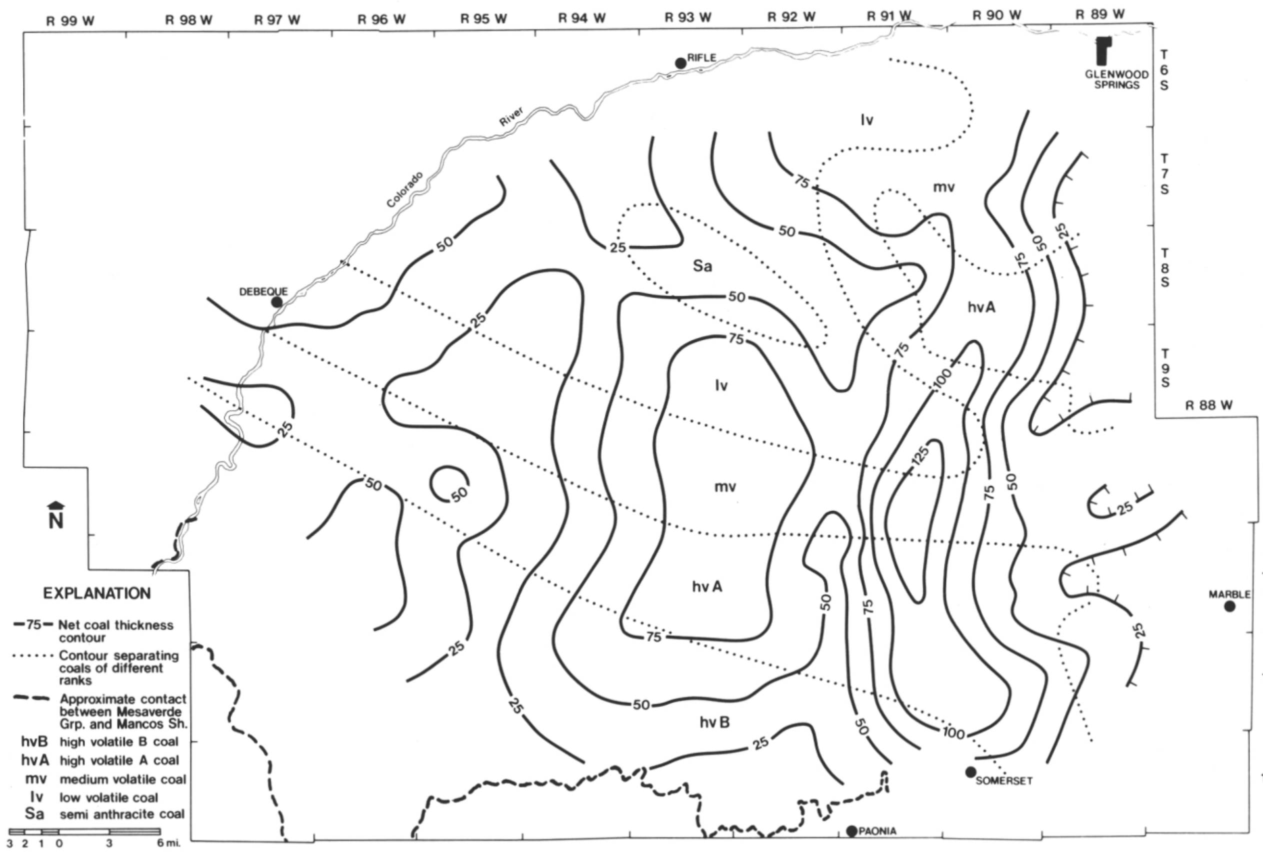

Figure 6. Net coal isopach and coal rank map of the Cretaceous Mesaverde coals, southern Piceance Basin (after Fender and Murray, 1978; Freeman, 1979). Isopachs in feet.

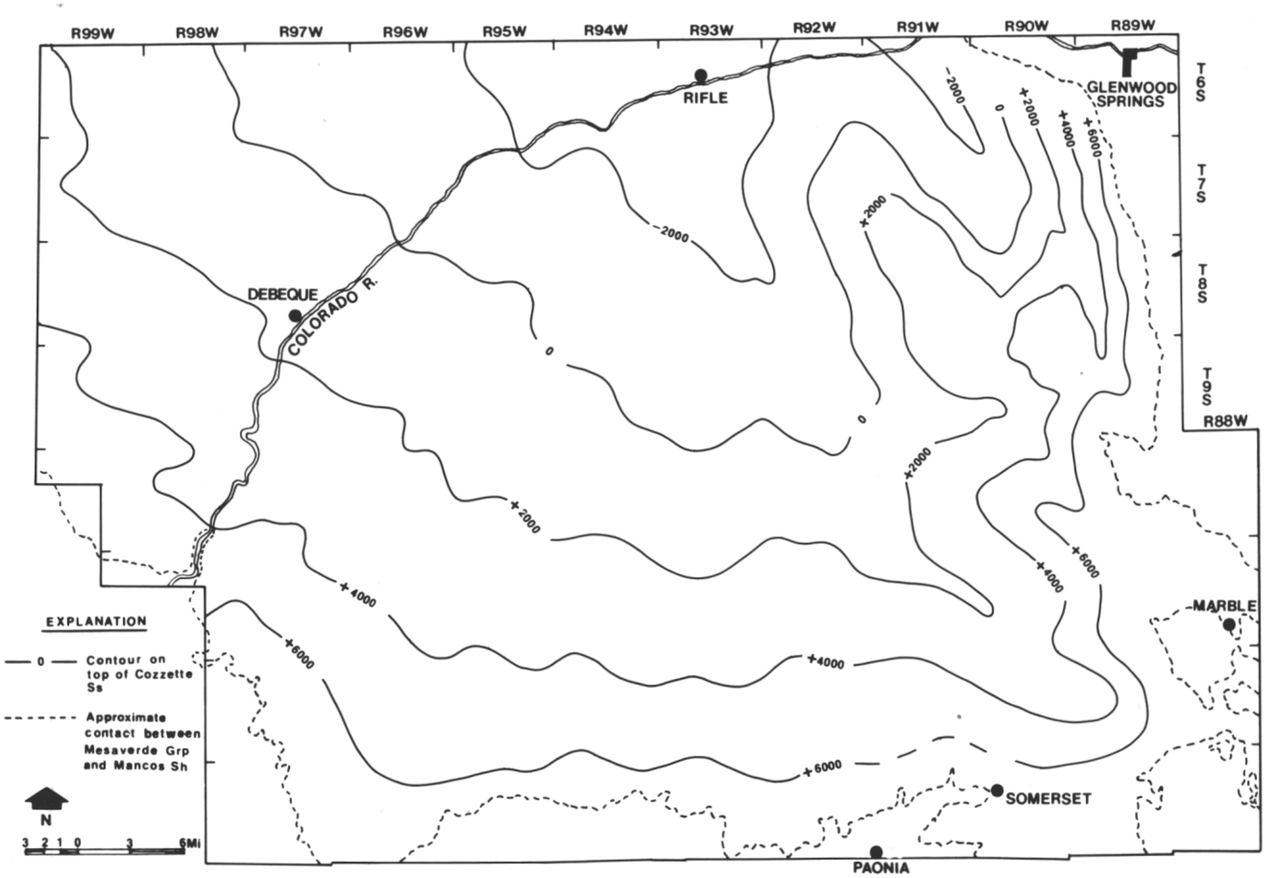

Figure 7. Structure on the top of the Cretaceous Cozzette Sandstone in the southern Piceance Basin (after Fender and Murray, 1978). Contours in feet.

Table 1. Coal sample and desorption data.

CGS no.	Formation name	Depth to coal bed (ft)	Bed thickness (ft)	Total gas (cm³/g)	Total gas (ft³/t)	Apparent rank of coal	% methane in gas	Heating value of gas (Btu/ft³)
	SAN JUAN RIVER COAL REGION							
1	Menefee	295	9+	.17	5	hvBb	[1]	
2	Menefee	310	7.5	.32	10	hvAb		
	GREEN RIVER COAL REGION							
5	Williams Fork	1283	11.5	NC[2]	NC	hvCb		
6	Williams Fork	1393	11.0	?	?	hvCb		
7	Williams Fork	488	1.3	NC	NC	hvCb		
8	Williams Fork	335	8.5	.24	8	hvCb		
9	Williams Fork	1104	4.5	NC	NC	hvCb		
10	Williams Fork	1123	9.7	NC	NC	hvBb		
68	Williams Fork	176.5	20.6	0.11	4	subA-hvCb		
69	Williams Fork	644.0	3.6	0.09	3	hvCb		
70	Williams Fork	720.9	3.0	0.0	0	hvCb		
71	Williams Fork	766.3	9.0	0.50	16	hvCb		
72	Williams Fork	799.8	7.3	0.18	6	hvCb		
82	Williams Fork	3660	3	7.84	251	hvBb	81.78	825
83	Williams Fork	3663	6	0.58	18	shale	53.21	538
84	Williams Fork	3684	4	7.99	256	shale		
85	Williams Fork	3929	5	3.77	121	hvBb		
86	Williams Fork	3947	.2	3.86	124	hvBb		
87	Williams Fork	3958	1	2.72	87	hvBb		
88	Williams Fork	4658	15.6	9.01	288	hvBb		
89	Williams Fork	4658	15.6	8.41	269	hvBb		
90	Williams Fork	4658	15.6	9.26	296	hvBb		
91	Williams Fork	4658	15.6	9.4	301	hvBb		
92	Williams Fork	4658	15.6	8.56	274	hvAb	74.41	769
93	Williams Fork	4658	15.6	10.08	322	hvBb		
94	Williams Fork	4716	10	10.50	336	hvAb	69.45	741
95	Williams Fork	4716	10	11.76	376	hvBb		
	UINTA COAL REGION							
11	Williams Fork	2216	15	.50	16	--		
12	Williams Fork	2243	4	1.31	42	--		
13	Williams Fork	2122	12	.98	31	--		
14	Williams Fork	2106	8	.10	3	--		
15	Williams Fork	48.7	10.8	0	0	hvCb		
16	Williams Fork	502.6	12	0	0	hvCb		
17	Williams Fork	504	5.8	.19	6	hvCb		
18	Williams Fork	706.7	7.6	5.62	179	hvCb		
19	Williams Fork	706.7	7.6	.82	26	hvCb		
20	Williams Fork	1500	8.7	1.7[3]	54	mvb		
21	Williams Fork	1300-1500	25	.215[3]	7	mvb		
22	Williams Fork	2000	20	.22[3]	7	mvb		
23	Mesaverde Gp.[4]	992.5	14.5	.46	15	hvCb		
24	Mesaverde Gp.	579	4.5	0	0	hvCb		
25	Mesaverde Gp.	809	5.5	2.5	80	hvAb		
26	Mesaverde Gp.	1284.5	3.5	7	223	hvAb		
61	Williams Fork	144	13	0.36	12	subA-hvCb		
62	Williams Fork	144	13	0.39	13	subA-hvCb		
63	Williams Fork	163.5	19.5	0.24	8	subA-hvCb		
64	Williams Fork	287.5	4.3	0.15	5	subA-hvCb		
65	Williams Fork	294.8	20.7	0.116	4	subA-hvCb		
66	Mesaverde Gp.	1588	3	0.667	21	hvBb		
67	Mesaverde Gp.	1607	3	0.489	16	hvBb		
73	Mesaverde Gp.	685.2	.4	3.58	115	shale		
74	Mesaverde Gp.	698.1	.35	6.68	214	shale		
75	Mesaverde Gp.	772.35	.6	1.45	126	siltstone		
76	Mesaverde Gp.	770.88	.57	0.76	66	shale		
77	Mesaverde Gp.	759.2	.8	2.69	156	hvBb		
78	Mesaverde Gp.	809.3	.4	7.61	243	hvBb		
79	Mesaverde Gp.	835 ?	4.7	2.76	130	hvBb		
80	Mesaverde Gp.	835 ?	4.7	4.31	138	hvBb		
81	Mesaverde Gp.	962 ?	7.8	3.47	111	hvBb		
96	Williams Fork	873	4.8	2.49	80	hvBb		
97	Williams Fork	896	6.1	3.2	102	hvAb		
98	Williams Fork	905	1.6	3.74	120	hvAb		
	UINTA COAL REGION							
99	Williams Fork	948	2.9	3.88	124	hvAb		
100	Williams Fork	1133	6.7	0.28	9	hvAb		
101	Williams Fork	1133	6.7	6.81	218	hvAb	73.09	739
102	Williams Fork	1187	14	5.82	186	hvAb		
103	Williams Fork	1187	14	5.94	190	hvAb		
104	Williams Fork	1207	6.8	6.15	197	hvAb		
105	Williams Fork	1227	1.2	3.72	119	hvAb		
106	Williams Fork	782	13	6.06	194	hvAb		
107	Williams Fork	782	13	6.77	217	hvAb		
108	Williams Fork	719	6	6.62	212	hvAb		
109	Williams Fork	1182	6.9	5.70	182	hvAb		
110	Williams Fork	1236	12.7	5.93	190	hvAb		
111	Williams Fork	1260	5.3	6.53	209	hvAb		
112	Williams Fork	1516	12	3.16	101	hvAb		
113	Williams Fork	1583	8	3.36	108	hvAb		
114	Williams Fork	1583	8	4.12	132	hvAb		
115	Williams Fork	1783	12	5.42	173	hvAb		
116	Williams Fork	1783	12	2.99	96	hvAb		
117	Williams Fork	1830	14.65	6.10	195	hvAb		
118	Williams Fork	1830	14.65	5.53	177	hvAb		
119	Williams Fork	1854	6.7	5.98	191	hvAb		
120	Williams Fork	1854	6.7	7.66	245	hvAb		
123	Mesaverde Gp.	1324.68	1.17	2.04	65	hvCb		
124	Mesaverde Gp.	1330.6	8.21	2.25	72	hvCb	(47.63)[5]	
125	Mesaverde Gp.	1330.6	8.21	2.19	70	hvCb	(33.11)	
126	Mesaverde Gp.	1330.6	8.21	2.06	66	hvCb		
127	Mesaverde Gp.	1349.75	2.05	1.81	58	hvCb	(49.51)	
128	Mesaverde Gp.	741.75	6.43	0.64	20	hvCb		
129	Mesaverde Gp.	758.71	6.43	2.05	80	hvCb		
130	Mesaverde Gp.	758.71	2.22	2.25	72	hvCb		
131	Mesaverde Gp.	764.92	5.08	2.50	80	hvCb	(57.66) 58.6	610
132	Mesaverde Gp.	770	2.5	2.79	89	hvCb	(46.10) 49.2	506
133	Mesaverde Gp.	794.65	2.15	2.34	74	hvCb	(38.27) 39.3	403
134	Mesaverde Gp.	797.5	4.0	2.23	71	hvCb	(38.27) 37.8	388
135	Mesaverde Gp.	805.8	5.37	1.35	43	hvCb		
140	Mesaverde	7598	18	13.69	438	mvb	(82.99) 82.1	942
141	Mesaverde	7598	18	11.90	381	lvb	(79.63) 78.3, 85.9	854, 960
142	Mesaverde	1148.9	8	1.11	36	hvCb		
143	Mesaverde	1148.9	8	0.76	24	hvBb		
144	Mesaverde	1207	8.7	0.92	29	hvBb		
145	Mesaverde	1207	8.7	0.64	20	hvBb		
146	Mesaverde	1223	2	0.95	30	hvBb		
147	Mesaverde	878.75	.4	0.03	1	shale		
148	Mesaverde	879	3.3	0.29	9	hvCb		
149	Mesaverde	892.72	8.8	0.02	1	siltstone		
150	Mesaverde	898.45	8.8	0.02	1	siltstone		
151	Mesaverde	904.3	7.7	0.13	4	hvCb		
152	Mesaverde	904.3	7.7	0.20	6	hvCb		
153	Mesaverde	912.4	.95	0.01	0	shale		
154	Mesaverde	1186.5	1.88	0.02	1	sandstone		
155	Mesaverde	1190.96	2.74	0.03	1	shale		
156	Mesaverde	1197.15	3.05	0.03	1	siltstone		
157	Mesaverde	1197.35	3.05	1.32	42	hvCb		
158	Mesaverde	1198.65	8.4	1.19	38	hvCb		
159	Mesaverde	1208.34	1.32	0.01	0	siltstone		
160	Mesaverde	1187.7	3.5	0.97	31	hvCb		
184	Green River	795.3				oil shale		
185	Green River	1189.7				oil shale		
186	Williams Fork	7445	1					
187	Williams Fork	7476.5	1					

1. blanks indicate gas analyses not run
2. NC = not calculated
3. mine samples; gas contents probably higher
4. Gp. = group
5. heating value not measured if methane percentage in parentheses
6. the following blank spaces indicate data not yet available

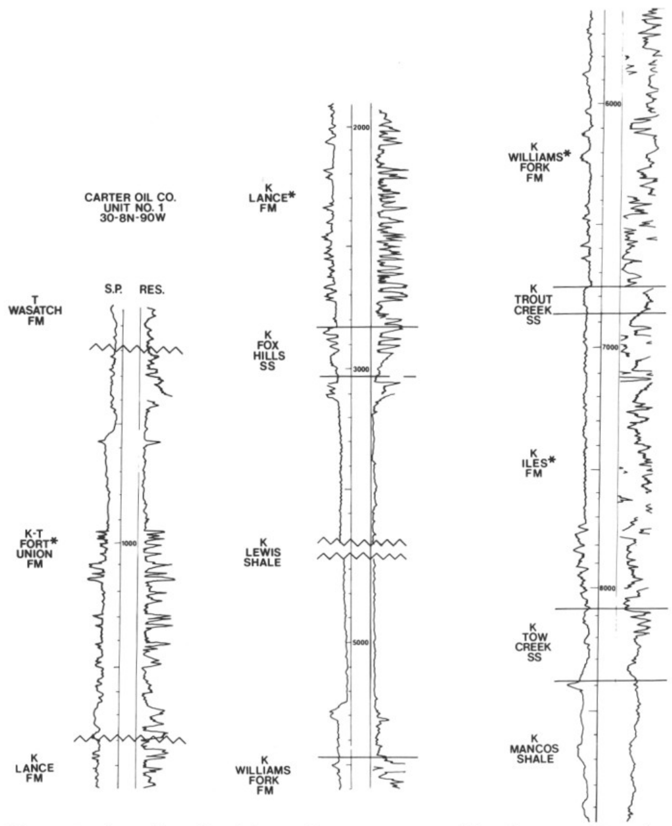

Figure 8. Log showing Upper Cretaceous and Tertiary coal-bearing formations in the Sand Wash Basin (modified from Rocky Mountain Association of Geologists, 1975). Coal-bearing formations marked by an asterisk.

developed as the Mesaverde coals. Net coal thicknesses range from 0 to 7.3 m, with the thickest individual coal bed attaining 3.6 m.

The Fort Union Formation rests unconformably on the Lance. It was deposited in a fluvial environment and is predominantly drab brown and gray sandstones, shales, and coals. Fort Union coals are the thickest reported in the five coal bearing formations. Individual coals are up to 15 m thick. Net coal thicknesses range from 0 to 33.5 m.

The Wasatch Formation overlies the Fort Union and consists of fluvial gray and pink arkosic sandstones, mudstones, conglomerates, and coals. Coals found in the Wasatch are, as a rule, thin and sparse.

Figure 9 is a net coal isopach map combining coal thicknesses from the Lance and Fort Union formations. Mesaverde coals were not included in the isopach due to scarcity of well log data and the Wasatch coals due to their sparseness. The mapped area is marked by the basal contact of the Wasatch Formation and by the Colorado state line. The isopach map should not be used to interpret specific depositional trends as the map is a composite of two formations deposited in two different environments.

Methane

Evidence for the presence of coal bed methane is found in both coal mine records and oil and gas data within the Green River Region-Sand Wash Basin. Coal mine records report the following: The Wadge No. 1, No. 2 mine complex (T.6N., R.97W.) was rocked by a gas explosion in 1942. Another mine, the Apex No. 2 Mine (T.4N., R.86W.), recorded an average gas emission of 322 m^3/d (11.4 MCFD) in 1974 (Fender and Murray, 1978, table 1).

Well records obtained during oil and gas exploration offer conclusive evidence of the presence of coal bed methane at depths greater than 900 m. At these depths, mudlogs show gas kicks from coals; these kicks generally increase in strength with increasing depth. Gas buildups are often reported when drilling through coal sections. Coal cores bleeding gas have also been recovered.

Coal cores from four coal exploratory and one oil and gas test in the Green River Region have been desorbed (Table 1). The coal exploration core samples taken at depths of 53-427 m in T.5N., R.86-87W. yielded from 0 to 0.50 cm^3/G (0-16 ft^3/t). Core samples taken from the oil and gas test (T.7N., R.90W.) at depths of between 1,097 to 1,440 m, contained from 0.58 to 11.76 cm^3/g (18 to 376 ft^3/t).

The Sand Wash Basin of the Green River Region is believed to have a high potential as:

1) The amount of gas in the coals increases with increasing depth, and
2) Many of the thick coal sequences shown in Figure 9 occur under sufficient overburden to retain this gas.

The CGS will be calculating methane resources for the Sand Wash Basin in the near future.

CONCLUSIONS

The three regions of western Colorado contain basins with high methane potential. These areas may be found using coal rank,

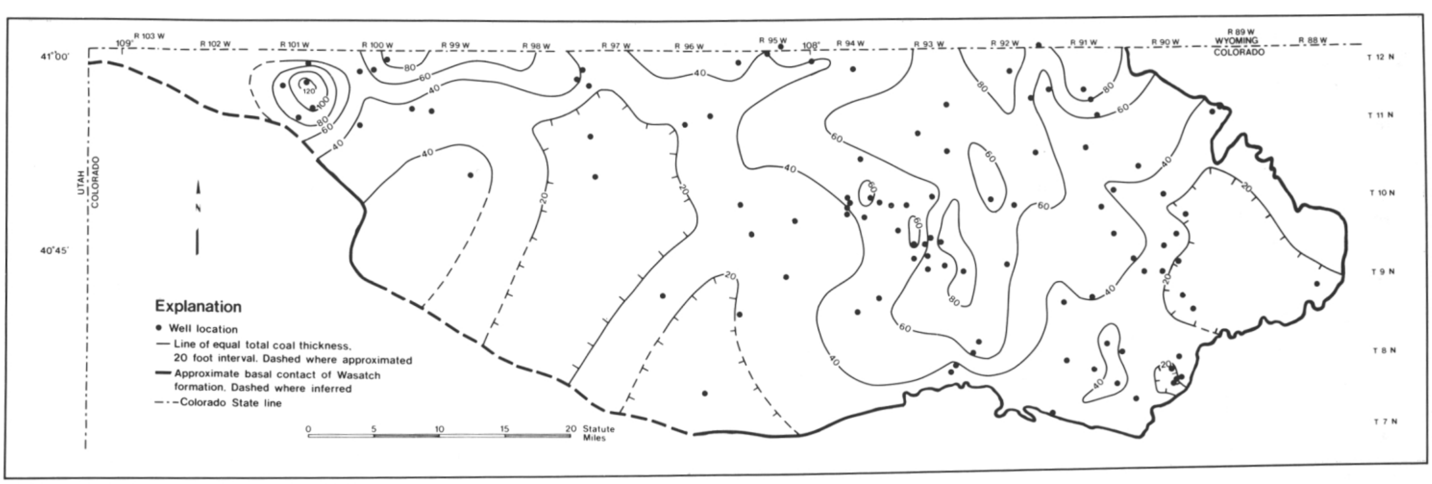

Figure 9. Net coal thickness map of the Lance and Fort Union formations, Sand Wash Basin.

depth, and desorption data obtained at little cost when drilling for coal reserve information or oil and gas. Potential coal reservoirs should be considered during all such exploration so they can be quickly developed when the economics so justify.

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