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GEOPHYSICAL AND LITHOLOGICAL LOGS FROM THE 1982 AND 1983 COAL DRILLING AND CORING PROGRAM, CASTLE ROCK 1/2° x 1° QUADRANGLE

by

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COLORADO GEOLOGICAL SURVEY

1983

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Castle Rock 1/2⁰ x 1⁰ Quadrangle
Plate 1

INTRODUCTION

The Colorado Geological Survey, under a United States Geological Survey grant, conducted an exploratory coal drilling program in the Castle Rock $1/2^{\circ} \times 1^{\circ}$ Quadrangle. The program was designed to assist in the evaluation of the coal resources of the quadrangle, particularly to fill in gaps of information on coal quality. The Colorado Geological Survey awarded the drilling contract to Teton Exploration Drilling Co., Inc., of Casper, Wyoming and the geophysical logging contract to Geoscience Associates, Inc. of Boulder, Colorado.

Drill-site locations were determined following a thorough evaluation of existing logs for water wells, oil and gas exploration holes, and mineral exploration holes. The final sites were selected based upon owner approval and were located at previous oil and gas or exploration drill sites to aid in determining core depths. The holes were located primarily in two different areas--just west of the Buick-Matheson area, an area in which Laramie Formation coals are about 500 to 1,000 feet in depth and the Ramah-Fondis area, where lignite of the Denver Formation is generally at shallow depths. Since a scarcity of information is available on Laramie Formation coals beyond shallow depths, one goal of the drilling project was to obtain coal quality data on deeper Laramie coals. Further evaluation of the quality of shallow Denver Formation lignites was desired in certain areas; these holes were rotary drilled down through the Laramie Formation to obtain additional needed information on deeper Laramie coals.

11 holes were drilled and geophysically logged at eight drill sites with a coal suite (natural gamma, density, resistivity, and caliper) logging tool. Two of these holes, CGS-44CR and CGS-44CR2, were redrills due to lost core recovery. One hole, CGS-46C, was offset from an initial rotary hole to core. At each of the six remaining sites there was one hole drilled; three of these were spot-cored for anticipated thicker coal zones and three were rotary drilled only, due to insufficiently thick coal to justify coring. Two samples were taken of Laramie Formation coal from two sites, and five samples were collected for Denver Formation coals from three sites. Analyses for these samples are shown in the tables accompanying this report.

Lithologies were compiled from interpretations of the drill cuttings, cores, and geophysical logs. Note that on the strip logs "T" denotes tonstein and "L" denotes lost core.

Unless otherwise noted, all measurements are given in feet; to convert feet to meters, multiply feet by 0.3048.

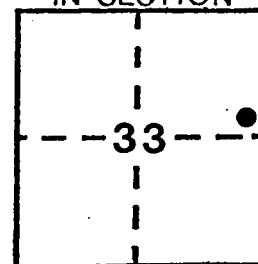
COLORADO GEOLOGICAL SURVEY

DRILL HOLE LOG, CASTLE ROCK 1/2° x 1° QUADRANGLE

Hole No.: CGS-40C
 Date Logged: 1/11/83
 Drilled Depth: 1320'
 Logged Depth: 1273'
 Drilling Medium: mud
 Fluid Level: 110'
 Cored: X Yes No

Section: 33 SENE
 Township: 9S
 Range: 62W
 Elevation(Ft): 6215
 County: Elbert
 State: Colorado
 USGS Topographic
 Quadrangle: Fondis 7.5'

LOCATION
IN SECTION




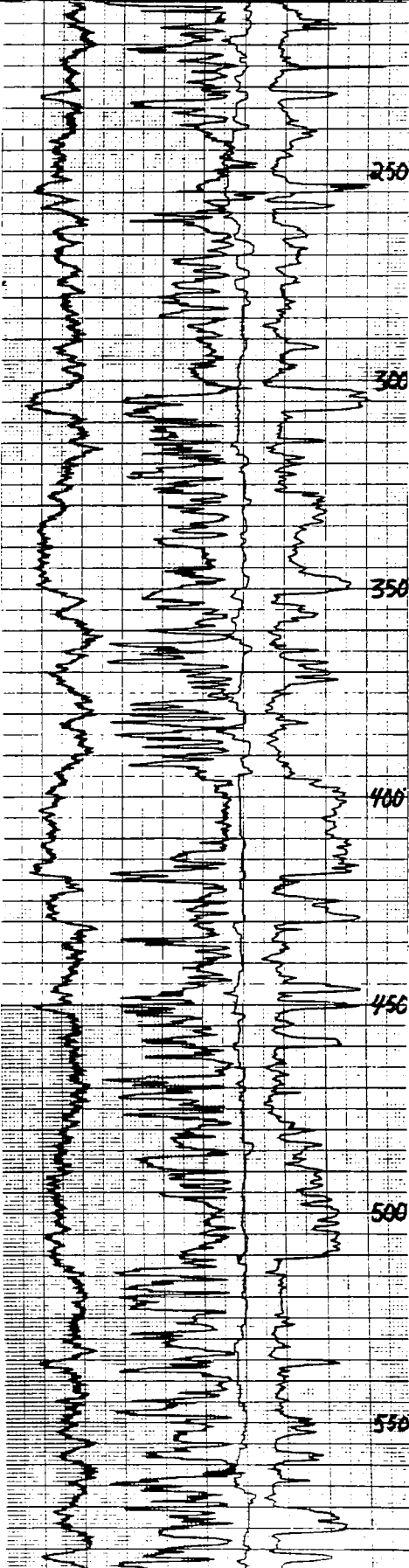
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Density (Den): T.C. 1	Scale 800 cps/in	Logging Speed 20	fpm
Caliper (C):	Scale 20 in/in	Logging Speed 20	fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed 20	fpm

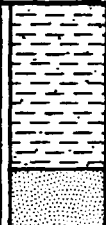

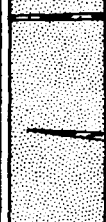
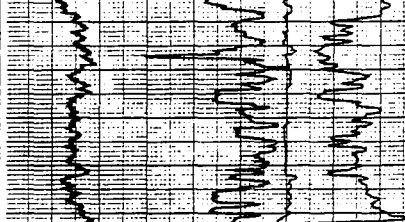
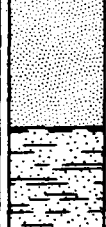
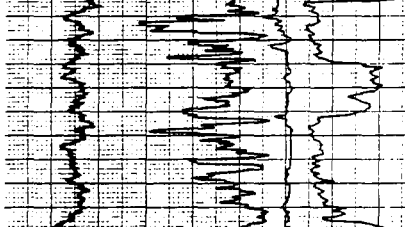
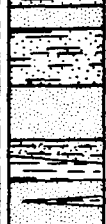

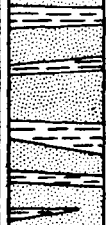
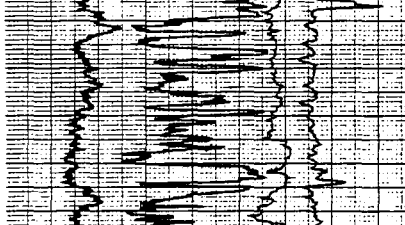
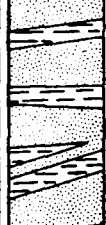
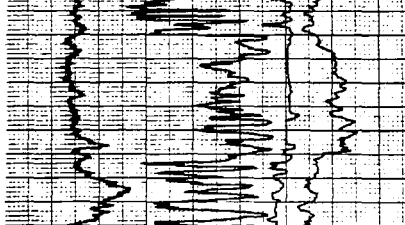
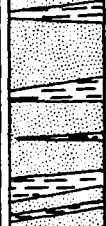
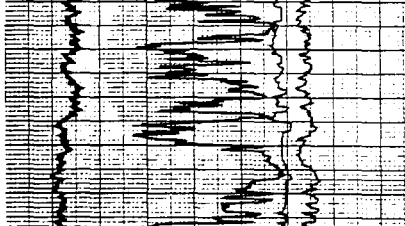

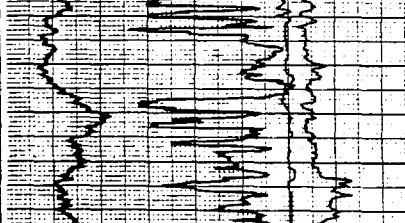
Remarks: Cored 70.5' to 117.0'


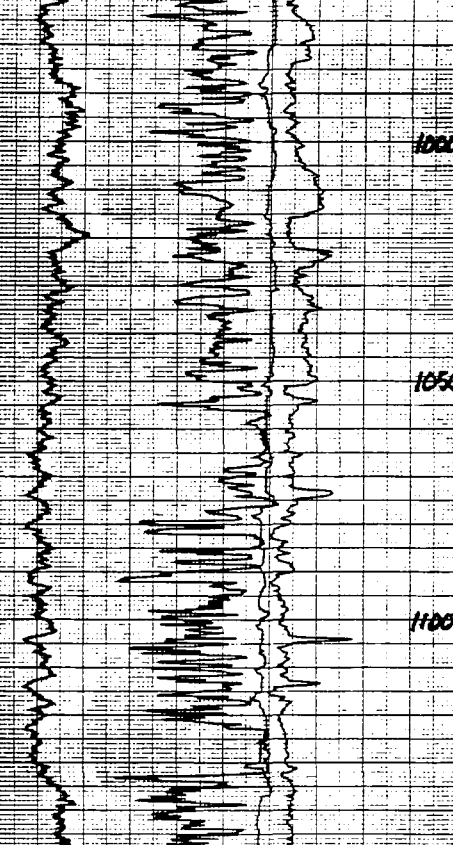

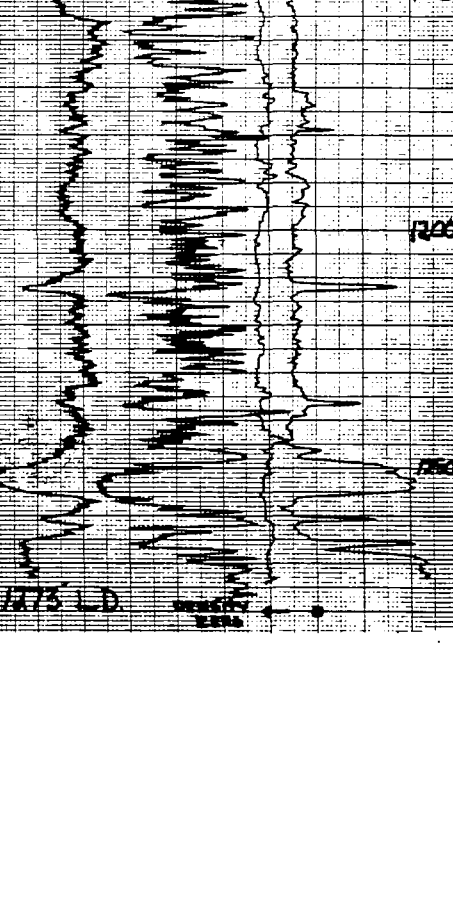
LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
Quaternary (reworked Dawson)				
0-17	sandstone; coarse, light yellow to orange, oxidized			
Tertiary-Cretaceous Denver Formation				
17-22	claystone; medium brown with moderate carb debris			
22-67	claystone; light green to gray, silty and sandy with thin sandstone interbeds			
67-69	sandstone; slightly silty, light brown, slightly carbonaceous			
69-69.5	lignite			
69.5-70.5	sandstone; as above cored - 70.5' to 117.0' see core descriptions			
117-134	sandstone; as above, coarsens upward			
134-150	claystone; light to medium gray, sandy			
150-151	lignite			
151-155.5	claystone; as above			
155.5-157	lignite			
157-161.0	claystone; as above			
161.0-164.5	lignite			

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-40C - Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
164.5-171	claystone; medium to dark gray, trace lignite inclusions		
171-172	lignite		
172-185	claystone; medium to dark gray, carbonaceous, lignite inclusions		
185-186	lignite; very dirty		
186-193	claystone; dark gray, carbonaceous, sandy		
193-203	sandstone; fine to medium grained, light gray		
203-204	lignite		
204-231.5	interbedded sandstone and claystone; sandstone-as above; claystone-medium gray, sandy		
231.5-233	lignite		
233-252.5	claystone; medium to dark gray, sandy, increasing sand toward base		
252.5-255.5	sandstone; fine to medium grained, light gray		
255.5-257.5	claystone		
257.5-259	lignite; dirty at top		
259-302	interbedded claystone and sandstone; claystone-medium gray, silty and sandy; sandstone-light gray, fine to medium grained		
302-307.5	lignite; dark brown to black		
307.5-327	interbedded claystone and sandstone; increasing sandstone toward base		
327-351	sandstone; fine to medium grained, light gray		
351-354	claystone; medium to dark gray		
354-358	sandstone; argillaceous, as above		
358-364.5	claystone; as above, with carb. streaks		
364.5-365.5	lignite		
365.5-368	claystone; medium to dark gray		
368-373	interbedded sandstone and claystone; mostly sandstone, both as above		
373-392	interbedded claystone and sandstone, mostly claystone, both as above		
392-416	sandstone; fine grained, light gray		
416-419	lignite; parting in center		
419-423	claystone; medium gray, very silty		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-40C - Continued



















LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
423-431	sandstone; argillaceous, light to medium gray, fine to medium grained			600
431-445.5	claystone; medium to dark gray, very silty, trace thin sandstone interbeds, coarser towards base			
445.5-447.5	lignite; very dirty, especially at top			
447.5-450.0	claystone			650
450-452	lignite; parting in center			
452-480	claystone; medium to dark gray, with thin interbeds of light gray sandstone			
480-512	sandstone; medium grained, light gray, very argillaceous top 10'			700
512-535	claystone; medium gray, sandy and silty			
535-536.5	lignite			
536.5-570	interbedded claystone and sandstone; 50/50; claystone-medium to dark gray, sandy; sandstone-light gray, medium grained			750
570-575.5	lignite; several partings top half			
575.5-581	claystone; as above			
581-583	lignite			800
583-622	claystone; medium to dark gray, silty			
Cretaceous Arapahoe Formation				
622-706	sandstone; fine to medium grained, light gray with trace thin interbeds of medium gray, silty claystone			850
706-728	claystone; medium gray, silty and sandy			
728-733	sandstone; medium grained, light gray			
733-745	claystone; as above			900
745-756	sandstone; as above			
756-953	interbedded sandstone and claystone; mostly light gray sandstone, very argillaceous			
953-1015	sandstone; light gray, very argillaceous			950
1015-1023	claystone; medium gray, rather hard			
1023-1051	sandstone; medium grained, light gray, silty with thin claystone interbeds			

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
<p>Laramie Formation</p> <p>1051-1156 claystone; medium gray, very silty and sandy with thin sandstone interbeds at 1054', 1073', 1104', 1113'</p> <p>1156-1212 claystone; medium gray, little sand or silt content</p> <p>1212-1213 coal</p> <p>1213-1236 claystone; as above</p> <p>1236-1237 siderite</p> <p>1237-1246 claystone; as above</p> <p>1246-1248 sandstone; argillaceous, fines upward</p> <p>1248-1250 claystone; carbonaceous, with possible splits off coal at base</p> <p>1250-1256.5 coal</p> <p>1256.5-1260.5 claystone; medium to dark gray, carbonaceous at top</p> <p>1260.5-1261.5 coal</p> <p>1261.5-1264.5 claystone; medium to dark gray, carbonaceous</p>		
<p>Laramie-Fox Hills Aquifer</p> <p>1264.5-1273 sandstone; fine grained, light gray</p> <p>1273-1320 sandstone; as above, below log</p>		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-40C

INTERVAL CORED: 70.5' to 117.0'

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
70.5-70.75 sandstone; medium grained, black, carbonaceous		 50
70.75-70.95 tonstein; light brown, slightly sandy, slightly carbonaceous		
70.95-71.5 interbedded lignite and tonstein; lignite-shaly, tonstein-as above		
71.5-71.7 tonstein; light grayish brown		 80
71.7-72.3 lignite; dark brown to black, solid, slightly dirty, tonstein blebs		 90
72.3-72.5 lignite; as above, very broken		
72.5-72.9 tonstein; light gray		
72.9-73.5 lignite; black, rather bright, solid, trace resin and claystone at top		 100
73.5-73.55 claystone; black, carbonaceous		 Fluid Level
73.55-73.65 sandstone; fine to medium grained, medium brown		 120
73.65-74.9 sandstone; fine to medium grained, medium green, slightly shaly		
74.9-76.5 lost		
76.5-82.5 sandstone; fine to medium grained, medium green, shaly, thin carb bands (rippled)		 140
82.5-87.9 as above; with thin claystone laminations, more abundant toward base		
87.9-88.5 lost		
88.5-89.6 interbedded claystone and sandstone; claystone-medium gray, sandy, with fine grained sandstone		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-40C

INTERVAL CORED: 70.5' to 117.0' - continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
89.6-95.3 interbedded claystone and sandstone; very sandy, medium gray claystone, with trace carb laminations		
95.3-95.9 claystone; medium gray, slightly sandy, trace carb debris		
95.9-96.6 claystone; light to medium gray, very broken, slickensides		
96.6-97.1 sandstone; fine to medium grained, light gray, trace claystone inclusions		
97.1-100 sandstone; as above		
100-101.5 sandstone; light to medium gray, shaly, abundant shale inclusions, moderate carb laminations		
101.5-101.8 claystone; medium gray, trace carb inclusions		
101.8-102.3 claystone; as above, abundant lignite inclusions, slickensides		
102.3-102.4 lignite; medium bright, conchoidal fracture, angular top contact		
102.4-102.6 lost		
102.6-103.7 claystone; medium gray, sandy, trace carb and lignite inclusions, some interbedded tonstein at base		
103.7-108.5 lignite; medium bright to dull, solid, rather dirty, trace tonstein throughout, abundant tonstein top 1', 0.05' tonstein interbeds at 104.7' and 106.8', trace fusain and resin, gradational top contact, very shaly top 0.1', slight conchoidal fracture, heavy		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-40C

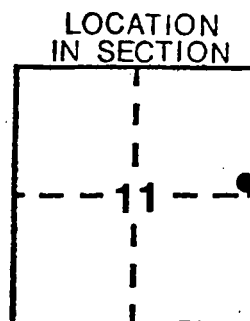
INTERVAL CORED: 70.5' to 117.0' - continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
108.5-112.85 lignite; no visible disseminated tonstein, tonstein interbeds at 108.7' to 108.85' and 0.05' at 111.3', sharp basal contact		
112.85-113.3 interbedded sandstone and claystone; both dark brown, lignite interbeds, carbonaceous		
113.3-116.2 sandstone; medium to coarse grained, light gray to green, moderate carb inclusions		
116.2-117 lost		

DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ x 1⁰ QUADRANGLE

Hole No.: CGS-41C
 Date Logged: 7/2/82
 Drilled Depth: 1304'
 Logged Depth: 1110'
 Drilling Medium: mud
 Fluid Level: 34'
 Cored: XYes No

Section: 11 SENE
 Township: 11S
 Range: 62W
 Elevation(Ft): 6397
 County: El Paso
 State: Colorado
 USGS Topographic
 Quadrangle: Calhan 7.5'



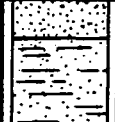
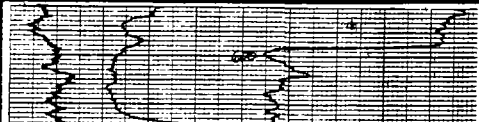
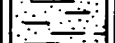
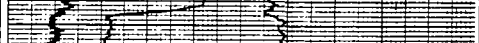

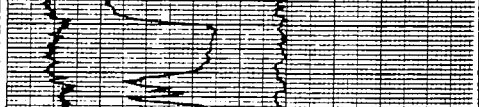

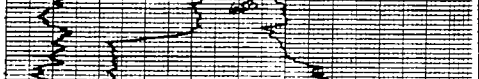





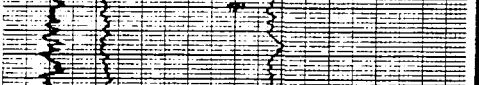
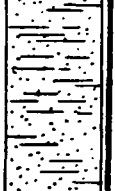
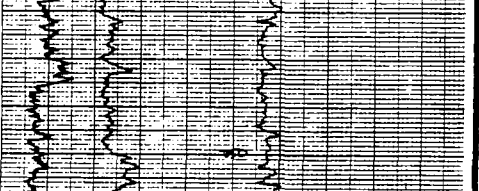
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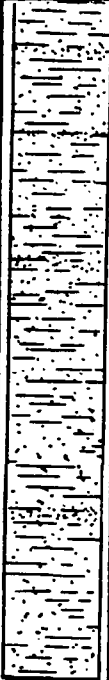
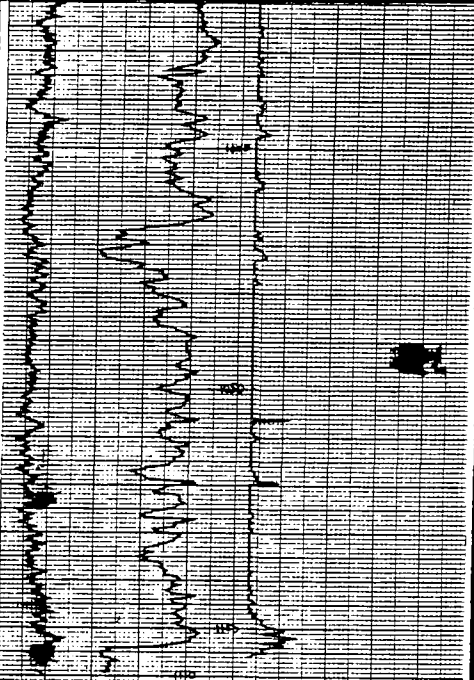
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Density (Den): T.C. 3	Scale 800 cps/in	Logging Speed 20 fpm
Caliper (C):	Scale	Logging Speed fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed 20 fpm

Remarks: No caliper curve. Density 416' to 1110' without sidewall contact. Cored 175.5' to 187.5', 283' to 306.2', 319' to 331'.

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
<p>Quaternary</p> <p>0-9 sand, gravel; brown, medium grained to pebbles, argillaceous</p> <p>Tertiary-Cretaceous Denver Formation</p> <p>9-20 claystone; medium brown to orange, oxidized, slightly silty</p> <p>20-45 claystone; light to medium gray, sandy and silty</p> <p>45-56 claystone; medium gray to dark brown, carbonaceous, silty</p> <p>56-59 lignite; medium brown, oxidized</p> <p>59-85 claystone; light to medium gray, very silty at base</p> <p>85-90 claystone; medium gray to brown, with abundant carb debris</p> <p>90-100 claystone; medium gray, sandy and silty</p> <p>100-101 sandstone; argillaceous, light gray</p> <p>101-123 claystone; light to medium gray, silty and sandy, interbedded hard and soft</p> <p>123-124 sandstone; light to medium gray, with abundant clay</p>		

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
124-175.5	claystone; light to medium gray, brown at base, slightly sandy, very silty, with trace carb debris Cored 175.5' to 187.5' see core descriptions		
187.5-190	claystone; medium to dark brown to gray, slightly silty		
190-190.5	lignite; dark brown		
190.5-199	claystone; medium to dark gray, with moderate carb debris		
199-200	lignite; dark brown		
200-202.5	claystone; as above		
202.5-203	lignite; dark brown		
203-212	claystone; medium gray, silty		
212-219	sandstone; silty, light to medium gray, argillaceous		
219-283	claystone; medium gray, very silty, with trace carb debris cored 283' to 306.2' see core descriptions		
306.2-312	claystone; medium gray, sandy and silty		
312-319	sandstone, light to medium gray, argillaceous, with claystone interbeds cored 319' to 331' see core descriptions		
331-402.5	claystone; medium gray, sandy		
402.5-404	lignite; dark brown		
404-405	claystone; as above		
405-406	lignite; dark brown		
406-420	claystone; as above		
420-422	lignite; dark brown		
422-424.5	claystone; as above		
424.5-426	lignite; dark brown		
426-448	claystone; as above		
448-479	claystone; as above, with abundant thin sandstone interbeds		
Cretaceous Arapahoe Formation			
479-518	sandstone; medium gray, medium grained, with large claystone interbeds		
518-572	claystone; medium gray, sandy, sandstone at 543'-544'		


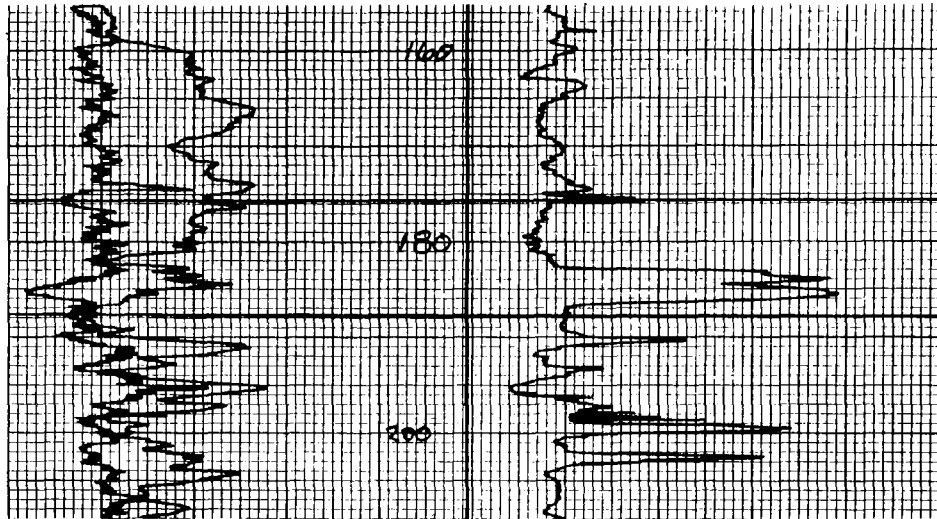
LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
572-598 sandstone; medium gray, medium grained, with claystone interbed near top		
598-661 claystone; medium gray, sandy		
661-690 sandstone; medium gray, medium grained, with thin interbeds of claystone		
690-825 claystone; medium gray, sandy, increasingly sandy bottom half		
825-844 sandstone; light to medium gray, with thin claystone interbeds		
844-943 claystone; medium gray, slightly sandy, with sandy zone in middle		
943-967 sandstone; medium gray, medium grained Laramie Formation		
967-1160 claystone; light to medium gray, with thin sandy zones, carbonaceous 1055' to 1070' Geophysical log to 1110 only (above Laramie coal zone)		

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		 <p> <i>Checked by</i> <i>Dr. R. H. H.</i> <i>Dr. R. H. H.</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> <i>10/10/56</i> </p>

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-41C

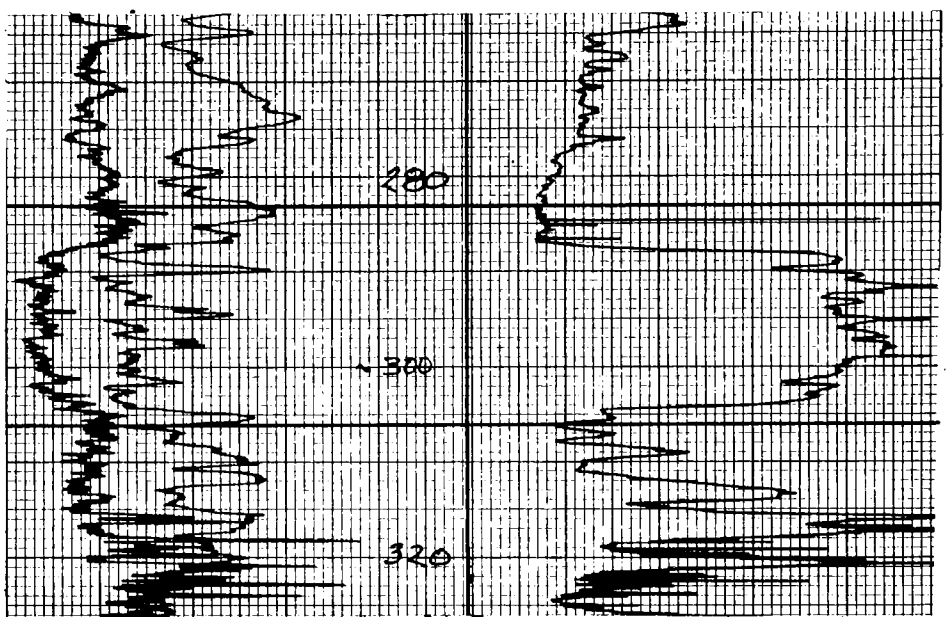

INTERVAL CORED: 175.5' to 187.5'

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
175.5-177.1	claystone; light greenish gray, very sandy, rather hard			
177.1-177.7	claystone; medium gray, slightly sandy, with trace lignite inclusions, slickensides			
177.7-181.7	claystone; medium gray, slightly sandy, with abundant slickensides, moderate carb debris			
181.7-181.9	claystone; dark gray to black, carbonaceous			
181.9-182.3	lignite; dark brown, shaly, with abundant inclusions of carb claystone			
182.3-182.7	tonstein; very light brown, silty, with carb debris			
182.7-183.1	lignite; as above			
183.1-183.4	tonstein; as above			
183.4-183.8	siltstone; dark brown, argillaceous, with abundant carb debris, coal inclusions and tonstein			
183.8-185.1	lignite; dark brown, rather blocky, solid, rather hard, moderately dull to dull, conchoidal fracture, very dirty, slightly vertical cleat, abundant tonstein inclusions top 0.2' and moderate laminations throughout			
185.1-185.2	tonstein; as above			
185.2-187.5	lost recovery			

**COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION**

HOLE NO.: CGS-41C

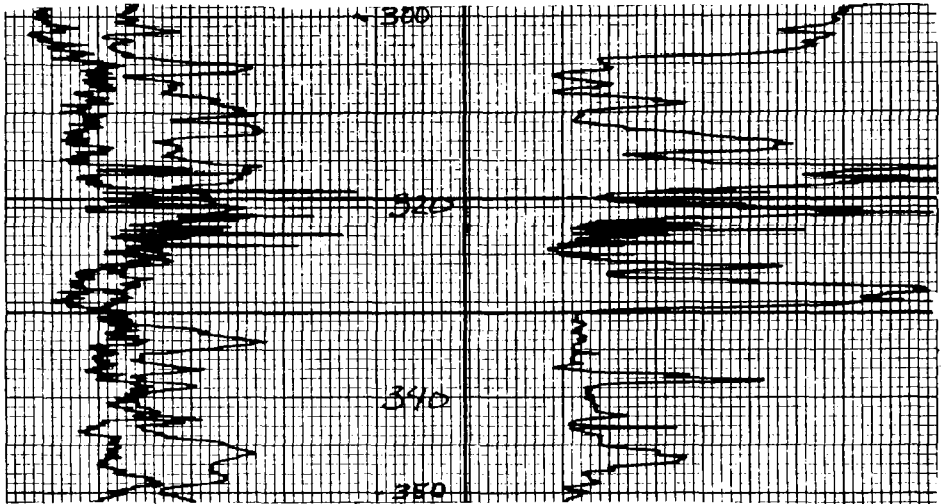
INTERVAL CORED: 283' to 306'

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
283-286.2 claystone; medium gray, slightly sandy, rather hard, trace carb debris		
286.2-286.4 siltstone; medium grayish brown, sandy, moderate tonstein inclusions		
286.4-286.9 siltstone; as above, no tonstein, carbonaceous, with moderate lignite inclusions		
286.9-303.4 lignite; dark brown, moderately dull to dull, mostly solid, hard, conchoidal fracture, very dirty, slight vertical cleat, abundant tonstein laminations throughout		
303.4-303.6 claystone; dark gray, very silty, abundant carb debris and slickensides		
303.6-306.2 sandstone; medium gray, very fine-grained, slightly wet, argillaceous, slickensides, trace claystone inclusions, moderate carb inclusions		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-41C

INTERVAL CORED: 319' to 331'

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
319-319.2 claystone; medium gray, very sandy, thin sandstone laminations, one large tonstein interbed		
319.2-319.4 sandstone; medium gray, wet, with abundant carb laminations		
319.4-322.8 claystone; medium gray, slightly sandy, platy, trace carb debris, 4 large tonstein interbeds (approx. 0.5')		
322.8-323.4 claystone; medium to dark gray, trace carb		
323.4-323.7 claystone; dark gray to black, abundant slickensides and carb debris; moderate pyrite		
323.7-324.8 lignite; dark brown to black, solid, rather hard, very dirty, with moderate dissiminated pyrite, 2 thin tonstein interbeds and small tonstein inclusions		
324.8-325.7 claystone; medium gray, slightly soft with abundant slickensides, trace carb debris		
325.7-326.4 lignite; dark brown, solid heavy, very dirty, claystone inclusions, trace pyrite		
326.4-327.0 claystone; black, carbonaceous, abundant tonstein interbeds, lignite interbed near base		
327.0-327.9 lignite; dark brown, solid, dirty, abundant tonstein interbeds, 1 large slickenside, trace pyrite		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-41C

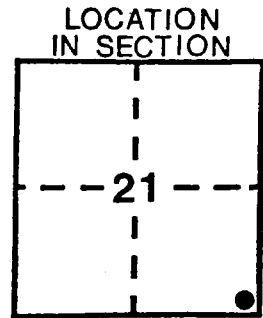
INTERVAL CORED: 319' to 331 - continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
327.9-328.9	lignite; as above, with no tonstein interbeds, trace disseminated tonstein		
328.9-331.0	lost		

COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ °x1° QUADRANGLE

Hole No.: CGS-42
 Date Logged: 1/21/83
 Drilled Depth: 884'
 Logged Depth: 872'
 Drilling Medium: mud
 Fluid Level: 5'
 Cored: Yes XNo

Section: 21 SESE
 Township: 11S
 Range: 60W
 Elevation(Ft): 6475
 County: El Paso
 State: Colorado
 USGS Topographic
 Quadrangle: Alta Vista 7.5'



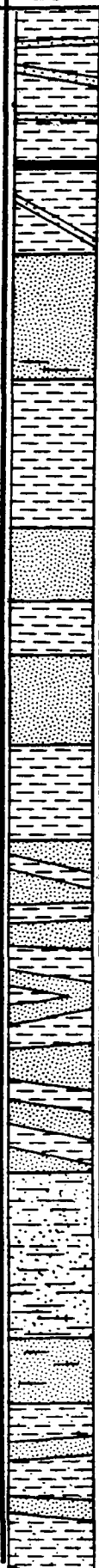
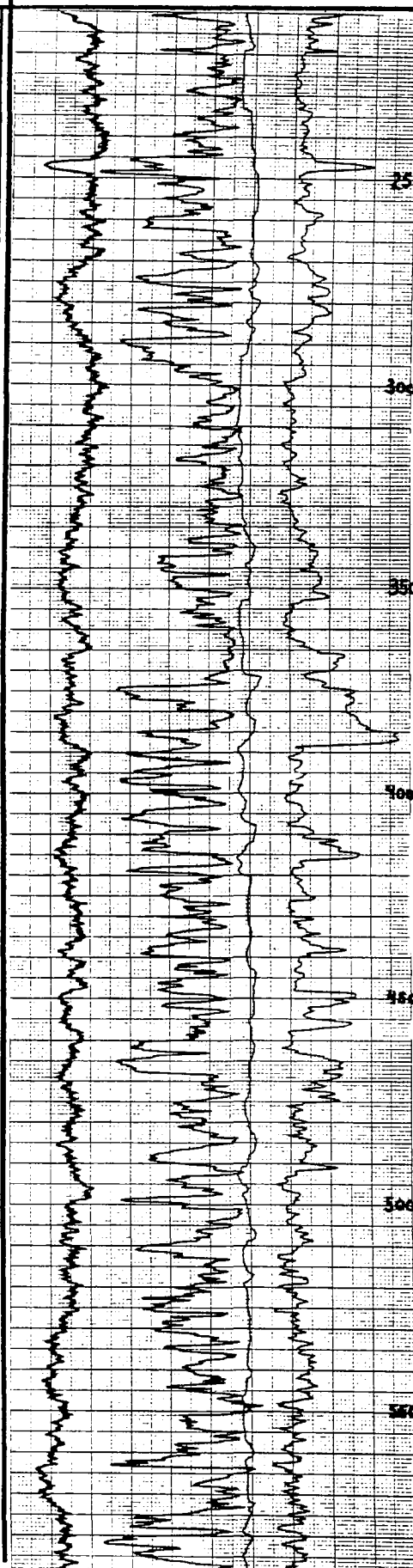
Geophysical Logs:

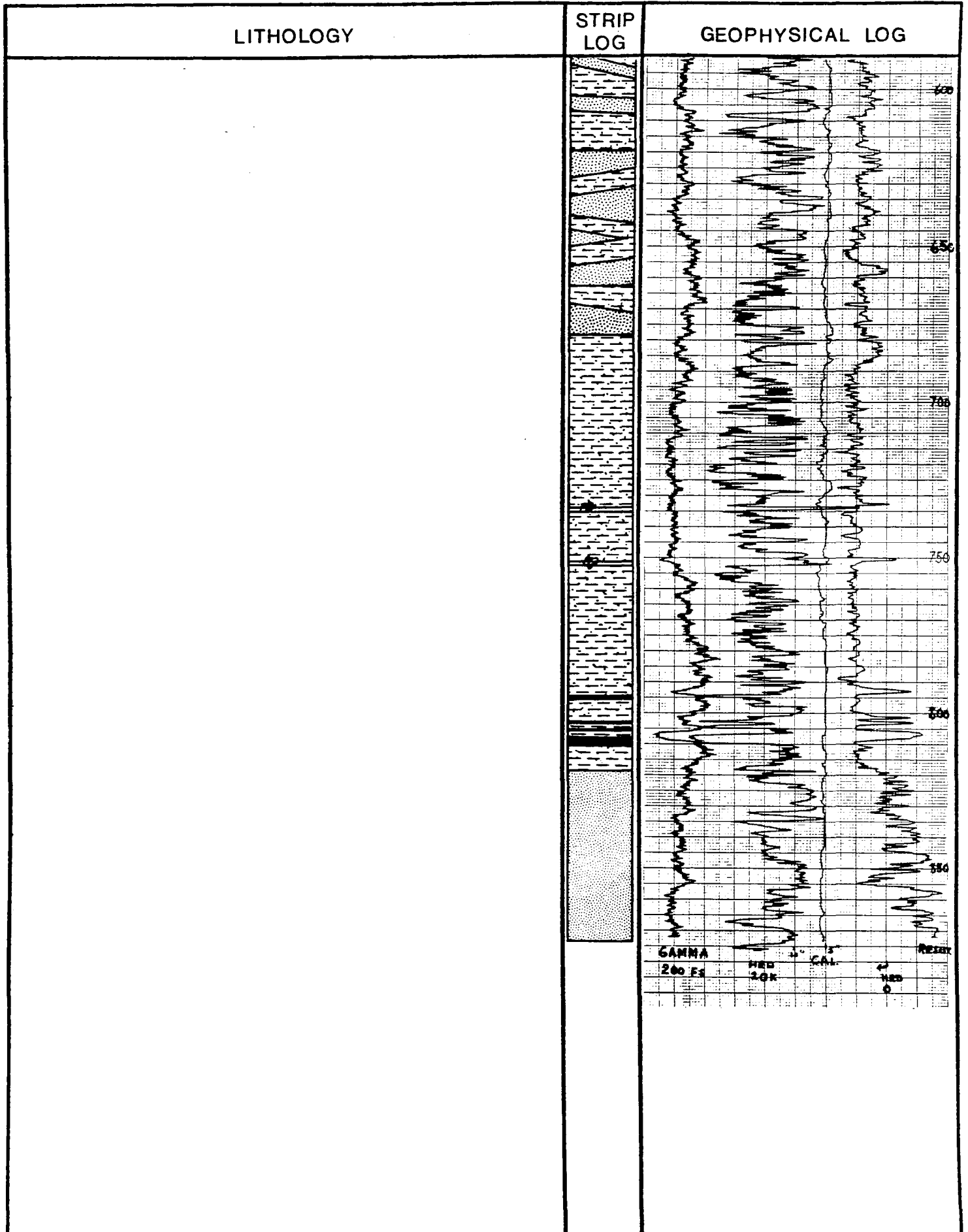
Gamma (G): T.C. 10	Scale 80 cps/in	Logging Speed	20 fpm
Density (Den): T.C. 1	Scale 800 cps/in	Logging Speed	20 fpm
Caliper (C):	Scale 20 in/in	Logging Speed	20 fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed	20 fpm

Remarks:

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
<p>Quaternary</p> <p>0-138 interbedded sand and gravel; medium orangish brown, coarse sand</p> <p>Tertiary-Cretaceous Denver Formation</p> <p>138-151 claystone; medium gray, silty</p> <p>151-163 sandstone; medium gray, very argillaceous</p> <p>163-192 interbedded sandstone and claystone; as above, coarsens upward</p> <p>192-203 sandstone; as above, with thin claystone interbeds</p> <p>203-207 claystone; medium gray, slightly silty</p> <p>207-210 lignite; dark brown, very dirty at top</p> <p>210-246 claystone; as above, with thin sandstone interbeds</p> <p>246-248.5 lignite; as above</p> <p>248.5-269 claystone; as above</p> <p>Cretaceous Arapahoe Formation</p> <p>269-299 sandstone; medium gray, fine to medium grained, coarsens upward, very argillaceous toward base</p>		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-42 - Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG		
299-335	claystone; light to medium gray				
335-353	sandstone; medium gray, medium grained				
353-366	claystone; as above				
366-388	sandstone; as above				
388-411	claystone; as above				
411-492	interbedded sandstone and claystone; as above				
492-532	claystone; medium gray, very silty and sandy				
532-548	sandstone; light to medium gray, very argillaceous				
Laramie Formation					
548-618	interbedded claystone and sandstone; as above, mostly claystone				
618-677	interbedded sandstone and claystone; as above, 50/50				
677-732	claystone; medium gray to brown, silty and sandy				
732-733	siderite; very dense				
733-750	claystone; as above				
750-751	siderite; as above				
751-793	claystone; medium gray, less silt and sand than above, coarsens upward				
793-794	coal				
794-801	claystone; medium to dark gray, little silt				
801-802	coal; black, rather hard, dirty				
802-803	claystone; as above				
803-804	coal; as above				
804-806	claystone; as above				
806-809	coal; black, fairly clean				
809-817	claystone; as above				
Laramie-Fox Hills Aquifer					
817-873	sandstone; light gray, fine grained; base log at 873'				
873-884	sandstone; as above; below log				

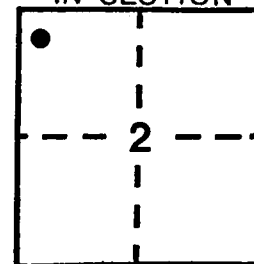


COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ x 1⁰ QUADRANGLE

Hole No.: CGS-43
 Date Logged: 6/27/82
 Drilled Depth: 743'
 Logged Depth: 740'
 Drilling Medium: mud
 Fluid Level: 76'
 Cored: Yes X No

Section: 2 NWNW
 Township: 10S
 Range: 60W
 Elevation(Ft): 6125
 County: Elbert
 State: Colorado
 USGS Topographic
 Quadrangle: Simla 7.5'

LOCATION
IN SECTION

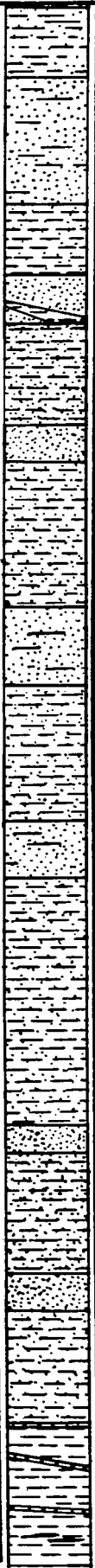
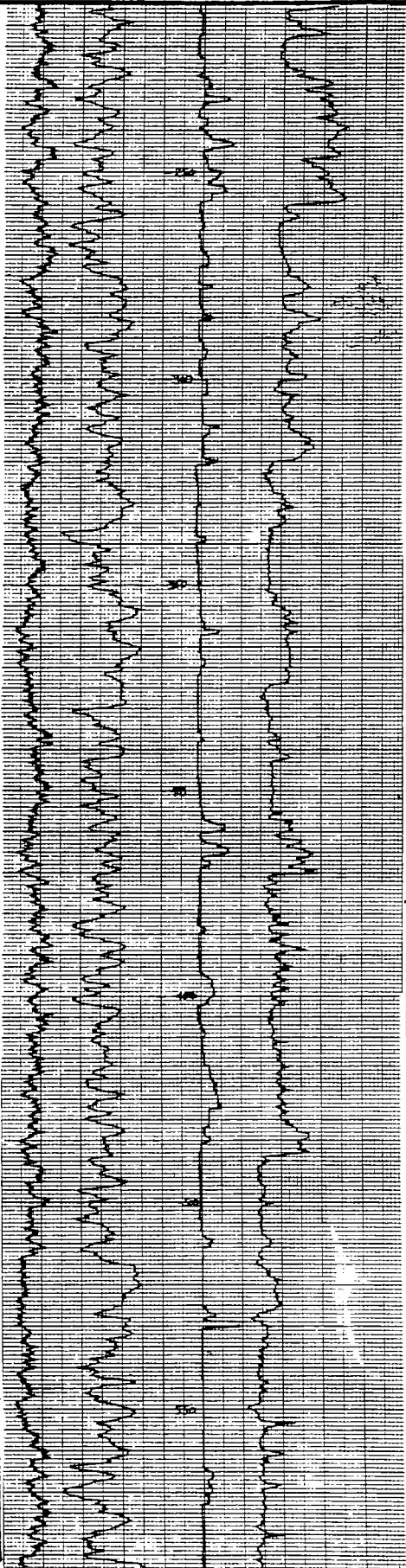


Geophysical Logs:


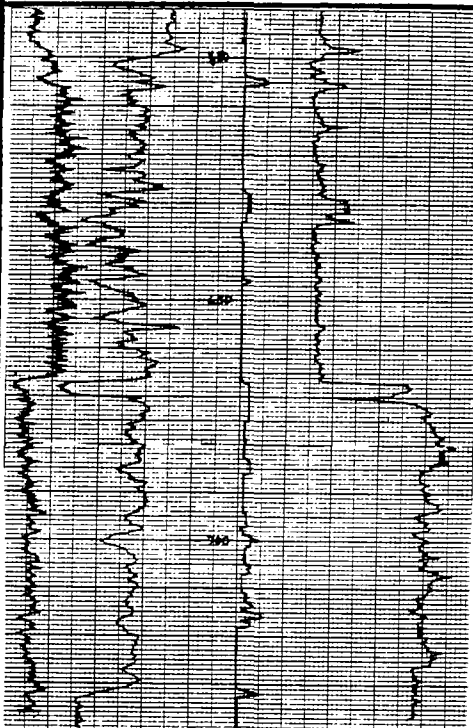
Gamma (G): T.C. 10	Scale 80 cps/in	Logging Speed 20 fpm
Density (Den): T.C. 3	Scale 800 cps/in	Logging Speed 20 fpm
Caliper (C):	Scale 8 in/in	Logging Speed 20 fpm
Resistance (Res):	Scale 80 ohm/in	Logging Speed 20 fpm

Remarks:

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
Quaternary				
0-5	top soil, sandy, medium gray to medium brown			
Cretaceous				
Arapahoe Formation				
5-10	claystone; dark gray, with sand, medium grained			
10-20	sandstone; light yellow brown, medium grained			
20-35	sandstone; light brown, with clay			
35-60	sandstone; light to medium brown, medium grained, with medium gray clay 50' to 60'			
60-119	claystone; medium gray to green to brown, sandy, abundant sand 115' to 120'			
119-150	sandstone; light to medium gray, medium grained, with clay 120' to 125', trace carb debris 125' to 140'			
150-183	claystone; medium gray, sandy, with increasing sand and carb debris toward base			
183-211	sandstone; light gray, medium grained, trace carb debris			
211-228	claystone; medium gray to green, sandy			

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
228-258	sandstone; medium gray, medium grained, with clay		
258-275	claystone; medium gray to brown, slightly sandy		
275-286	sandstone; medium gray, medium green, with interbedded clay		
286-313	claystone; medium gray to brown, sandy		
313-320	sandstone; medium gray to light green, medium grained		
320-355	claystone; medium gray, sandy		
355-374	sandstone; medium gray, medium grained, argillaceous, with medium gray to light green clay		
Laramie Formation			
374-407	claystone; medium gray, sandy		
407-421	sandstone; medium gray, medium grained, with moderate clay		
421-481	claystone; medium gray to brown (some green), sandy		
481-488	sandstone; medium gray, medium grained		
488-517	claystone; medium gray to brown with sand		
517-526	sandstone; light gray, medium grained		
526-553	claystone; as above		
553-554	sandstone; medium to light gray, medium to coarse grained		
554-587	claystone; medium gray, with thin sandstone lenses, carbonaceous at 580'		
587-600	sandstone; medium gray with clay		
600-605	claystone; medium gray to black to brown, with carb debris		
605-633	claystone; as above, thin sand lenses		
633-634	lignite; dark brown		
634-667	claystone; medium gray, sandy, carb debris		
667-670	lignite; dark brown, rather hard		
670-670.5	claystone; as above		
Laramie-Fox Hills Aquifer			
670.5-740	sandstone; light to medium gray to green, with interbedded claystone		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-43 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		 <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: left;"> <p>Depth 100' 0" 100' 10" 100' 20" 100' 30" 100' 40" 100' 50" 100' 60" 100' 70" 100' 80" 100' 90" 100' 100"</p> </div> <div style="text-align: center;"> <p>Depth 100' 0" 100' 10" 100' 20" 100' 30" 100' 40" 100' 50" 100' 60" 100' 70" 100' 80" 100' 90" 100' 100"</p> </div> <div style="text-align: center;"> <p>Depth 100' 0" 100' 10" 100' 20" 100' 30" 100' 40" 100' 50" 100' 60" 100' 70" 100' 80" 100' 90" 100' 100"</p> </div> <div style="text-align: center;"> <p>Depth 100' 0" 100' 10" 100' 20" 100' 30" 100' 40" 100' 50" 100' 60" 100' 70" 100' 80" 100' 90" 100' 100"</p> </div> </div>

DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ ° x 1° QUADRANGLE

Hole No.: CGS-44C

Date Logged: 6/24/82

Drilled Depth: 623'

Logged Depth: 610'

Drilling Medium: mud

Fluid Level: 45'

Cored: X Yes No

Section: 25 SWS

Township: 8S

Range: 60W

Elevation(Ft): 6125

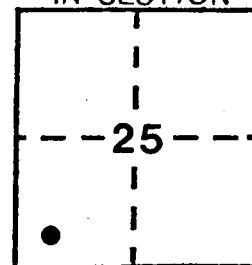
County: Elbert

State: Colorado

USGS Topographic

Quadrangle: Kuhn's Crossing, 7.5'

LOCATION
IN SECTION



Geophysical Logs:

Gamma (G): T.C. 10

Density (Den): T.C. 3

Caliper (C):

Resistance (Res):

Scale 80 cps/in

Scale 800 cps/in

Scale 8 in/in

Scale 80 ohms/in

Logging Speed

Logging Speed

Logging Speed

Logging Speed

20 fpm

20 fpm

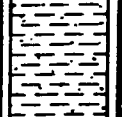
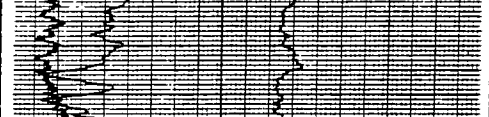

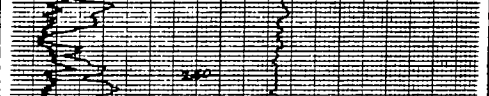


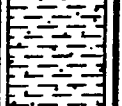
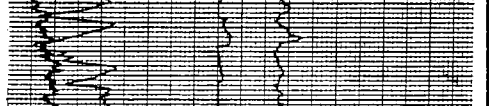



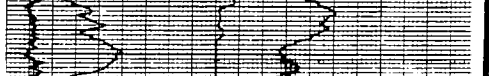




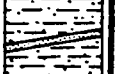







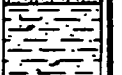

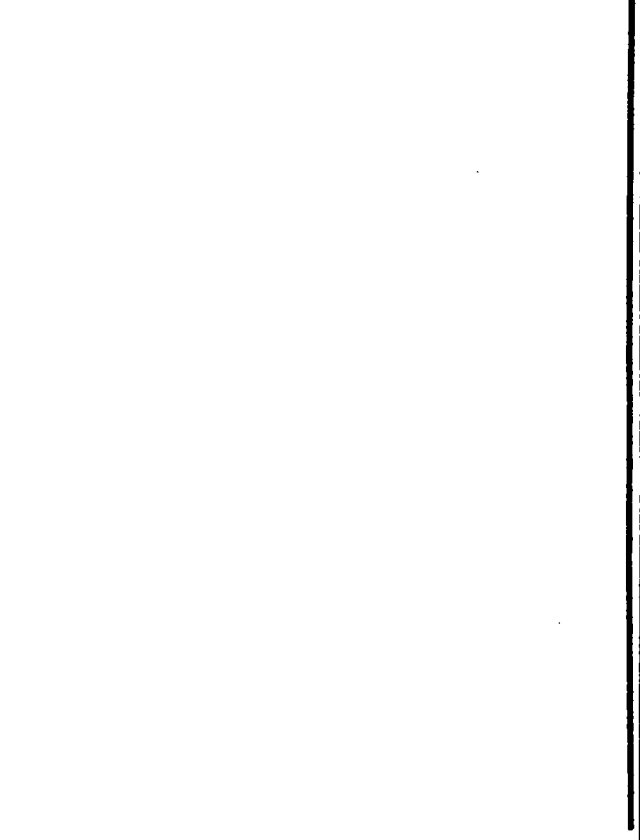
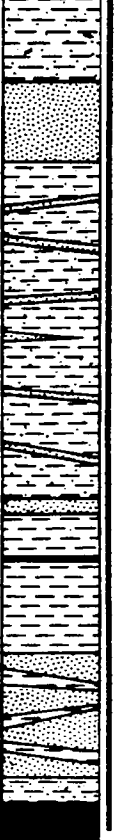
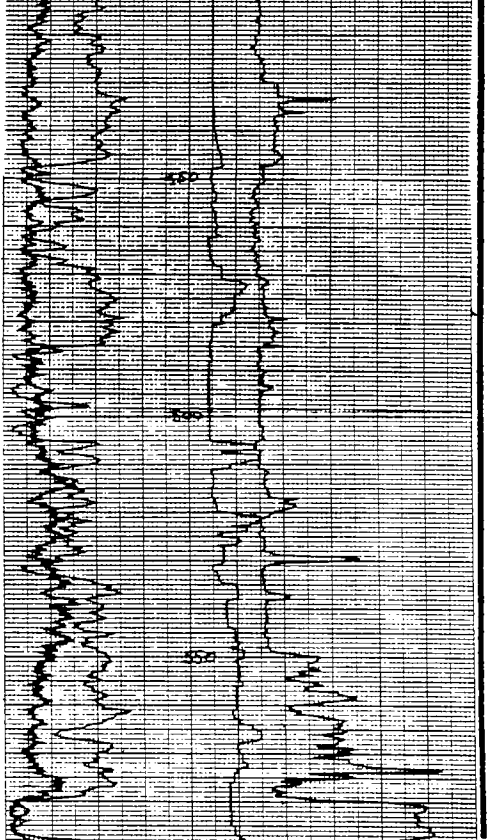
20 fpm

20 fpm

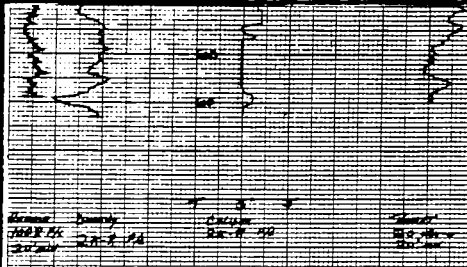
Remarks: Lost recovery of all core.

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
Quaternary		
0-10 clay; brown, calcareous with fine sand		
10-15 gravel; brown, calcareous, with clay, as above		
Cretaceous Arapahoe Formation		
15-45 sandstone; light to medium brown and orange, fine grained		
45-109 sandstone; brown to gray, fine to medium grained, with thin claystone interbeds, possible siderite at base		
109-120 claystone; medium gray, sandy		
120-127 sandstone; light gray, fine grained		
127-152 claystone; as above		
152-200 sandstone; gray, medium grained, with thin claystone interbeds		
Laramie Formation		
200-306 claystone; light to medium gray to green, slightly sandy, interbedded hard and soft		
306-317 sandstone; light gray, fine to medium grained		
317-374 claystone; light to medium to dark gray, with trace green and brown, sandy and silty, trace carb debris, thin sandstone interbeds		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-44C - Continued

	LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
374-398	sandstone; medium gray, medium to coarse grained, slightly argillaceous, wet		
398-430	claystone; medium gray to green, sandy and silty, trace carb debris		
430-447	sandstone; light gray, very argillaceous, slightly carbonaceous		
447-517	claystone; medium gray, silty, with thin sandstone interbeds, carbonaceous near base		
517-520	sandstone; light gray, medium grained, trace carb debris		
520-529	claystone; medium to dark gray, moderately carbonaceous		
529-530.5	coal; black		
530.5-549	claystone; medium gray		
549-575	sandstone; medium gray with claystone interbeds		
575-580	claystone; medium to dark gray, sandy		
580-588	coal; dark brown to black		
Laramie-Fox Hills Aquifer			
588-623	sandstone; medium gray, fine to medium grained		
			

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-44C - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		

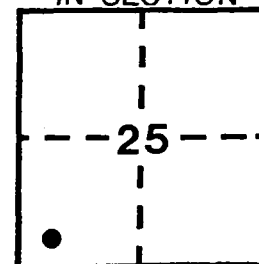
COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ x 1⁰ QUADRANGLE

Hole No.: CGS-44CR
 Date Logged: 6/25/82
 Drilled Depth: 623'
 Logged Depth: 615'
 Drilling Medium: mud
 Fluid Level: 69'
 Cored: ^XYes No

Section: 25 SWSW
 Township: 8S
 Range: 60W
 Elevation(Ft): 6125
 County: Elbert
 State: Colorado

USGS Topographic
 Quadrangle: Kuhn's Crossing, 7.5'

LOCATION
 IN SECTION



Geophysical Logs:

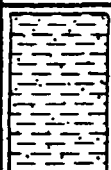

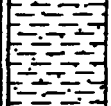





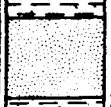


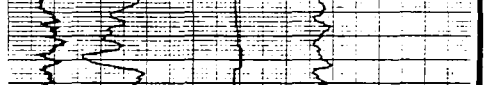

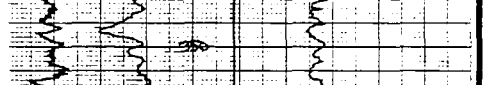





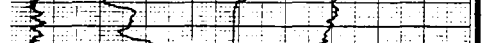

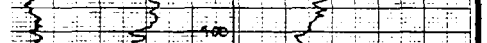

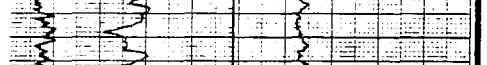

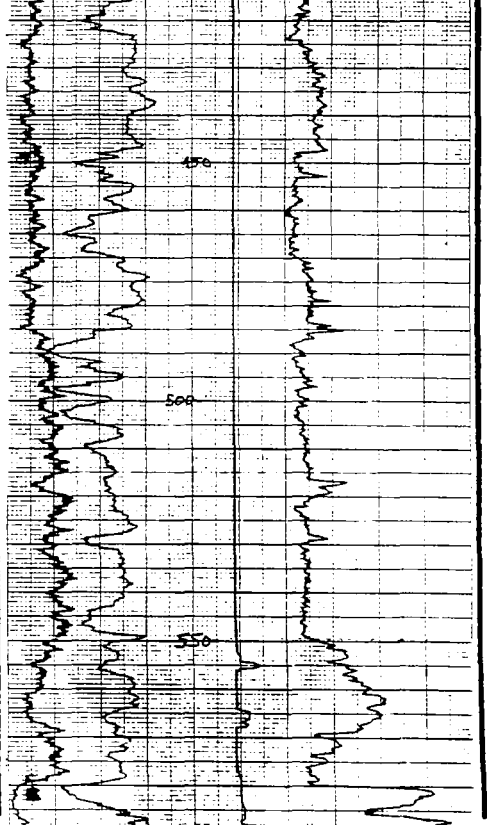
Gamma (G): T.C. 10	Scale 80 cps/in	Logging Speed	20 fpm
Density (Den): T.C. 3	Scale 800 cps/in	Logging Speed	20 fpm
Caliper (C):	Scale 8 in/in	Logging Speed	20 fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed	20 fpm

Remarks: Lost recovery of coal core.
 35' west of CGS-44C.

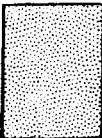

Location is approximately

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
<p>Quaternary</p> <p>0-10 clay; brown, calcareous with fine sand</p> <p>10-15 gravel; brown, calcareous with clay as above</p> <p>Cretaceous</p> <p>Arapahoe Formation</p> <p>15-45 sandstone; light to medium brown and orange, fine grained</p> <p>45-113 sandstone; brown to gray, fine to medium grained with thin claystone interbeds, possible siderite at base</p> <p>113-122 claystone; medium gray, sandy</p> <p>122-128 sandstone; light gray, fine grained</p> <p>128-157 claystone; as above</p> <p>157-198 sandstone; gray, medium grained, thin claystone interbeds and argillaceous 170' to 198'</p> <p>Laramie Formation</p> <p>198-304 claystone; light to medium gray to green, slightly sandy, interbedded hard and soft</p> <p>304-321 sandstone; light gray, fine to medium grained</p>		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-44CR - Continued

	LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
321-374	claystone; light to medium to dark gray, with trace green and brown, sandy and silty, trace carb debris, thin sandstone interbeds		
374-401	sandstone; medium gray, medium to coarse grained, slightly argillaceous, wet		
401-424	claystone; medium gray to green, sandy and silty, trace carb debris		
424-448	sandstone; light gray, very argillaceous, slightly carbonaceous		
448-517	claystone; medium gray, silty with thin sandstone interbeds, carbonaceous near base		
517-520	sandstone; light gray, medium grained, trace carb debris		
520-550	claystone; medium gray with thin coal at 528'		
550-569	sandstone; medium gray with thin claystone interbeds		
569-580	claystone; medium to dark gray, sandy		
580-584	coal; black		
584-586	claystone (from log)		
Laramie-Fox Hills Aquifer			
586-623	sandstone; medium gray, fine to medium grained		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-44CR- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		

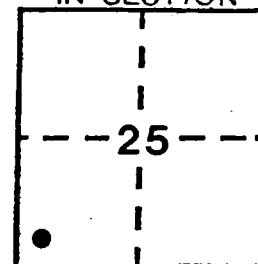
COLORADO GEOLOGICAL SURVEY

DRILL HOLE LOG, CASTLE ROCK 1/2°x1° QUADRANGLE

Hole No.: CGS-44CR2
 Date Logged: 6/28/82
 Drilled Depth: 623'
 Logged Depth: 608'
 Drilling Medium: mud
 Fluid Level: 73'
 Cored: X Yes No

Section: 25 SWS
 Township: 8S
 Range: 60W
 Elevation(Ft): 6125
 County: Elbert
 State: Colorado
 USGS Topographic
 Quadrangle: Kuhn's Crossing, 7.5'


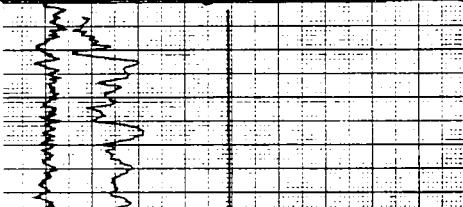

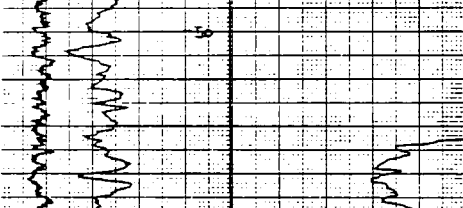
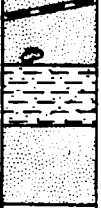
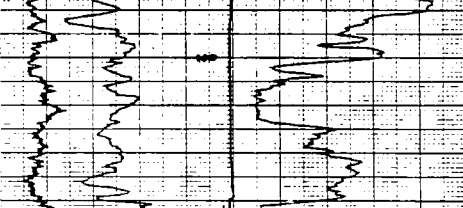
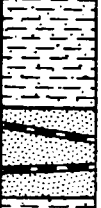
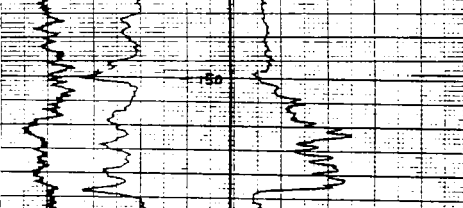

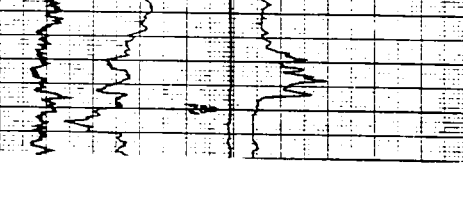


LOCATION
IN SECTION



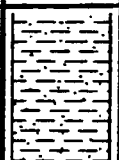

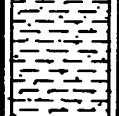
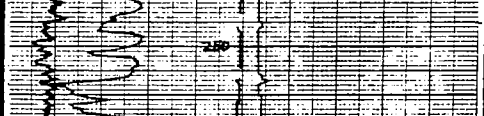




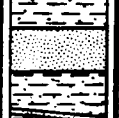





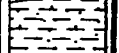
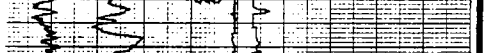
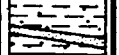
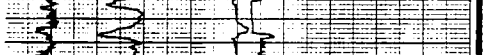
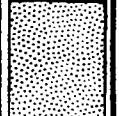

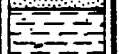
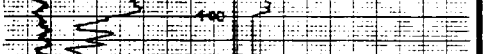
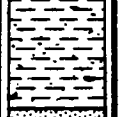
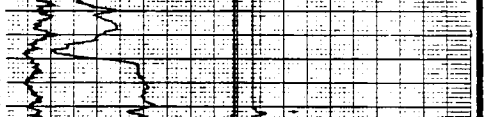
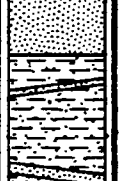
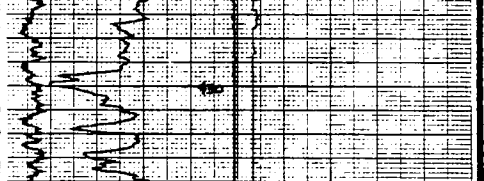


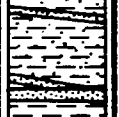



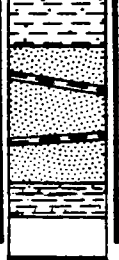
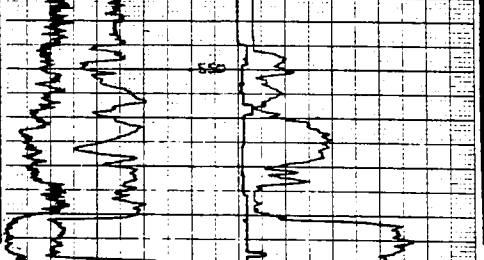
Geophysical Logs:

Gamma (G): T.C. 10	Scale 80 cps/in	Logging Speed 20 fpm
Density (Den): T.C. 3	Scale 800 cps/in	Logging Speed 20 fpm
Caliper (C):	Scale 8 in/in	Logging Speed 20 fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed 20 fpm


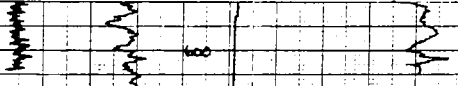
Remarks: Approximately 35'E of CGS-44C.
 Cored 580.7' to 589.2'

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
Quaternary				
0-10	clay; brown, calcareous, with fine sand			
10-15	gravel; brown, calcareous, with clay, as above			
Cretaceous Arapahoe Formation				
15-45	sandstone; light to medium brown to orange, fine grained			
45-101	sandstone; brown to gray, fine to medium grained, thin claystone interbeds, possible siderite at base			
101-114	claystone; medium gray, sandy			
114-130	sandstone; light gray, fine grained			
130-154	claystone; as above			
154-173	sandstone; gray, medium grained, thin claystone interbeds			
173-188	claystone; as above			
188-197	sandstone; as above			
Laramie Formation				
197-302	claystone; light to medium gray to green, slightly sandy, interbedded hard and soft			
302-311	sandstone; light gray, fine to medium grained			

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-44CR2 - Continued

	LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
311-373	claystone; light to medium to dark gray, with trace green and brown, sandy and silty, trace carb debris, thin sandstone interbeds		
373-399	sandstone; medium gray, medium to coarse grained, slightly argillaceous, wet		
399-431	claystone; medium gray to green, sandy and silty, trace carb debris		
431-444	sandstone; light gray, very argillaceous, slightly carbonaceous		
444-515	claystone; medium gray, silty, thin sandstone interbeds, carbonaceous near base		
515-518	sandstone; light gray, medium grained, trace carb debris		
518-528	claystone; medium to dark gray, trace carb debris		
528-529.5	coal; black		
529.5-546	claystone; medium gray, slightly sandy		
546-574	sandstone; medium gray, with claystone interbeds, argillaceous at top and base		
574-577	claystone; medium to dark gray, sandy		
577.0-577.2	claystone; dark brown to black, sandy, abundant carb debris, trace slickensides		
577.2-580.7	claystone; medium to dark gray, sandy, moderate carb debris, thin sandstone laminations cored 580.7' to 589.2' see core descriptions		
Laramie-Fox Hills Aquifer			
589.2-589.3	sandstone; medium gray, medium grained, calcareous, well cemented		
589.3-589.9	sandstone; medium to dark brown, slightly argillaceous, abundant carb debris, rather soft		
589.9-592.0	sandstone; light yellowish gray, medium grained, soft, wet		
592-623	sandstone; medium gray, fine to medium grained		


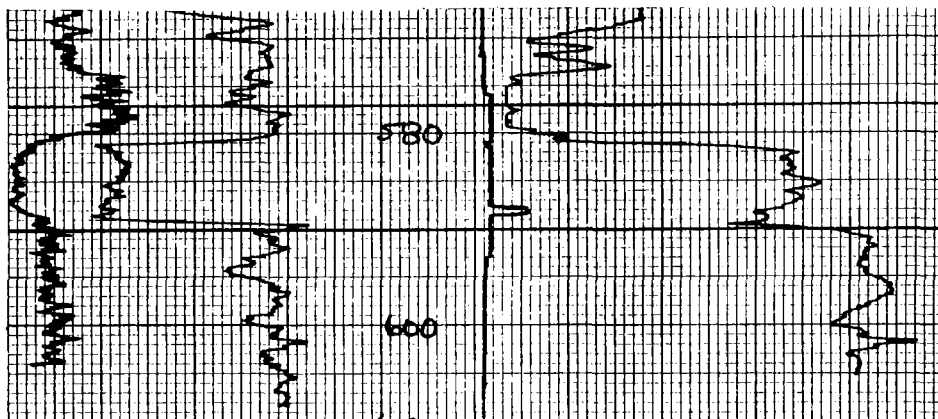
COLORADO GEOLOGICAL SURVEY
Hole No. CGS-44CR2 Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		 <p> <i>Elect</i> <i>Depth</i> <i>Cal</i> <i>Res</i> <i>100 R FS</i> <i>20 R FS</i> <i>20 R</i> <i>20 R</i> <i>20 R</i> <i>20 R</i> <i>20 R</i> <i>20 R</i> </p>

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-44CR2

INTERVAL CORED: 577.0' to 589.9'

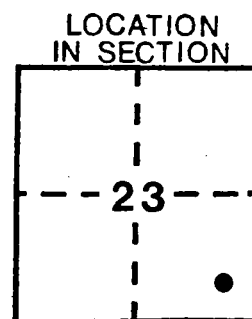
LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
577.0-577.2	claystone; dark brown to black, sandy, abundant carb debris, trace slickensides		
577.2-580.7	claystone; medium to dark gray, sandy, moderate carb debris, thin sandstone laminations		
580.7-589.2	coal; dark brown to black, blocky, solid, pronounced face cleat, slightly wet, few visible impurities, angular top contact, trace plant-fill pyrite near base, slightly boney basal 0.5'		
Laramie-Fox Hills Aquifer			
589.2-589.3	sandstone; medium gray, medium green, calcareous, well cemented		
589.3-589.9	sandstone; medium to dark brown, slightly argillaceous, abundant carb debris, rather soft		

COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ °x1° QUADRANGLE

Hole No.: CGS-45C
 Date Logged: 1/18/83
 Drilled Depth: 540'
 Logged Depth: 535'
 Drilling Medium: air/mud
 Fluid Level: 0
 Cored: X Yes No

Section: 23 SESE
 Township: 7S
 Range: 60W
 Elevation(Ft): 5705
 County: Elbert
 State: Colorado

USGS Topographic
 Quadrangle: Cattle Gulch 7.5'



Geophysical Logs:

Gamma (G): T.C. 10	Scale 80 cps/in	Logging Speed	20 fpm
Density (Den): T.C. 1	Scale 400 cps/in	Logging Speed	20 fpm
Caliper (C):	Scale 20 in/in	Logging Speed	20 fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed	20 fpm

Remarks: Cored 484' to 499.1'

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
Quaternary				
0-5	sand; light brown, fine grained, dry			
5-10	sand; light to medium brown, medium to coarse grained, dry			
10-47	sand; medium orangish brown, medium to coarse grained, with some gravel near base			
Cretaceous				
Arapahoe Formation				
47-70	interbedded sandstone and gravel; veri-colored, up to 1 cm plus			
70-73	claystone; medium to dark brown, sandy			
73-88	sandstone; medium to dark brown, very argillaceous			
88-90	claystone; as above			
90-96	sandstone; medium to dark gray, very shaly			
96-131	sandstone; medium gray, medium grained, very friable			
131-137	claystone; as above			
137-167	sandstone; as above			



Hole No. CGS-45C - Continued

Laramie Formation	
167-290	claystone; medium gray with some green and brown, very silty, sandy in places, with underbeds of light gray, fine grained sandstone
290-309	sandstone; medium gray, fine to medium grained, argillaceous
309-318	claystone; medium gray, silty and sandy, very soft and sticky
318-334	sandstone; medium gray, fine to medium grained, fines upward (more argillaceous at top)
334-422	claystone; medium gray with some green and brown, very silty, sandy in places with interbeds of light gray, fine grained sandstone
422-450	sandstone; as above
450-456	claystone; medium to dark gray, silty, carbonaceous
456-458	coal
458-484	claystone; as above cored 484' to 499.1' see core descriptions
499.1-500	claystone
500-504	coal
Laramie-Fox Hills Aquifer	
504-540	sandstone; light gray, fine grained

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-45C

INTERVAL CORED: 484' to 499.1'

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
484-486.6 lost		
486.6-486.7 claystone; medium gray to green, slightly sandy		
486.7-487.6 coal; black, very broken, as below, except very bony top 0.4'		
487.6-492.1 coal; black, very broken-several places, approx. 0.05' from 489.5' to 492.1' (mostly solid), medium bright to dull, vertical cleat, mostly dull, abundant fusain		
492.1-497.0 coal; as above, several broken places		
497.0-497.1 claystone; very dark brown, carbonaceous, rather soft, fissile		
497.1-497.5 claystone; dark brown to medium-dark gray, soft, fissile, carbonaceous at top, lighter color toward base		
497.5-497.8 siltstone; medium gray, rather hard, with fine grained sandstone		
497.8-499.1 lost		

COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}$ ° x 1° QUADRANGLE

Hole No.: CGS-46

Date Logged: 1/14/83

Drilled Depth: 1200'

Logged Depth: 1190'

Drilling Medium: mud

Fluid Level: 17'

Cored: Yes X No

Section: 32 SWNE

Township: 7S

Range: 61W

Elevation(Ft): 5990

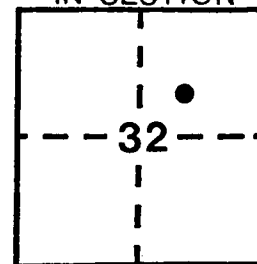
County: Elbert

State: Colorado

USGS Topographic

Quadrangle: Bijou 7.5

LOCATION
IN SECTION



Geophysical Logs:

Gamma (G): T.C. 10

Density (Den): T.C. 1

Caliper (C):

Resistance (Res):

Scale 80 cps/in

Scale 400 cps/in

Scale 20 in/in

Scale 80 ohms/in

Logging Speed

Logging Speed

Logging Speed

Logging Speed

20 fpm

20 fpm

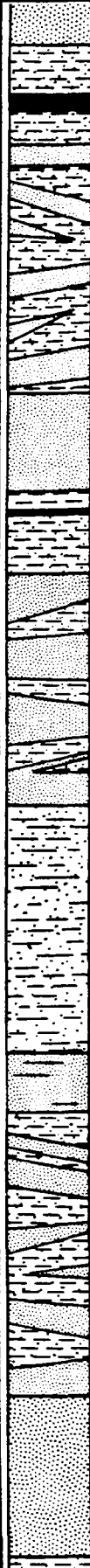
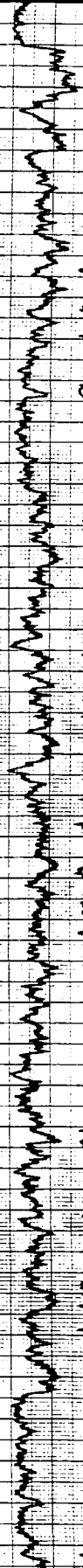
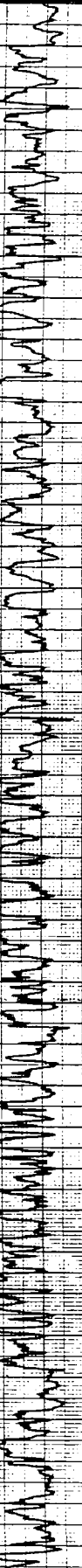
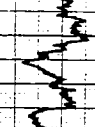
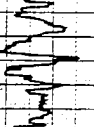
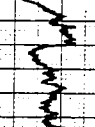
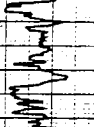
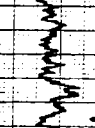
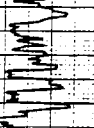
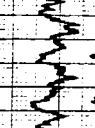

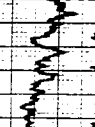
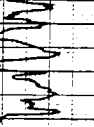
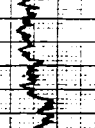
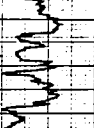
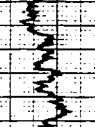
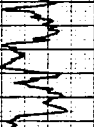
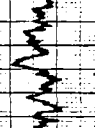

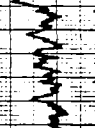

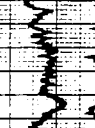

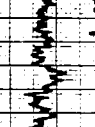

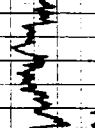

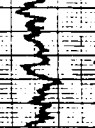

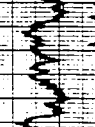

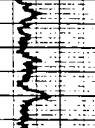
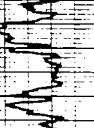
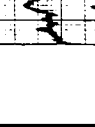
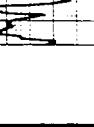
20 fpm

20 fpm

Remarks: Offset to core CGS-46C.

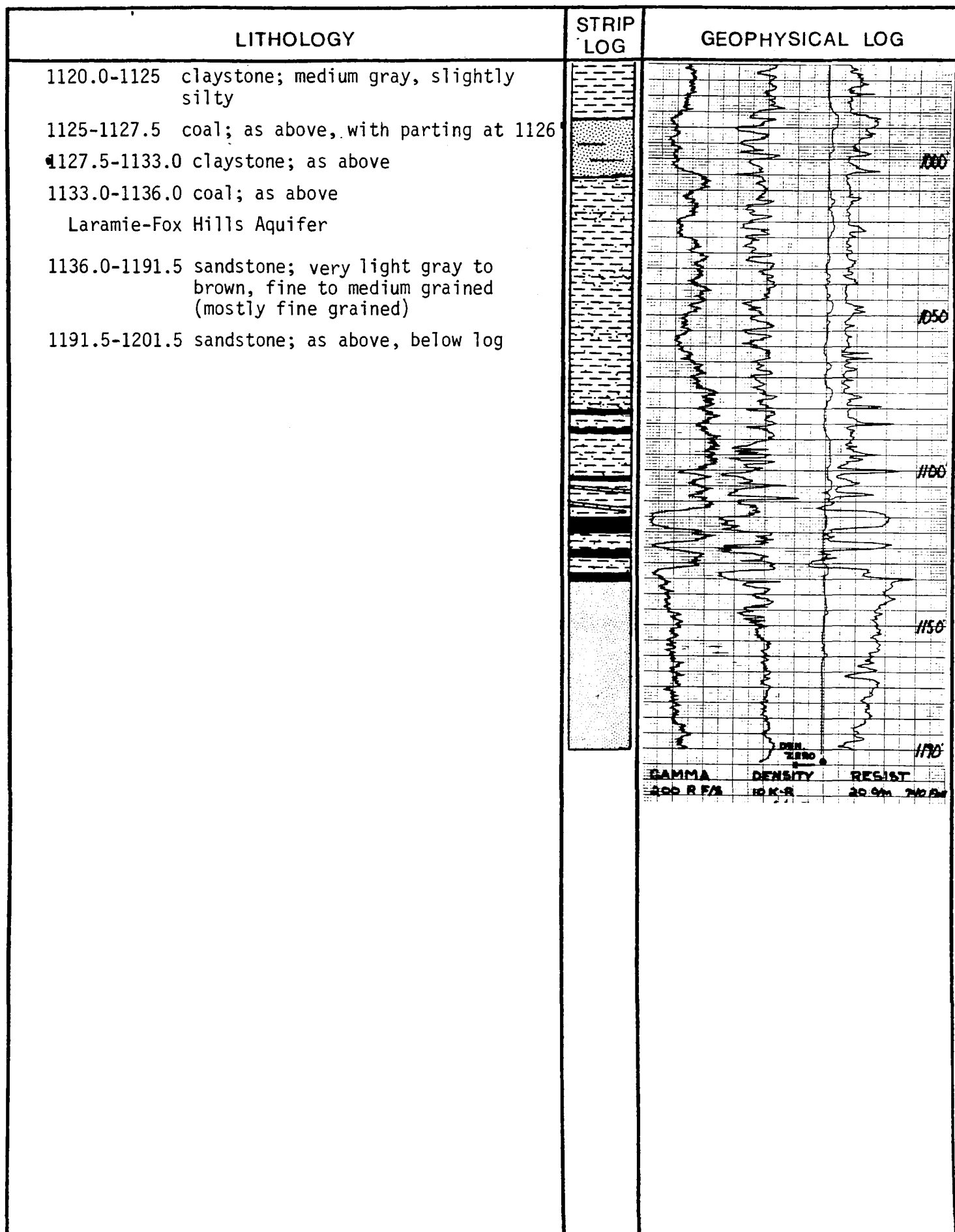
LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
<p>Quaternary (reworked Dawson?)</p> <p>0-14.5 interbedded sand and gravel; medium to medium coarse grained sand, light veri-colored gravel</p> <p>14.5-17.5 as above; trace uranium (from gamma curve)</p> <p>Tertiary-Cretaceous Denver Formation</p> <p>17.5-29.5 claystone; medium to dark brown, sandy</p> <p>29.5-51.5 claystone; medium gray, very silty, trace interbeds of light gray, fine grained sandstone</p> <p>51.5-55.5 sandstone; medium gray, argillaceous, with carb claystone interbeds</p> <p>55.5-57.5 sandstone; medium gray, carbonaceous, rather clean</p> <p>57.5-58.5 lignite</p> <p>58.5-60.5 sandstone; as above</p> <p>60.5-63.5 lignite</p> <p>63.5-67.5 sandstone; light gray, fine to medium grained</p> <p>67.5-99.5 claystone; medium gray to brown, very silty</p> <p>99.5-101 lignite</p>		

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-46 - Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
101-103	claystone; medium brown, silty			
103-104.5	lignite; very dirty			
104.5-105.5	claystone; as above			
105.5-110	lignite; very dirty at base			
110-112.5	claystone; as above			
112.5-114.5	lignite			
114.5-117.5	claystone; as above			
117.5-119.5	sandstone; as above			
119.5-122.5	lignite; parting near center			
122.5-128.5	claystone; light to medium gray and brown, silty			
128.5-151.5	sandstone; light gray, medium grained, fairly clean			
151.5-190.5	claystone; medium gray (slightly greenish in places), sandy, sandstone interbeds (especially 164.5-167.5')			
190.5-192.5	lignite			
192.5-197.5	claystone; as above			
197.5-222.5	sandstone; light gray, medium grained, slightly argillaceous			
222.5-234.5	claystone; medium to dark gray, silty			
234.5-238.5	lignite; very dirty, with interbeds of carbonaceous claystone			
238.5-246.5	claystone; medium gray, silty			
246.5-251.5	sandstone; light gray, fine grained, slightly shaly			
251.5-305.5	interbedded sandstone and claystone; as above, more sandstone toward base, claystone-soft and sticky to rather hard			
305.5-328.5	sandstone; light gray, fine to medium grained, rather clean			
328.5-333.5	claystone; medium to dark brown, rather hard			
333.5-334.5	lignite; very dirty			
334.5-348.5	claystone; medium gray, silty			
348.5-404.5	interbedded sandstone and claystone; sandstone-light gray, fine to medium grained, argillaceous, claystone-medium gray to green, silty to very silty, with thin lignite interbeds			
404.5-464.5	claystone; medium gray, very silty, soft, very sticky			

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-46 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
464.5-478.5 sandstone; light gray, rather argillaceous, hard in places		
478.5-546.5 interbedded claystone and sandstone; claystone-as above, with some very hard zones, possible sandstone 488' to 497' (poor resistivity curve approximately 480' to 540')		
Cretaceous Arapahoe Formation		
546.5-584.5 sandstone; light gray, medium grained		
584.5-674.5 claystone; medium gray, sandy and silty, with trace thin sandstone interbeds		
674.5-685.5 sandstone; as above		
685.5-810.5 interbedded sandstone and claystone; as above, mostly sandy claystone		
810.5-814.5 sandstone; as above		
814.5-833.5 claystone; medium gray, sandy, fines upward		
833.5-860.5 sandstone; light gray, fine to medium grained, rather clean		
Laramie Formation		
860.5-921.5 claystone; medium gray, slightly silty, very little or no sand		
921.5-944.5 sandstone; light gray, medium grained, argillaceous		
944.5-987.5 claystone; medium gray, with trace thin, white, fine grained sandstone interbeds		
987.5-1005.5 sandstone; as above, light gray, medium grained, argillaceous		
1005.5-1080.5 claystone; medium gray, slightly silty, with sandy zones		
1080.5-1081.5 coal; rather dirty, possibly thinner		
1081.5-1086 claystone; as above		
1086-1087 coal; as above		
1087-1101.5 claystone; as above		
1101.5-1103 coal; rather clean		
1103-1114.5 claystone; as above, with 2 thin interbeds of hard sandstone (dense)		
1114.5-1120.0 coal; black, rather hard		



COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}^{\circ} \times 1^{\circ}$ QUADRANGLE

Hole No.: CGS-46C

Date Logged: 1/15/83

Drilled Depth: 140'

Logged Depth: 139'

Drilling Medium: air

Fluid Level: 3'

Cored: X Yes No

Geophysical Logs:

Gamma (G): T.C. 10

Density (Den): T.C. 1

Caliper (C):

Resistance (Res):

Section: 32 SWNE

Township: 7S

Range: 61W

Elevation(Ft): 5990

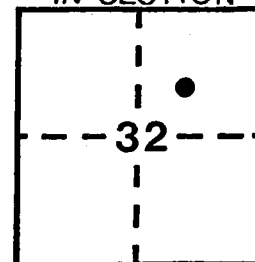
County: Elbert

State: Colorado

USGS Topographic

Quadrangle: Bijou 7.5'

LOCATION
IN SECTION



Scale 80 cps/in	Logging Speed	20 fpm
Scale 400 cps/in	Logging Speed	20 fpm
Scale 20 in/in	Logging Speed	20 fpm
Scale 20 ohms/in	Logging Speed	20 fpm

Remarks: Location approximately 5' west of CGS-46. Cored 51' to 68.7',
99' to 113'

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
Quaternary			
0-18	interbedded sand and gravel; medium to coarse grained brown sand and light veri-colored gravel		
Tertiary-Cretaceous			
Denver Formation			
18-51	claystone; medium brown to gray, silty and sandy cored 51' to 68.7' see core descriptions		
68.7-69.5	sandstone; light gray, medium grained, very friable, slightly wet		
69.5-99	claystone; medium gray to brown, very silty cored 99' to 113' see core descriptions		
113-114	claystone; medium brown, silty		
114-116	lignite		
116-118	claystone; as above		
118-120	sandstone; light gray, fine to medium grained		
120-123	lignite; parting near center		
123-129	claystone; light to medium gray and brown, silty		

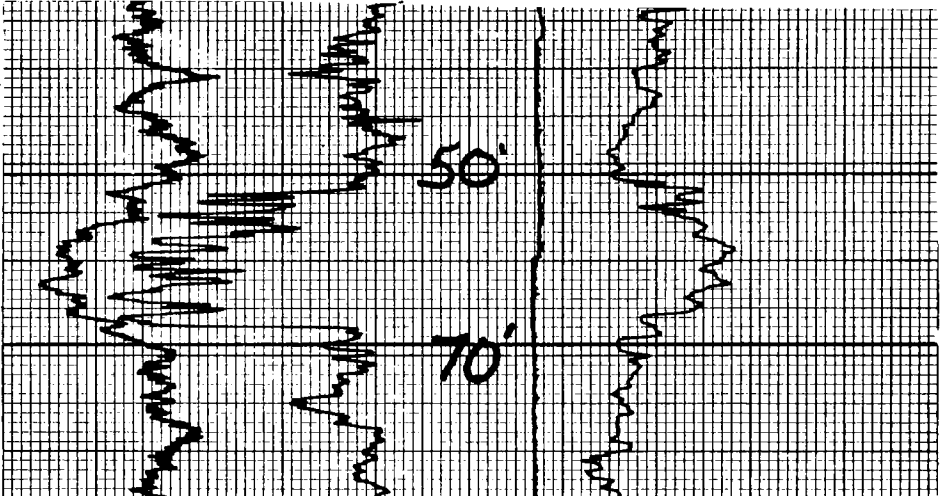
COLORADO GEOLOGICAL SURVEY
Hole No. CGS-46C - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
129-135 sandstone; light gray, medium grained, fairly clean		
135-140 sandstone; as above, below log.		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-46C

INTERVAL CORED: 51' to 68.7'

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
51-52.4 claystone; medium gray, slightly sandy, mostly solid, one slickenside, darker toward base		
52.4-52.65 lignite; black, broken, wet		
52.65-52.85 claystone; as above, slightly carbonaceous and dark gray toward base		
52.85-53.35 lignite; as above, moderate tonstein inclusions		
53.35-54.40 tonstein; lignite interbed near base		
54.40-54.85 lignite; dark brown to black, easily broken, wet		
54.85-55.15 claystone; medium brown, soft, carbonaceous, abundant small slickensides		
55.15-55.45 lignite; dark brown, dirty		
55.45-56.10 tonstein; with abundant carb laminations		
56.10-56.20 lignite; black, solid		
56.20-56.55 claystone; dark brown, carbonaceous, abundant tonstein		
56.55-57.35 lignite; black, solid, with moderate tonstein inclusions		
57.35-57.50 lignite; dark brown, rather soft, abundant tonstein		
57.50-58.10 tonstein; abundant carb debris		
58.10-60.3 lignite; black, slightly broken, vertical cleat, intervals of abundant disseminated pyrite, moderate tonstein, 0.05' tonstein laminations at 58.9' and 59.7'		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-46C

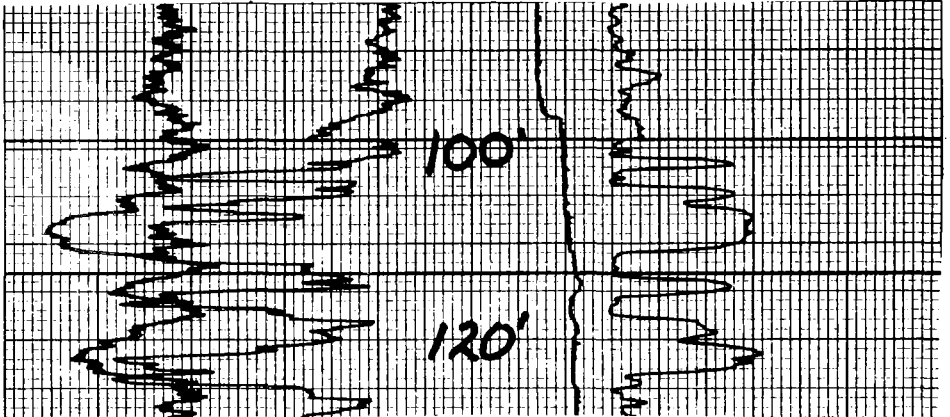

INTERVAL CORED: 51' to 68.7' - continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
60.3-60.5 lost (lignite)		
60.5-61.2 lignite; brown to black, solid, trace tonstein		
61.2-61.3 tonstein; very soft		
61.3-61.8 interbedded lignite and tonstein laminations; as above		
61.8-64.0 lignite; black, rather broken, trace tonstein laminations, large slickenside, trace fusain, rather dirty at top, vertical cleat at base		
64.0-64.15 tonstein; abundant carb debris		
64.15-64.40 lignite; black, solid, rather hard		
64.40-64.75 interbedded tonstein and lignite; mostly tonstein, thickly laminated		
64.75-66.30 lignite; black, rather broken, trace tonstein laminations, trace fusain, rather dirty at top, vertical cleat at base		
66.30-66.45 claystone; dark brown, carbonaceous, rather soft		
66.45-68.7 sandstone; light gray, medium grained, very friable, slightly wet		

COLORADO GEOLOGICAL SURVEY
CORE DESCRIPTION

HOLE NO.: CGS-46C

INTERVAL CORED: 99' to 113'

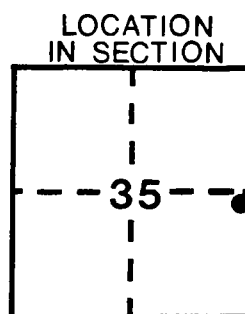
LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
99-101.25 claystone; medium gray, sandy, fine grained sideritic sandstone		
101.25-101.4 lignite; black, solid, rather hard, conchoidal fracture		
101.4-102.0 claystone; medium to dark (brownish) gray, slightly carbonaceous, trace slickensides		
102.0-102.4 lignite; dark brown, solid, very shaly, abundant tonstein laminations		
102.4-103.1 lignite; black, very broken, wet, trace tonstein, conchoidal fracture, vertical cleat		
103.1-104.7 claystone; medium gray, trace carb debris, thin coal laminations, slickensides near base		
104.7-105.25 claystone; dark brown, carbonaceous, trace tonstein inclusions, gradational at base into coal		
105.25-106.40 lignite; dark brown to black, medium solid to broken, abundant disseminated tonstein		
106.4-107.3 tonstein		
107.3-109 lignite; dark brown to black, dirty at top, disseminated tonstein top 0.5', conchoidal fracture, rather broken		
109-111.9 lignite; as above, mostly tonstein in bands, very broken in places, vertical cleat		
111.9-113.0 lost core (possible siltstone below coal)		

COLORADO GEOLOGICAL SURVEY
DRILL HOLE LOG, CASTLE ROCK $\frac{1}{2}^{\circ} \times 1^{\circ}$ QUADRANGLE

Hole No.: CGS-47
 Date Logged: 1/23/83
 Drilled Depth: 904'
 Logged Depth: 892'
 Drilling Medium: mud
 Fluid Level: 14'
 Cored: Yes XNo

Section: 35 NESE
 Township: 10S
 Range: 61W
 Elevation(Ft): 6185
 County: Elbert
 State: CO

USGS Topographic
 Quadrangle: Ramah North 7.5'



Geophysical Logs:

Gamma (G): T.C. 10	Scale 80 cps/in	Logging Speed	20	fpm
Density (Den): T.C. 1	Scale 800 cps/in	Logging Speed	20	fpm
Caliper (C):	Scale 20 in/in	Logging Speed	20	fpm
Resistance (Res):	Scale 80 ohms/in	Logging Speed	20	fpm

Remarks: Poor resistance curve 414' to 740'

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
Tertiary-Cretaceous Denver Formation				
0-34.5	clay; medium gray to brownish orange, very sandy, oxidized, with some medium grained sand			
34.5-41	lignite; dark brown to black, very dirty top half, parting in center			
41-52	clay; medium gray, slightly silty			
52-58	interbedded lignite and clay, clay-as above, mostly lignite			
58-60	lignite			
60-78	claystone; medium gray, slightly silty, sandy			
78-88	sandstone; light gray, fine grained, possible thin lignite at base			
88-90	claystone; as above			
90-91.5	lignite			
91.5-103.0	claystone; medium gray, sandy			
103-125	sandstone; light gray, fine to medium grained, with interbeds of claystone - as above			
125-140	claystone; green to gray, very silty and sandy			

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-47 - Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
140-151	interbedded claystone and sandstone; sandstone-light gray, fine grained, claystone-medium gray, very silty and sandy			
151-196	claystone; medium gray, silty and sandy, thin sandstone interbeds (as above), some carbonaceous claystone			
196-207	sandstone; white, fine grained, fines upward			
207-236	claystone; medium gray, silty, very sandy			
236-251	interbedded claystone and sandstone; both-as above			
251-260	claystone; medium to dark gray, very silty, sandy			
260-285	claystone; light gray to green, very silty and sandy, thin interbeds of sandstone-as above			
Cretaceous Arapahoe Formation				
285-310	sandstone; medium gray, medium grained			
310-323	claystone; medium green to gray, very silty and sandy			
323-362	sandstone; light gray, medium grained			
362-374	claystone; as above			
374-378	sandstone; as above, very argillaceous			
378-404	interbedded claystone and sandstone; claystone-medium gray, very sandy, sandstone-medium gray to green, medium grained			
404-437	sandstone; medium gray to green, medium-grained Note: very poor resistivity curve 414-740 (shorting out)			
437-451	claystone; medium gray, very silty, sandy			
451-501	interbedded claystone and sandstone; sandstone-green, medium to fine grained, claystone-medium gray to brown, very silty and sandy			
501-522	sandstone; light to medium gray to green, medium grained, very argillaceous			
Laramie Formation				
522-544	claystone; medium gray to green, very silty, with thin interbeds of sandstone-as above			
544-567	claystone; medium gray to greenish, silty, interbedded soft, sticky claystone			

COLORADO GEOLOGICAL SURVEY
Hole No. CGS-47 - Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
567-579	sandstone; light gray, fine grained			
579-601	claystone; as above			
601-618	sandstone; as above, rather argillaceous			
618-732	interbedded claystone and sandstone; mostly claystone, claystone-medium gray to brown, carbonaceous at base, mostly soft, very silty, sandstone-as above, rather hard			
732-753	sandstone; white, fine grained, rather hard			
753-801.5	claystone; medium gray, slightly silty, mostly rather hard			
801.5-804	claystone; medium to dark gray, carbonaceous			
804-806	coal; rather hard, clean			
806-807.6	claystone; as above			
807.6-809.0	coal; as above			
809.0-809.7	pyrite (very dense)			
809.7-811.1	coal; very shaly or possibly pyritic (high density)			
Laramie-Fox Hills Aquifer				
811.1-892	sandstone; light gray, fine to medium grained, clean			
892-900	sandstone; as above, below log			
			GAMMA 200 F/S	RES. 20K

Table 1

GEOCHEMICAL TESTING

COAL, WATER, AND MATERIALS ANALYSIS

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 03/22/83

USGS Lab No. W219133 State: CO Field ID: CGS40C

Lab No. U11202 *****

AIR DRY LOSS 24.19 RESIDUAL MOISTURE 10.55

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	32.18		
Ash	24.15	35.61	
Volatile Matter	24.33	35.87	55.71
Fixed Carbon	19.34	28.52	44.29
	-----	-----	-----
	100.00	100.00	100.00

ULTIMATE ANALYSIS			
Hydrogen	6.06	3.63	5.64
Carbon	30.62	45.15	70.12
Nitrogen	0.55	0.82	1.27
Sulfur	0.35	0.51	0.75
Oxygen	38.27	14.28	22.18
Ash	24.15	35.61	
	-----	-----	-----
	100.00	100.00	100.00

HEATING VALUE (BTU/LB) 5213 7687 11938

FORMS OF SULFUR			
Sulfate sulfur	0.01	0.02	0.03
Pyritic sulfur	0.05	0.07	0.11
Organic sulfur	0.29	0.42	0.65

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation 2640 F
Softening Temp. 2720 F
Fluid Temp. 2790 F

Forrest E. Walker
Forrest E. Walker
Director of Technical Services

GEOCHEMICAL TESTING**COAL, WATER, AND MATERIALS ANALYSIS**

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 01/07/83

USGS Lab No. D246946 State: -- Field ID: RC80

Lab No. U11106 *****

AIR DRY LOSS 22.52 RESIDUAL MOISTURE 12.09

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	31.89		
Ash	21.26	31.22	
Volatile Matter	24.90	36.56	53.16
Fixed Carbon	21.95	32.22	46.84
	<hr/>	<hr/>	<hr/>
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
ULTIMATE ANALYSIS			
Hydrogen	6.10	3.72	5.41
Carbon	32.91	48.31	70.24
Nitrogen	0.61	0.90	1.31
Sulfur	0.35	0.52	0.76
Oxygen	38.77	15.33	22.26
Ash	21.26	31.22	
	<hr/>	<hr/>	<hr/>
	100.00	100.00	100.00

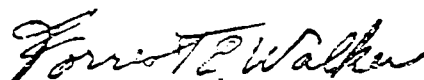
	As-received	Dry	Dry ash-free
HEATING VALUE (BTU/LB)	5566	8171	11880

	As-received	Dry	Dry ash-free
FORMS OF SULFUR			
Sulfate sulfur	0.02	0.03	0.04
Pyritic sulfur	0.02	0.03	0.04
Organic sulfur	0.31	0.46	0.66

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2630 F
Softening Temp.	2750 F
Fluid Temp.	2790 F


Forrest E. Walker
Director of Technical Services

GEOCHEMICAL TESTING**COAL, WATER, AND MATERIALS ANALYSIS**

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 01/07/83

USGS Lab No. D246947 State: -- Field ID: RC80

Lab No. U11107 *****

AIR DRY LOSS 22.41 RESIDUAL MOISTURE 7.66

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	28.35		
Ash	28.43	39.67	
Volatile Matter	24.86	34.70	57.52
Fixed Carbon	18.36	25.63	42.48
	-----	-----	-----
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
ULTIMATE ANALYSIS			
Hydrogen	5.64	3.45	5.72
Carbon	29.84	41.65	69.04
Nitrogen	0.60	0.83	1.38
Sulfur	0.87	1.21	2.01
Oxygen	34.62	13.19	21.85
Ash	28.43	39.67	
	-----	-----	-----
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
HEATING VALUE (BTU/LB)	5068	7074	11726

	As-received	Dry	Dry ash-free
FORMS OF SULFUR			
Sulfate sulfur	0.07	0.09	0.15
Pyritic sulfur	0.30	0.42	0.70
Organic sulfur	0.50	0.70	1.16

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2650 F
Softening Temp.	2780 F
Fluid Temp.	2800+ F

*Forrest E. Walker*Forrest E. Walker
Director of Technical Services

GEOCHEMICAL TESTING**COAL, WATER, AND MATERIALS ANALYSIS**

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 01/07/83

USGS Lab No. D246948 State: -- Field ID: RC80

Lab No. U11108 *****

AIR DRY LOSS 25.64 RESIDUAL MOISTURE 12.07

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	34.61		
Ash	7.32	11.19	
Volatile Matter	27.86	42.61	47.98
Fixed Carbon	30.21	46.20	52.02
	-----	-----	-----
	100.00	100.00	100.00

ULTIMATE ANALYSIS			
Hydrogen	6.77	4.42	4.98
Carbon	42.81	65.47	73.72
Nitrogen	0.92	1.41	1.59
Sulfur	0.35	0.53	0.60
Oxygen	41.83	16.98	19.11
Ash	7.32	11.19	
	-----	-----	-----
	100.00	100.00	100.00

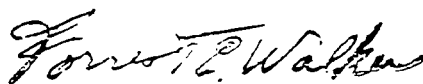
HEATING VALUE (BTU/LB)	7259	11101	12500
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FORMS OF SULFUR			
Sulfate sulfur	0.01	0.01	0.01
Pyritic sulfur	0.02	0.03	0.03
Organic sulfur	0.32	0.49	0.56

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2160 F
Softening Temp.	2350 F
Fluid Temp.	2400 F


Forrest E. Walker
Director of Technical Services

GEOCHEMICAL TESTING**COAL, WATER, AND MATERIALS ANALYSIS**

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 03/22/83

USGS Lab No. W219132 State: CO Field ID: CGS45C

Lab No. U11201 *****

AIR DRY LOSS 28.71 RESIDUAL MOISTURE 7.73

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	34.21		
Ash	11.21	17.05	
Volatile Matter	26.44	40.19	48.45
Fixed Carbon	28.13	42.76	51.55
	-----	-----	-----
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
ULTIMATE ANALYSIS			
Hydrogen	6.60	4.21	5.08
Carbon	39.84	60.57	73.02
Nitrogen	0.82	1.25	1.51
Sulfur	0.29	0.44	0.53
Oxygen	41.24	16.48	19.86
Ash	11.21	17.05	
	-----	-----	-----
	100.00	100.00	100.00

HEATING VALUE (BTU/LB)	6773	10296	12412
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FORMS OF SULFUR			
Sulfate sulfur	0.01	0.01	0.01
Pyritic sulfur	0.02	0.03	0.04
Organic sulfur	0.26	0.40	0.48

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2230 °F
Softening Temp.	2290 °F
Fluid Temp.	2390 °F

*Forrest E. Walker*Forrest E. Walker
Director of Technical Services

GEOCHEMICAL TESTING**COAL, WATER, AND MATERIALS ANALYSIS**

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 03/22/83

USGS Lab No. W219134 State: CO Field ID: CGS46C-1

Lab No. U11203 *****

AIR DRY LOSS 25.88 RESIDUAL MOISTURE 12.87

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	35.44		
Ash	23.21	35.95	
Volatile Matter	24.10	37.33	58.29
Fixed Carbon	17.25	26.72	41.71
	-----	-----	-----
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
ULTIMATE ANALYSIS			
Hydrogen	6.23	3.51	5.48
Carbon	28.67	44.40	69.32
Nitrogen	0.52	0.81	1.26
Sulfur	0.29	0.45	0.70
Oxygen	41.08	14.88	23.24
Ash	23.21	35.95	
	-----	-----	-----
	100.00	100.00	100.00

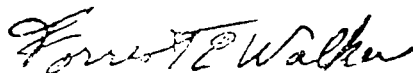
	As-received	Dry	Dry ash-free
HEATING VALUE (BTU/LB)			
	4829	7479	11677

	As-received	Dry	Dry ash-free
FORMS OF SULFUR			
Sulfate sulfur	0.01	0.02	0.03
Pyritic sulfur	0.02	0.03	0.05
Organic sulfur	0.26	0.40	0.62

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2800+ F
Softening Temp.	2800+ F
Fluid Temp.	2800+ F

Forrest E. Walker
Director of Technical Services

GEOCHEMICAL TESTING**COAL, WATER, AND MATERIALS ANALYSIS**

R.D. 2, BOX 124

Somerset, Pennsylvania 15501

Phone: (814) 445-6666 or 443-1671

COAL ANALYSIS REPORT

Client: United States Geological Survey Date of report: 03/22/83

USGS Lab No. W219135 State: CO Field ID: CGS46C-2

Lab No. U11204 *****

AIR DRY LOSS 28.63 RESIDUAL MOISTURE 10.98

	As-received	Dry	Dry ash-free
PROXIMATE ANALYSIS			
Moisture	36.47		
Ash	17.41	27.40	
Volatile Matter	26.95	42.42	58.43
Fixed Carbon	19.17	30.18	41.57
	-----	-----	-----
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
ULTIMATE ANALYSIS			
Hydrogen	6.31	3.51	4.84
Carbon	31.67	49.84	68.65
Nitrogen	0.64	1.01	1.39
Sulfur	0.34	0.53	0.73
Oxygen	43.63	17.71	24.39
Ash	17.41	27.40	
	-----	-----	-----
	100.00	100.00	100.00

	As-received	Dry	Dry ash-free
HEATING VALUE (BTU/LB)	5443	8567	11801

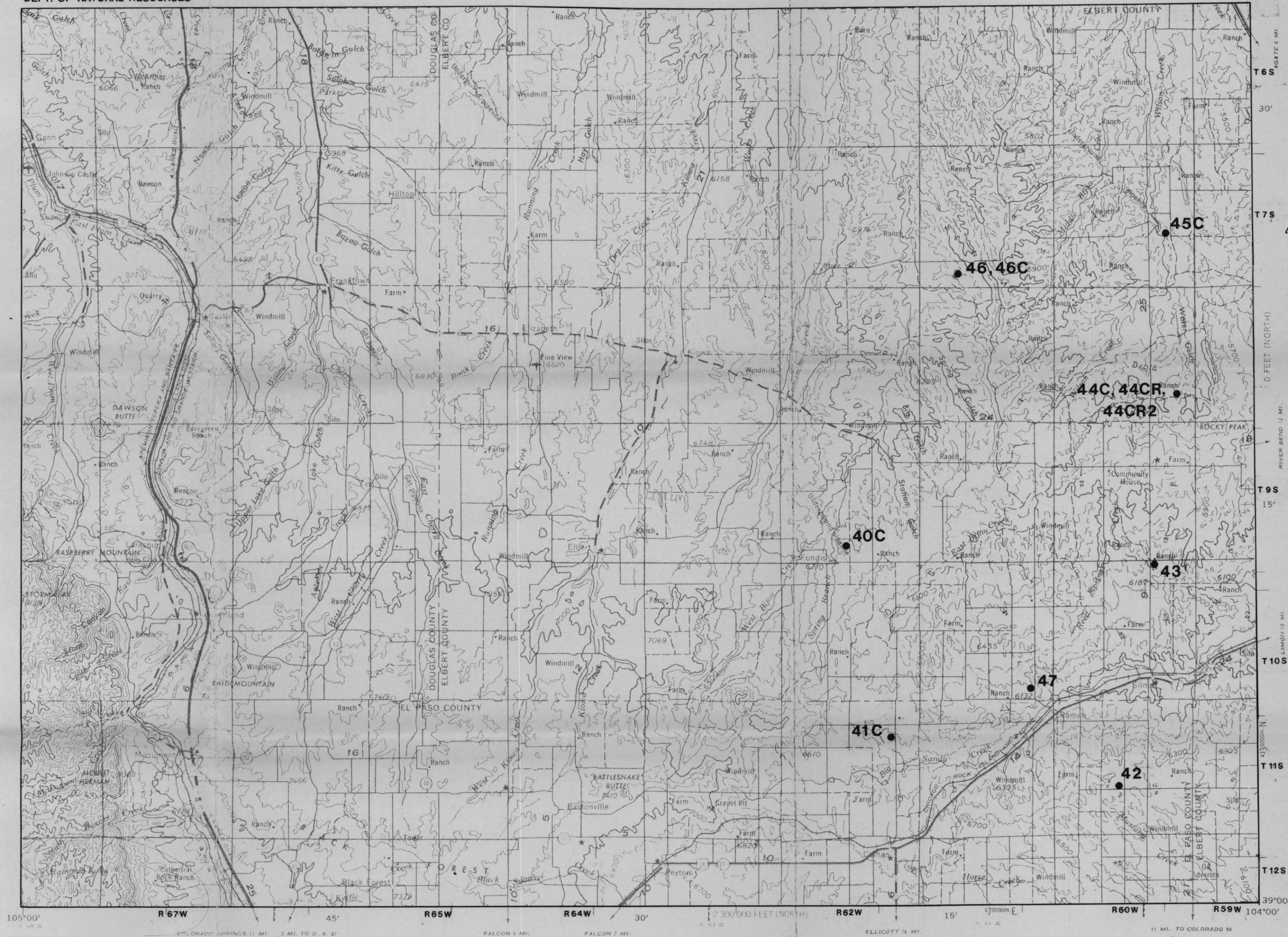
	As-received	Dry	Dry ash-free
FORMS OF SULFUR			
Sulfate sulfur	0.01	0.02	0.03
Pyritic sulfur	0.02	0.03	0.04
Organic sulfur	0.31	0.48	0.66

FREE SWELLING INDEX 0.0

ASH FUSION TEMPERATURES (Reducing Atmosphere)

Initial Deformation	2620 F
Softening Temp.	2670 F
Fluid Temp.	2760 F

*Forrest E. Walker*Forrest E. Walker
Director of Technical Services



SCALE
1:200,000

ALL HOLE NUMBERS
HAVE PREFIX "CGS"

INDEX MAP OF DRILL HOLE LOCATIONS, CASTLE ROCK 1/2° X 1° QUADRANGLE

BY
WYNN EAKINS
SUSAN BALLENSKI