

COLORADO GEOLOGICAL SURVEY

GEOPHYSICAL AND LITHOLOGICAL LOGS
FROM THE 1979 COAL DRILLING AND
CORING PROGRAM, DENVER EAST 1/2° x 1° QUADRANGLE

by

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INTRODUCTION

The Colorado Geological Survey, under United States Geological Survey grant #14-08-0001-G-577, conducted an exploratory coal drilling program in the Denver East 1/2° x 1° Quadrangle. The program was designed to evaluate the coal resources of the quadrangle, especially near the Denver Metropolitan Area. The Colorado Geological Survey awarded the drilling contract to Teton Exploration Drilling Co., Inc., of Casper, Wyoming and the Geophysical logging contract to Frontier Logging Corp. of Broomfield, Colorado.

Drill-site locations were determined after an extensive evaluation of water well logs, oil and gas well logs, and coal and uranium exploration hole logs was completed. The final locations were chosen on access availability and owner approval. The holes were drilled in two different areas; the Antelope Flats - Deer Trail area which contains the Laramie Formation coals and the Watkins - Lowry area which contains the Denver Formation lignites. Holes were drilled on both state and privately owned surface and minerals. Detailed information was needed close to the Denver Urban area. However, as much of this land is under the control of land development companies who were reluctant to give permission to drill on their properties, few holes were drilled in this area.

Twenty holes were drilled and geophysically logged with a coal suite (single-point resistance, focused density, caliper, and natural gamma) logging tool. Hole number CGS-10_c was cored continuously from 15 feet to 511.3 feet, and the remaining holes were drilled by conventional rotary methods. Core samples of the coal were taken in twined holes at CGS-4 and CGS-5. Coal samples taken from CGS-4_c, CGS-5_c and 10_c were sent to the USGS for analysis.

Selected coal samples were desorbed to determine methane content. Preliminary results indicate that the coal taken from holes CGS-4 and 5 contain 4-24 cf of methane/ton of coal while lignite taken from CGS-10_c contains no appreciable methane.

Lithologies were compiled by the author from the core the drill cuttings, and the geophysical logs. Similarity of the rock types permit the omission of full descriptions. Many lithologies have been combined in the descriptions to accomodate the reduced scale of the logs presented in this report.

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

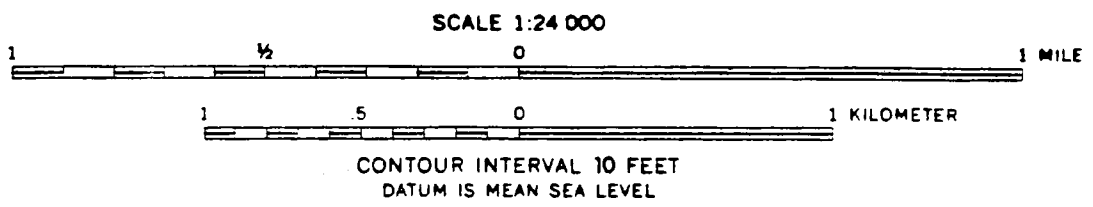
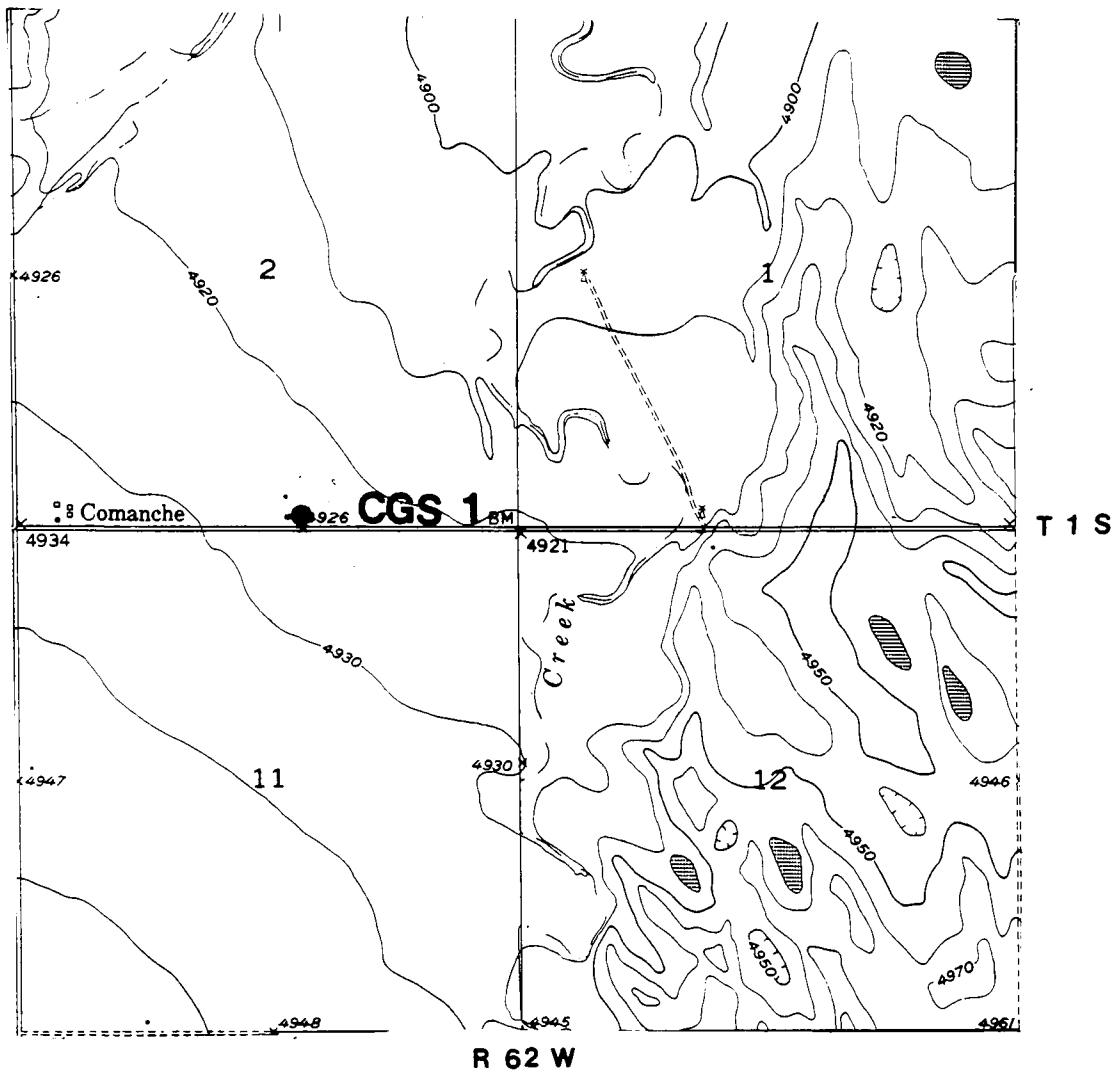


Figure 1.-- Location of drill holes in the Living Springs quadrangle.

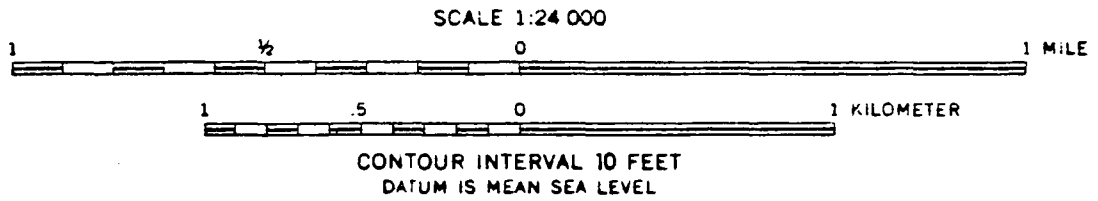
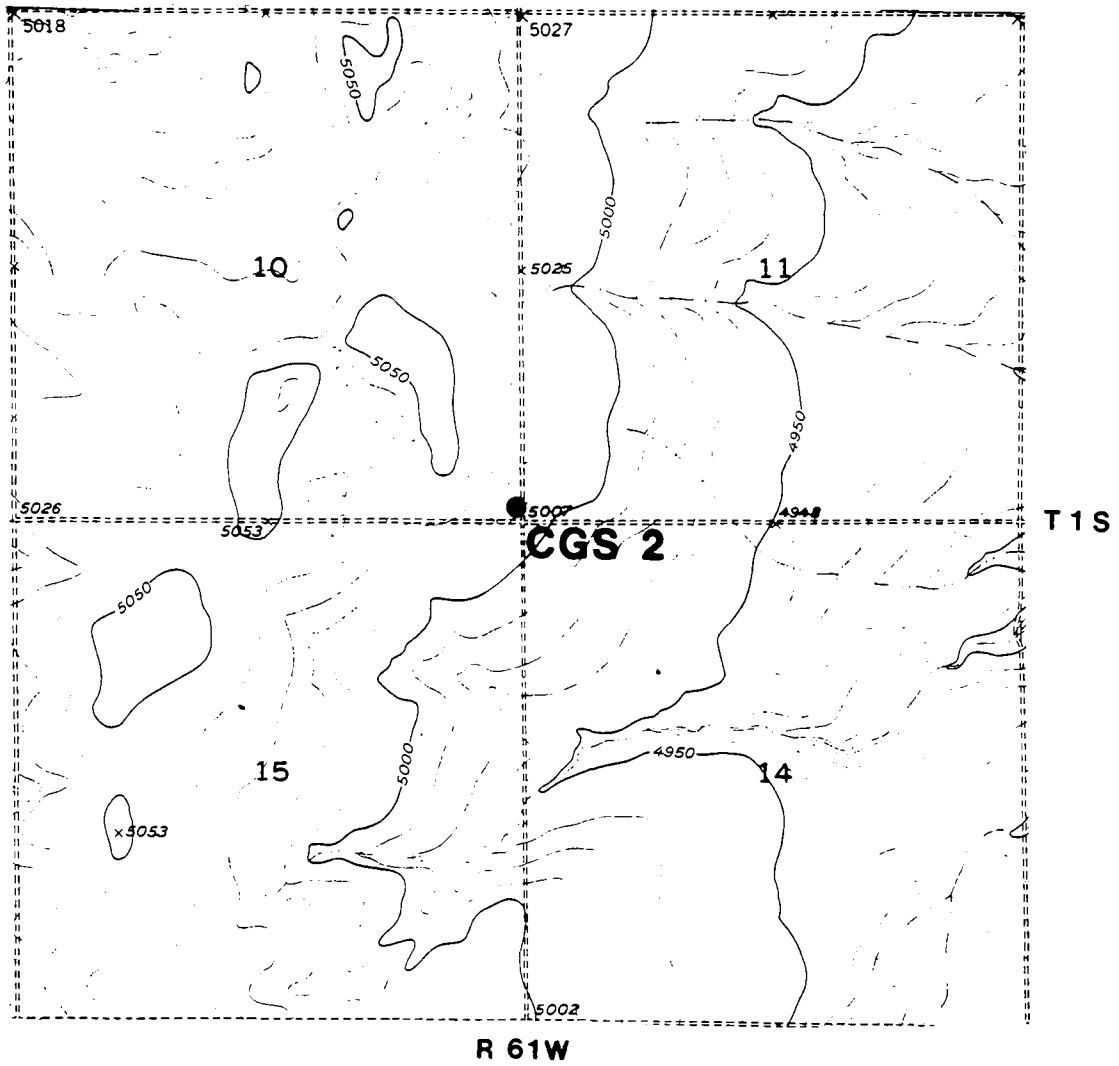


Figure 2.-- Location of drill holes Leader NW quadrangle.

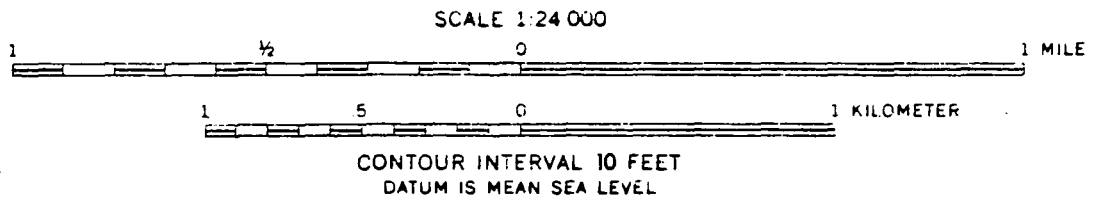
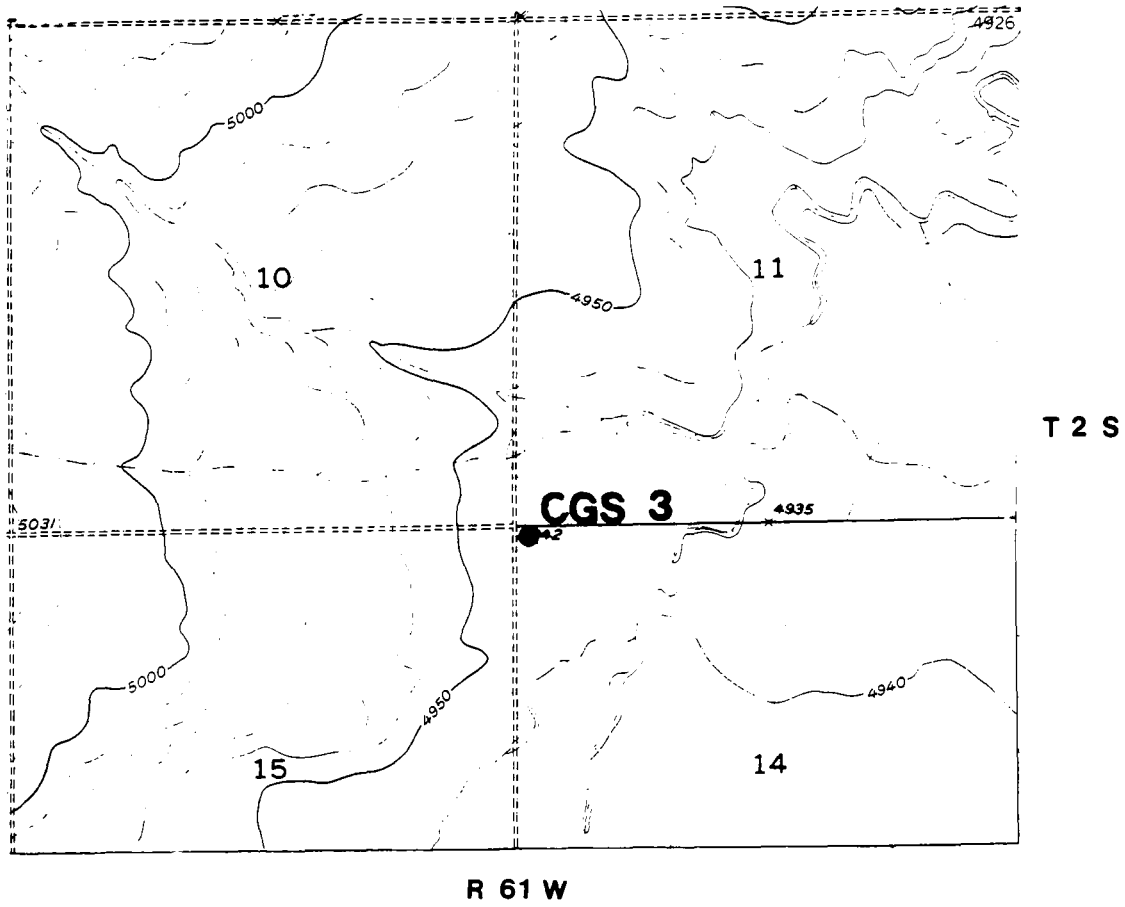


Figure 3.-- Location of drill holes in the Leader NW quadrangle.

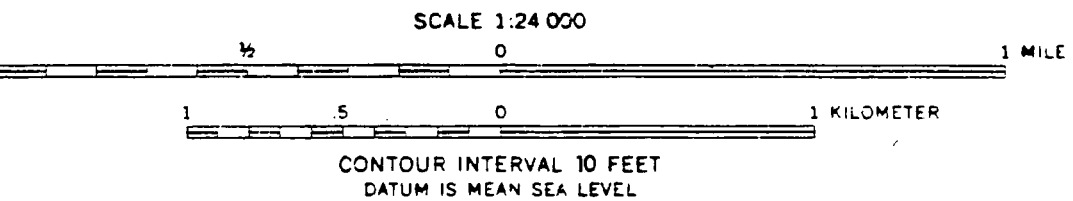
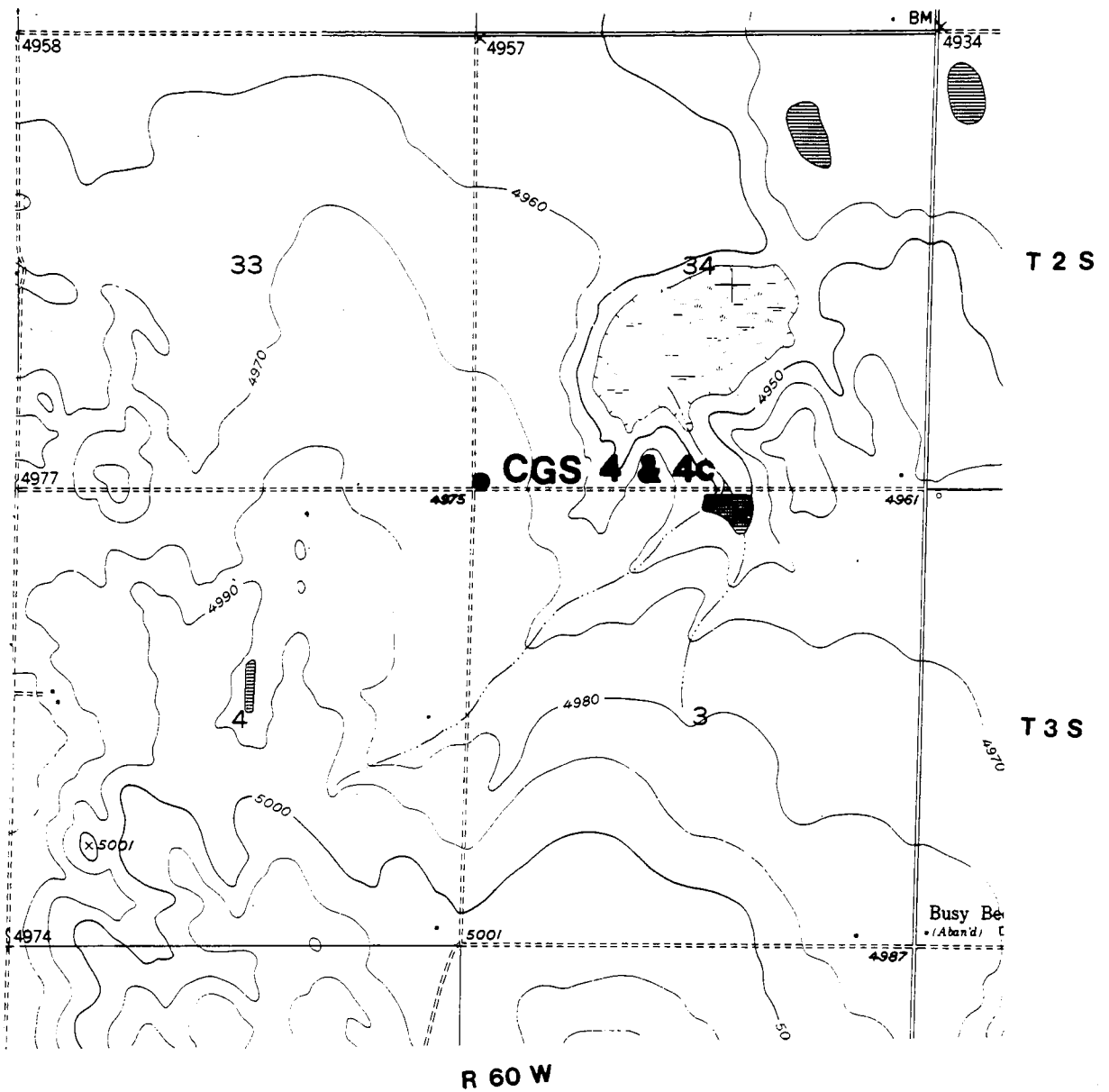


Figure 4.--Location of drill holes in the Leader SE quadrangle.

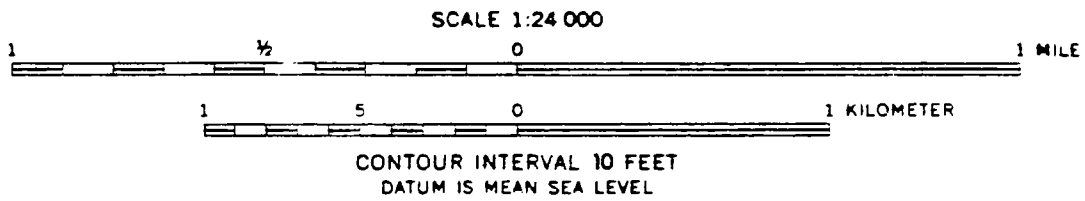
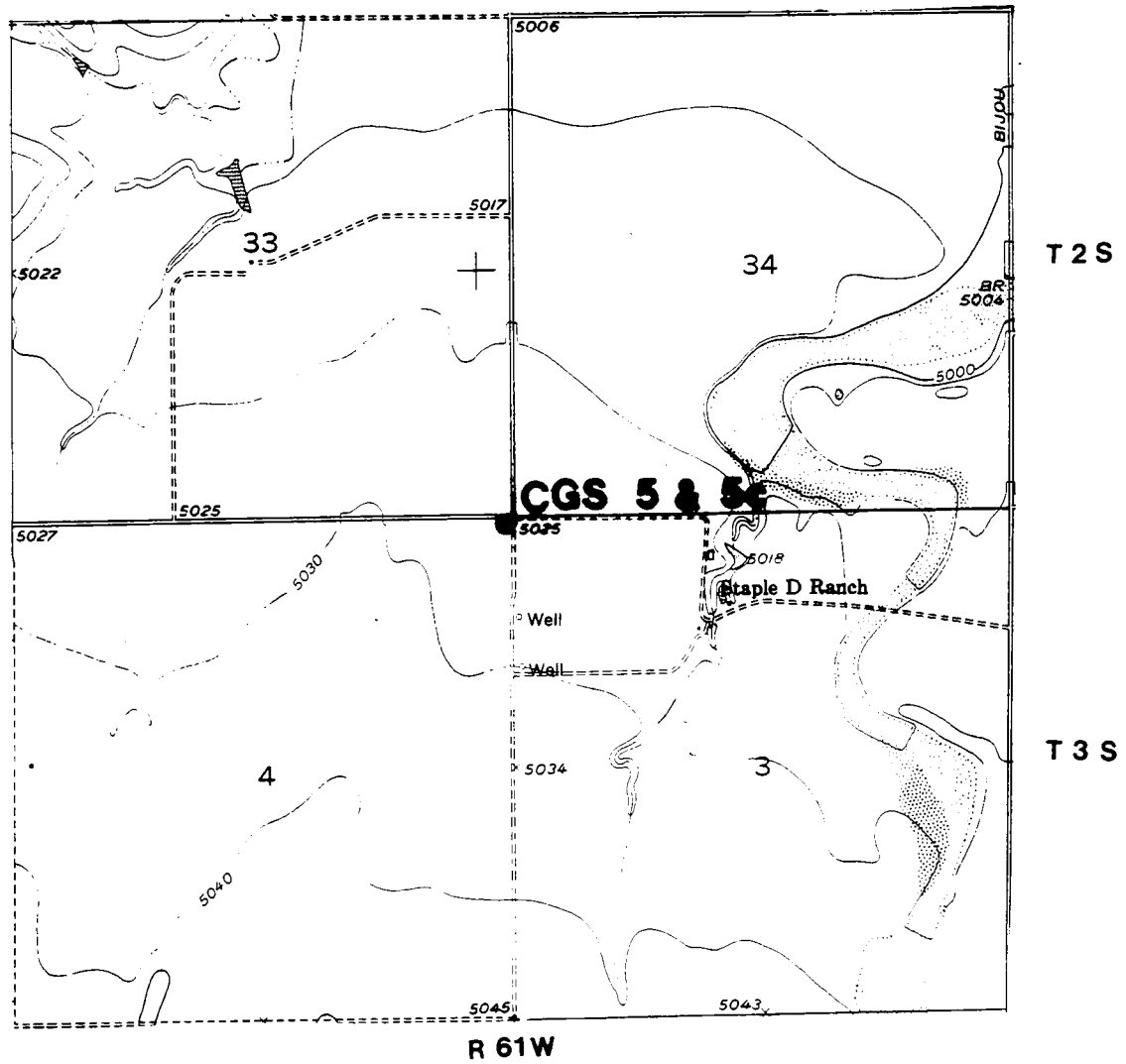


Figure 5.--Location of drill holes in the Leader SW quadrangle.

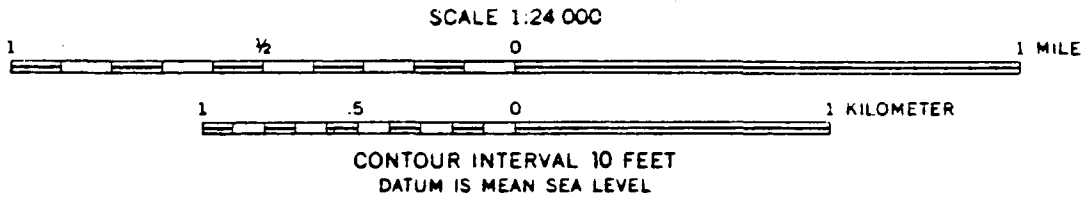
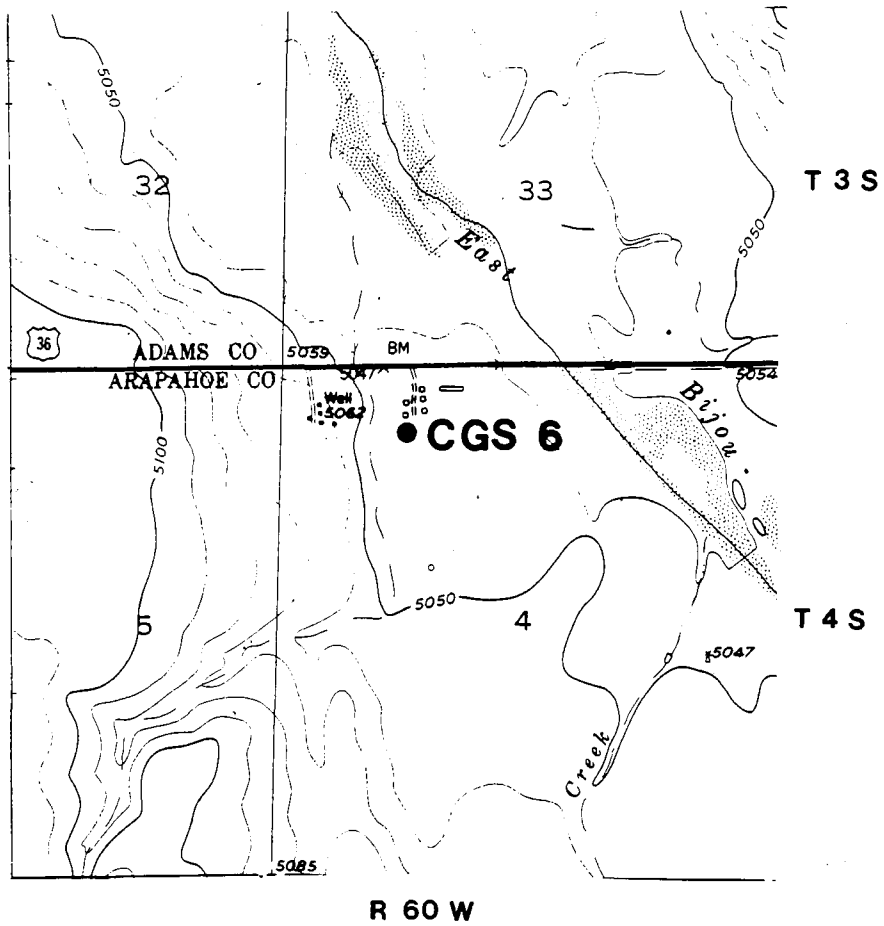


Figure 6.--Location of drill holes in the Peoria quadrangle.

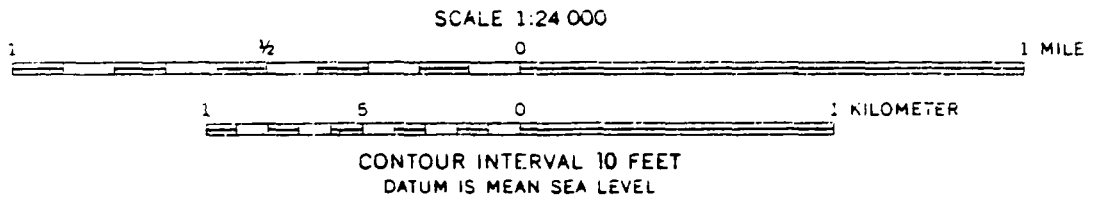
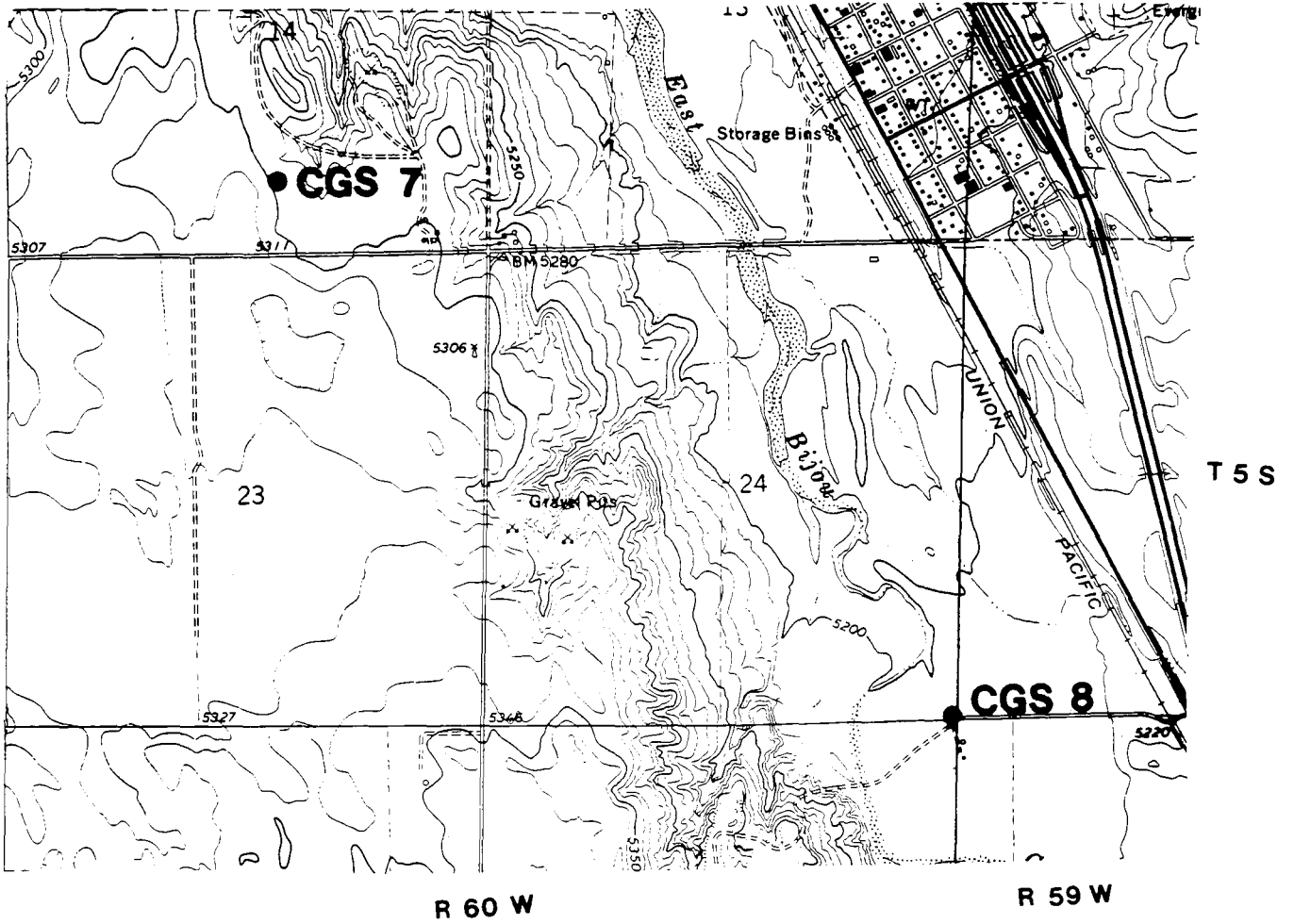


Figure 7.--Locations of drill holes in the Deer Trail quadrangle.

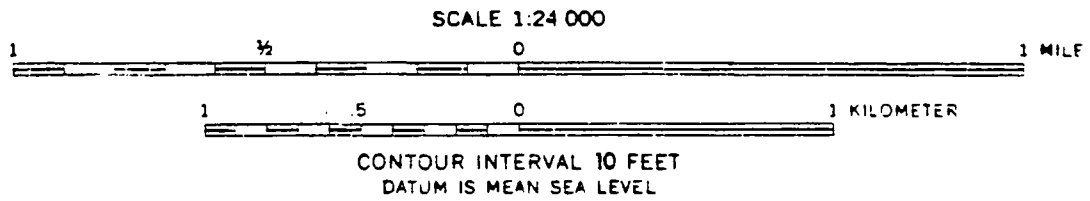
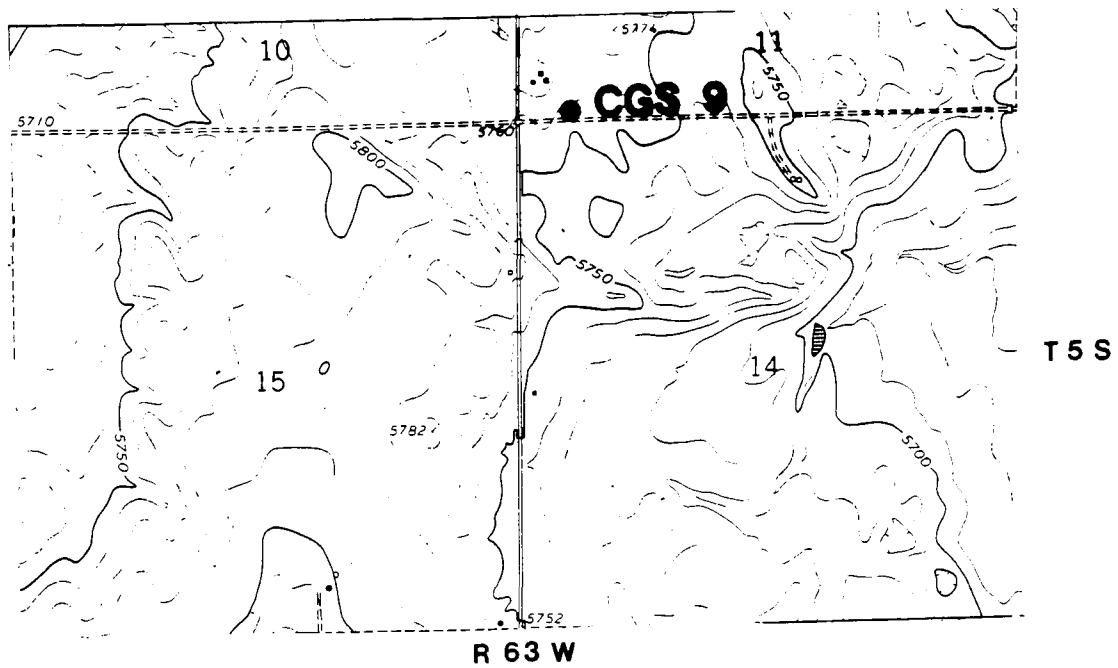


Figure 8.--Location of drill holes in the Strasburg SW quadrangle.

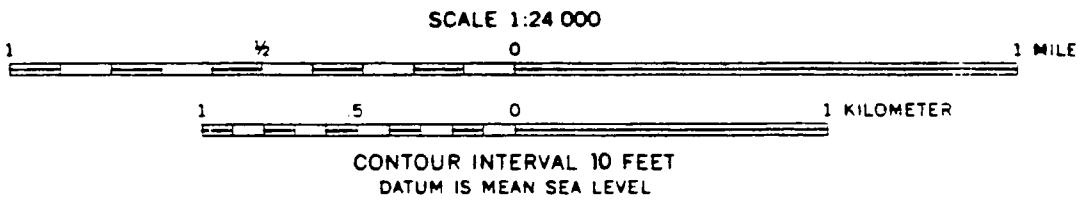
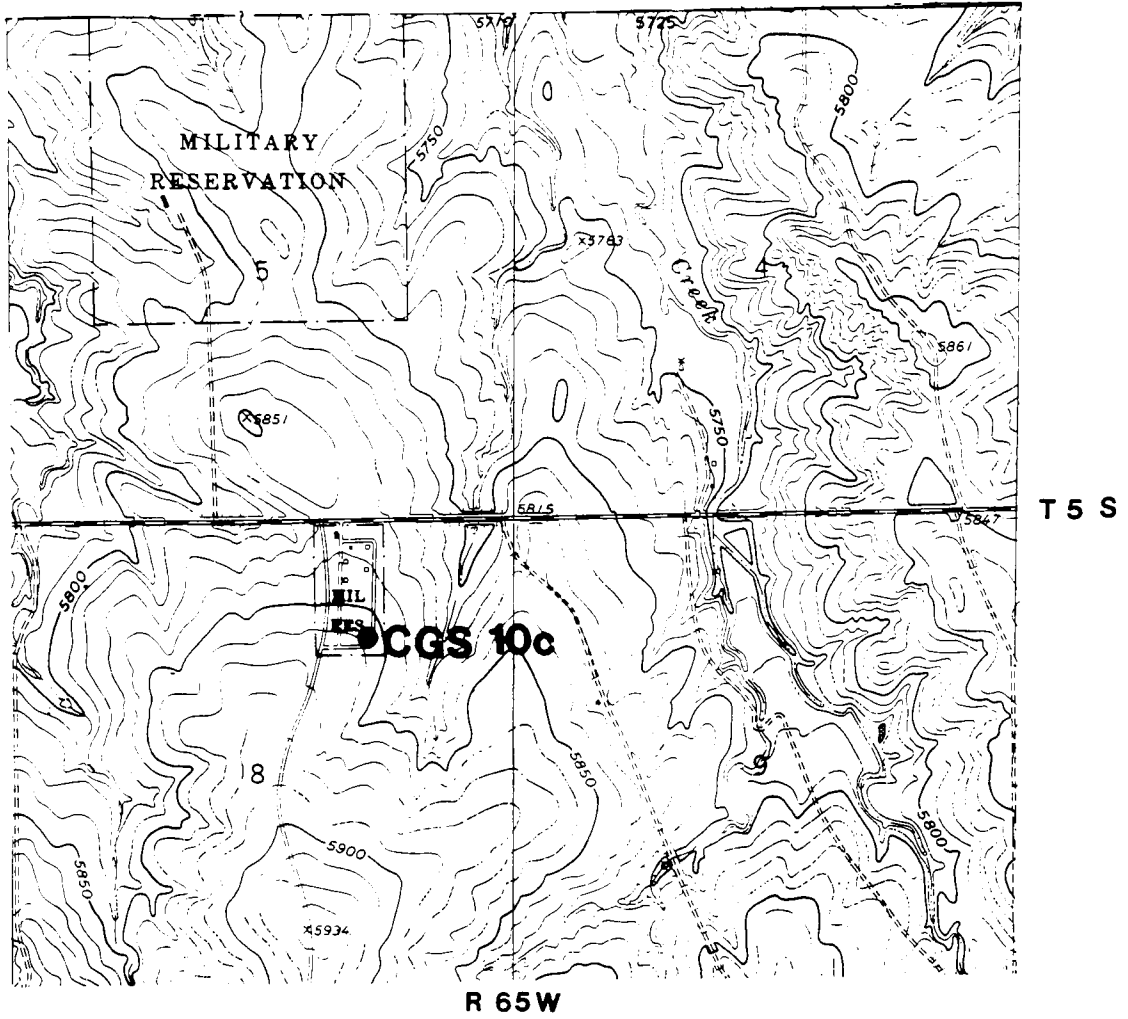


Figure 9.--Location of drill holes in the Coal Creek quadrangle.

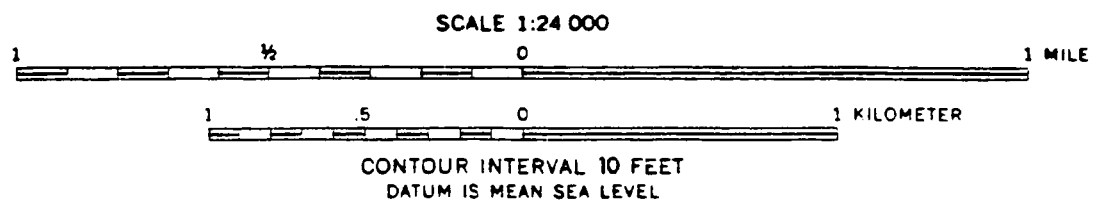
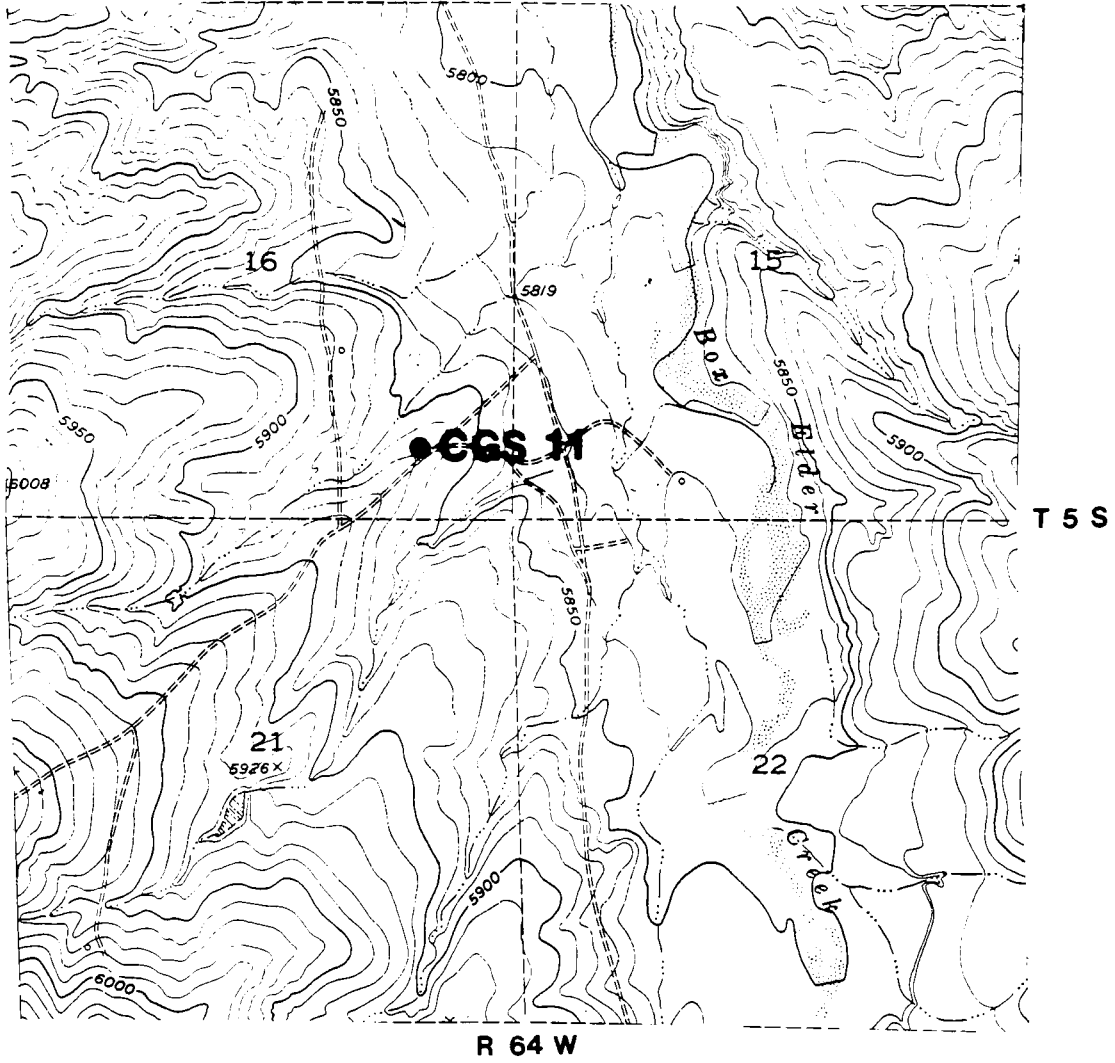


Figure 10.--Location of drill holes in the Watkins SE quadrangle.

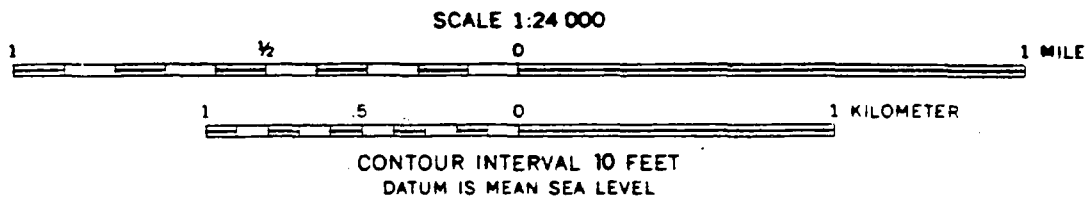
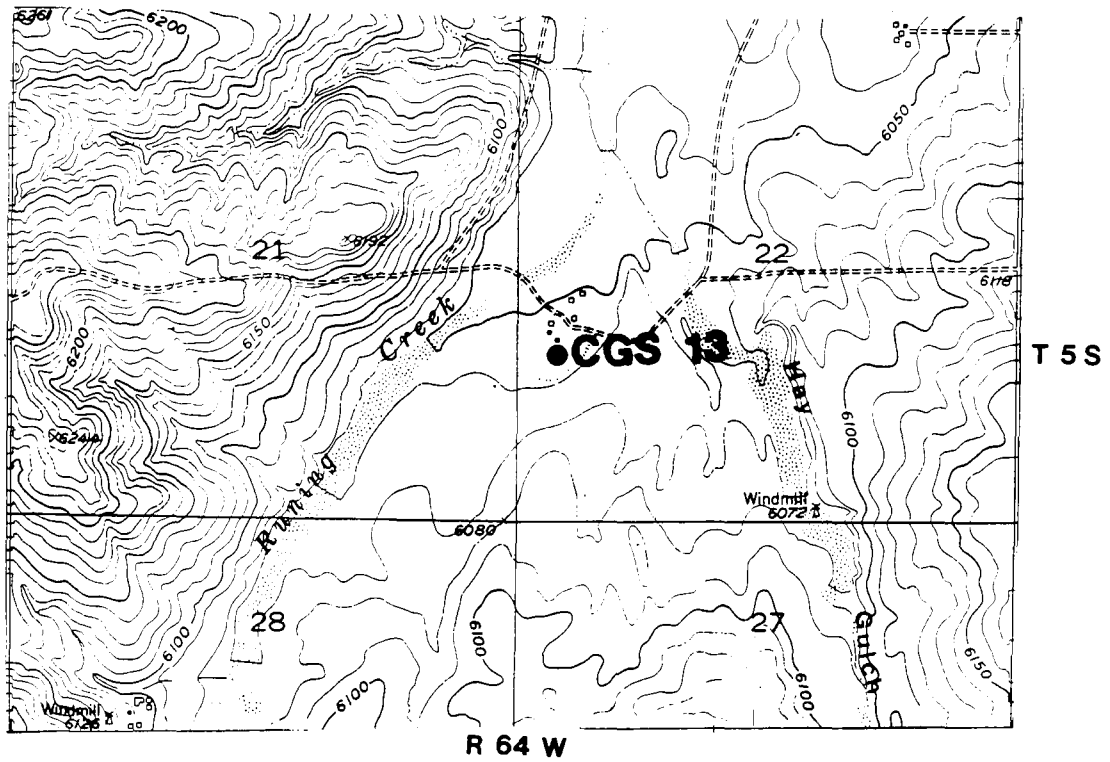


Figure 11.--Location of drill holes in the Watkins SE quadrangle.

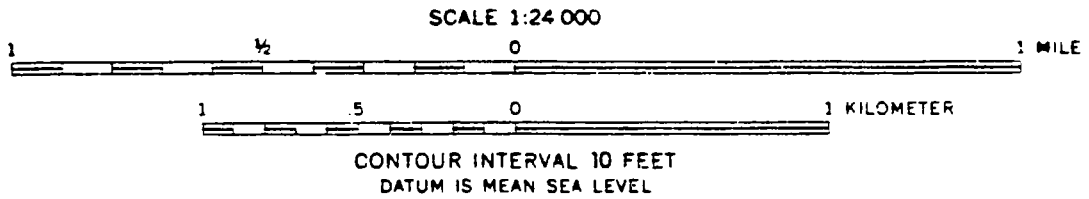
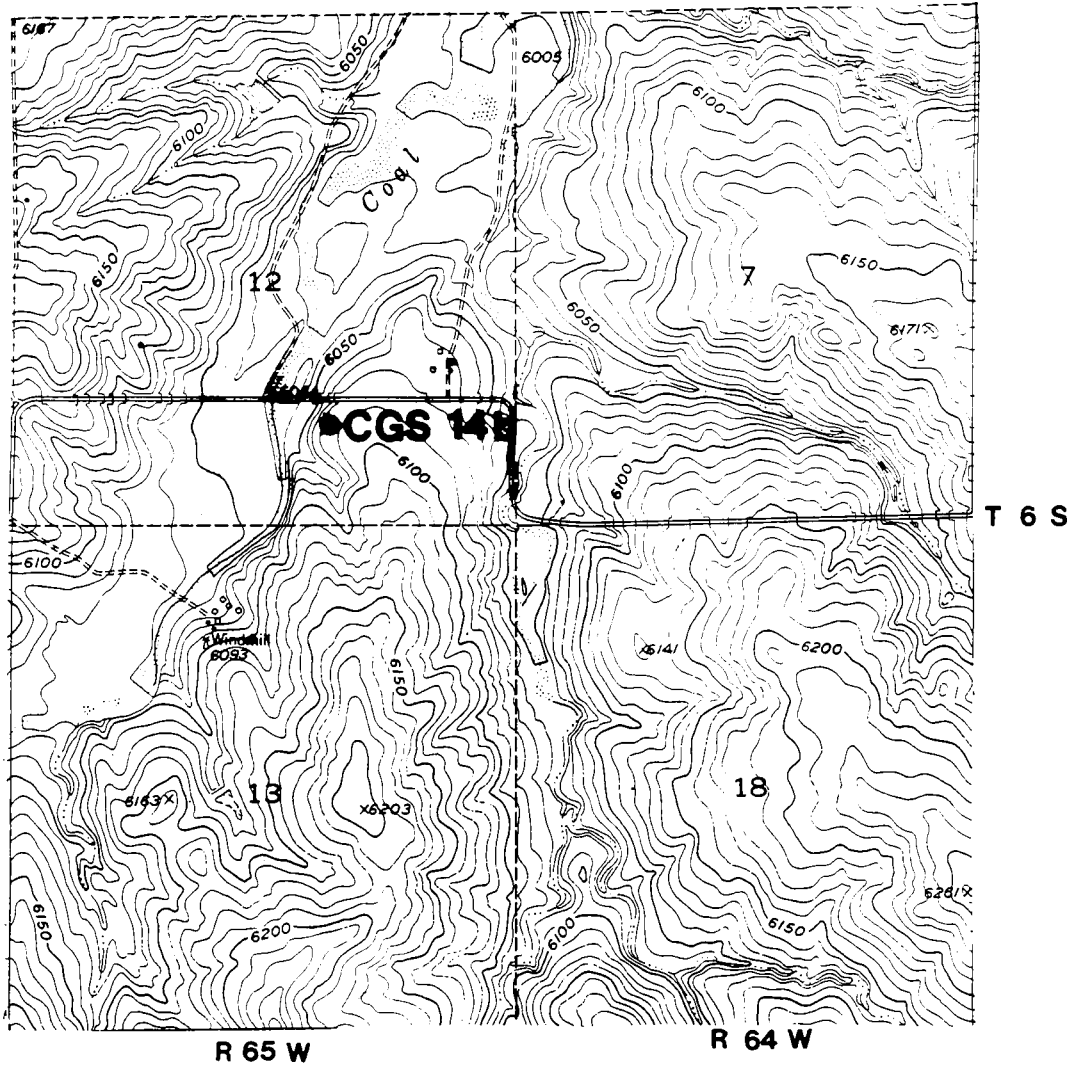


Figure 12.--Location of drill holes in the Watkins SE quadrangle.

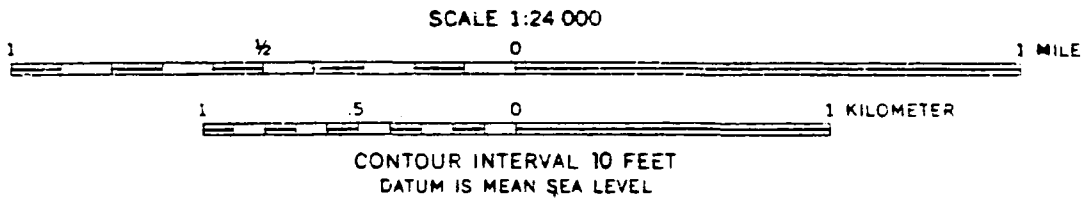
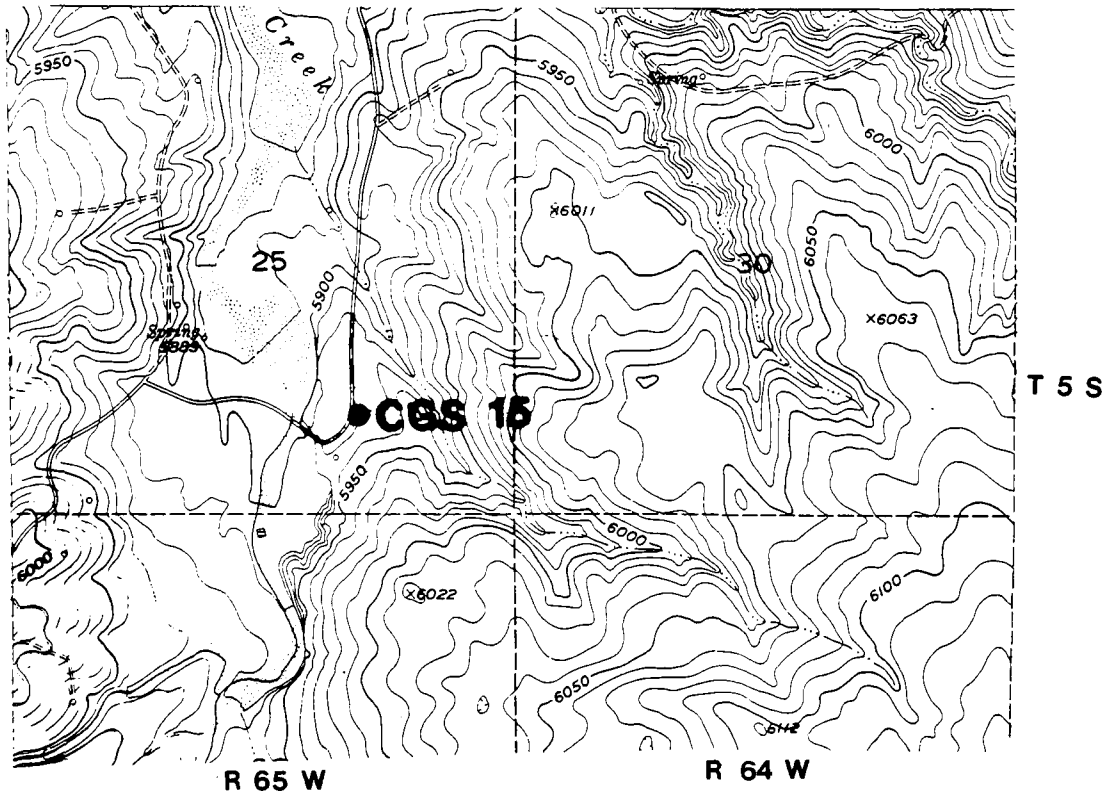


Figure 13.--Location of drill holes in the Watkins SE quadrangle.

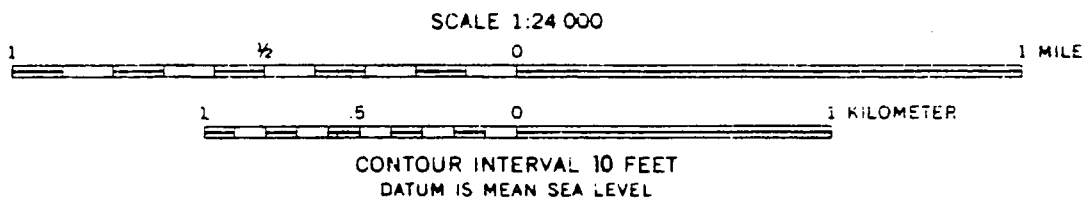
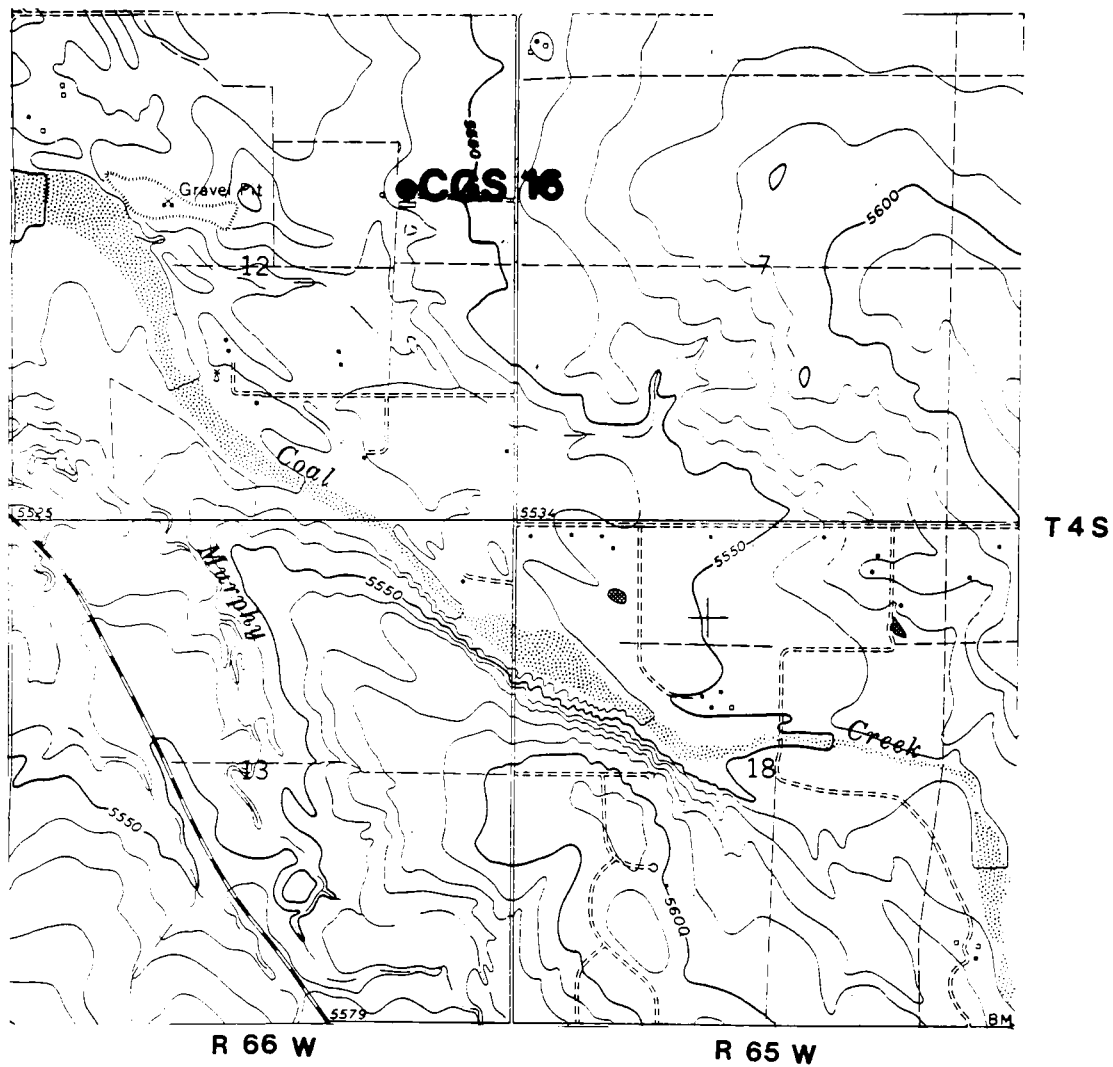


Figure 14.-- Location of drill holes in the Coal Creek quadrangle.

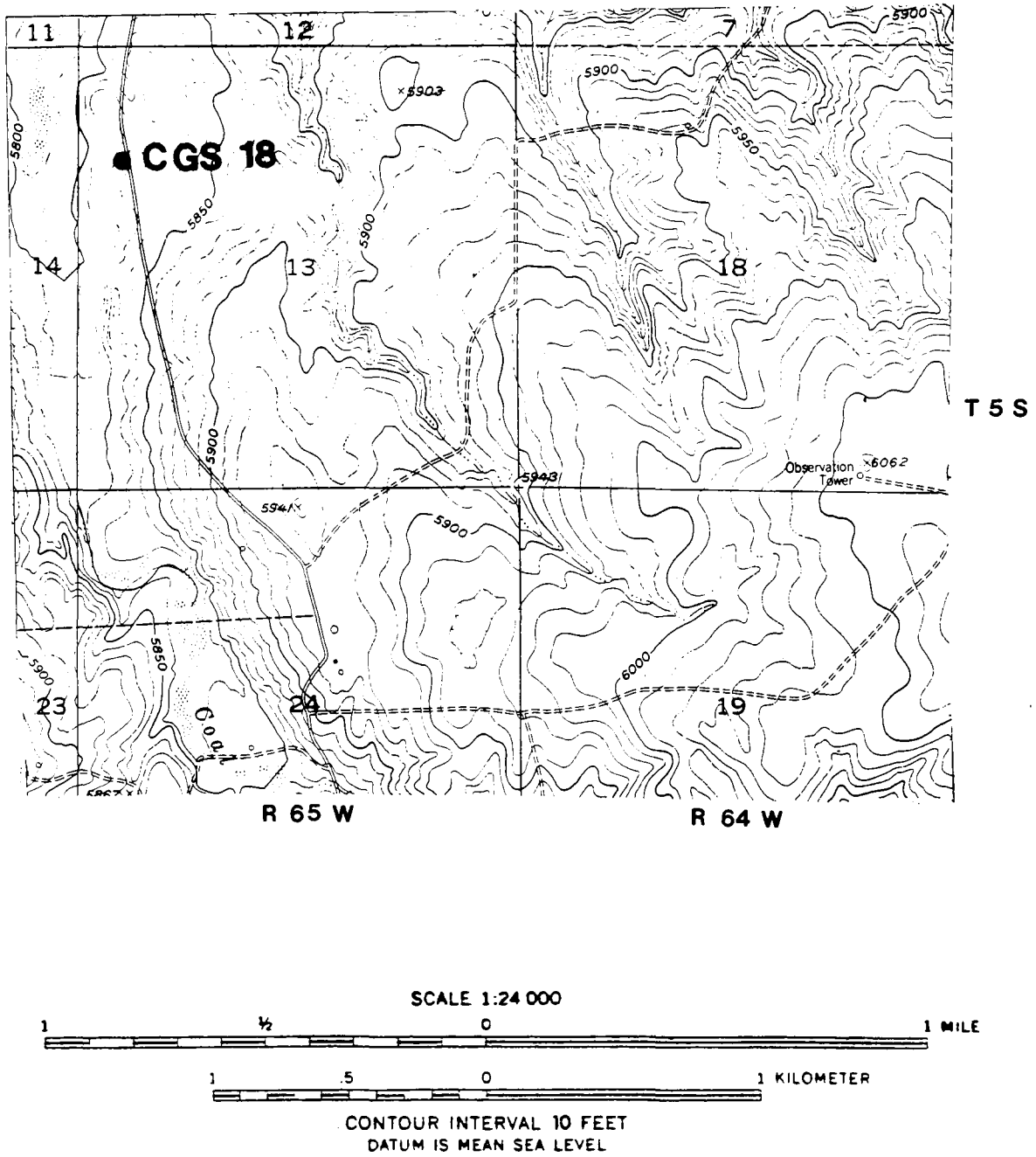


Figure 15.--Location of drill holes in the Watkins SE quadrangle.

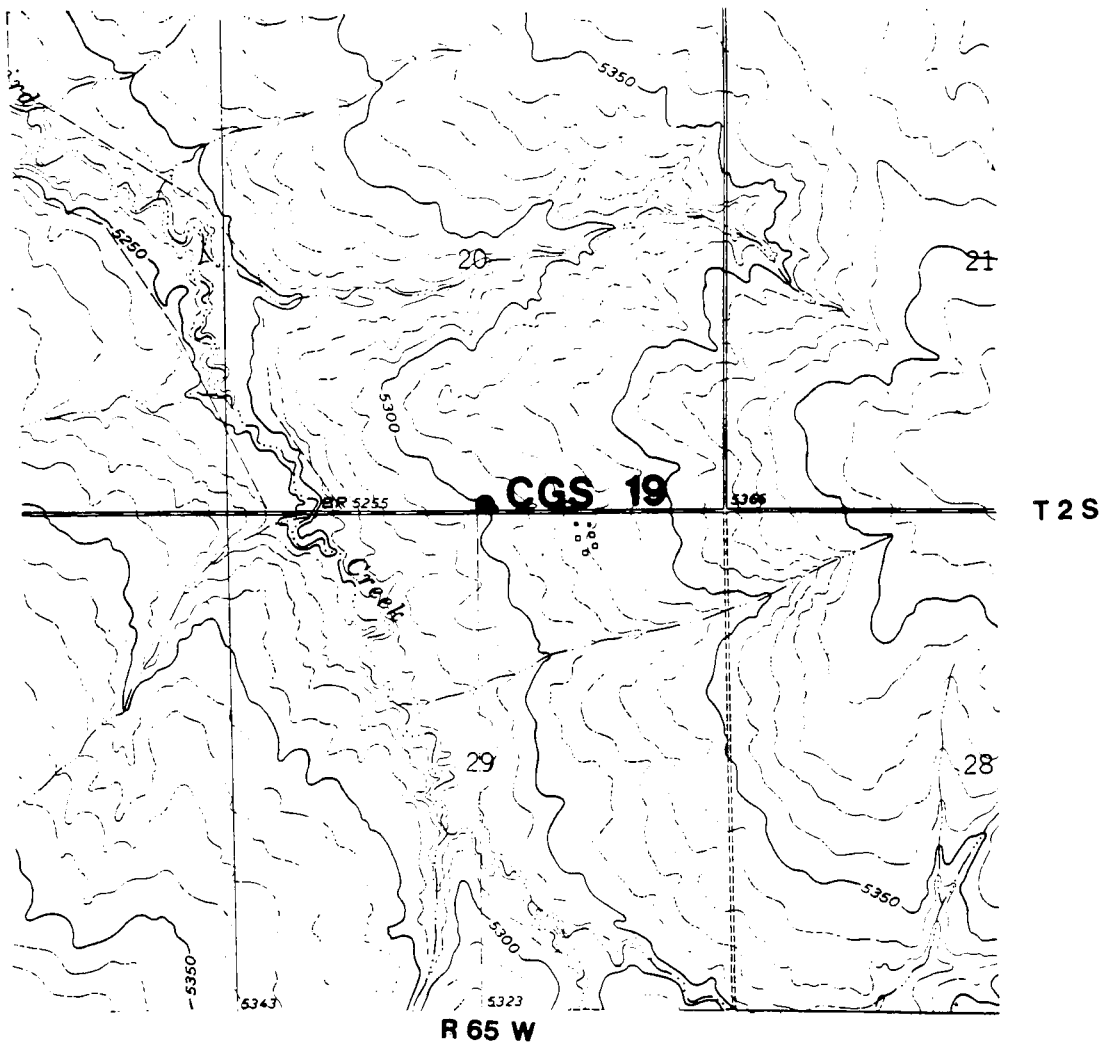


Figure 16.--Location of drill holes in the Box Elder School quadrangle.

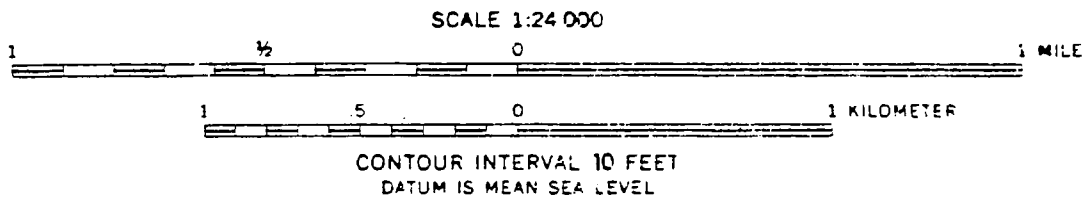
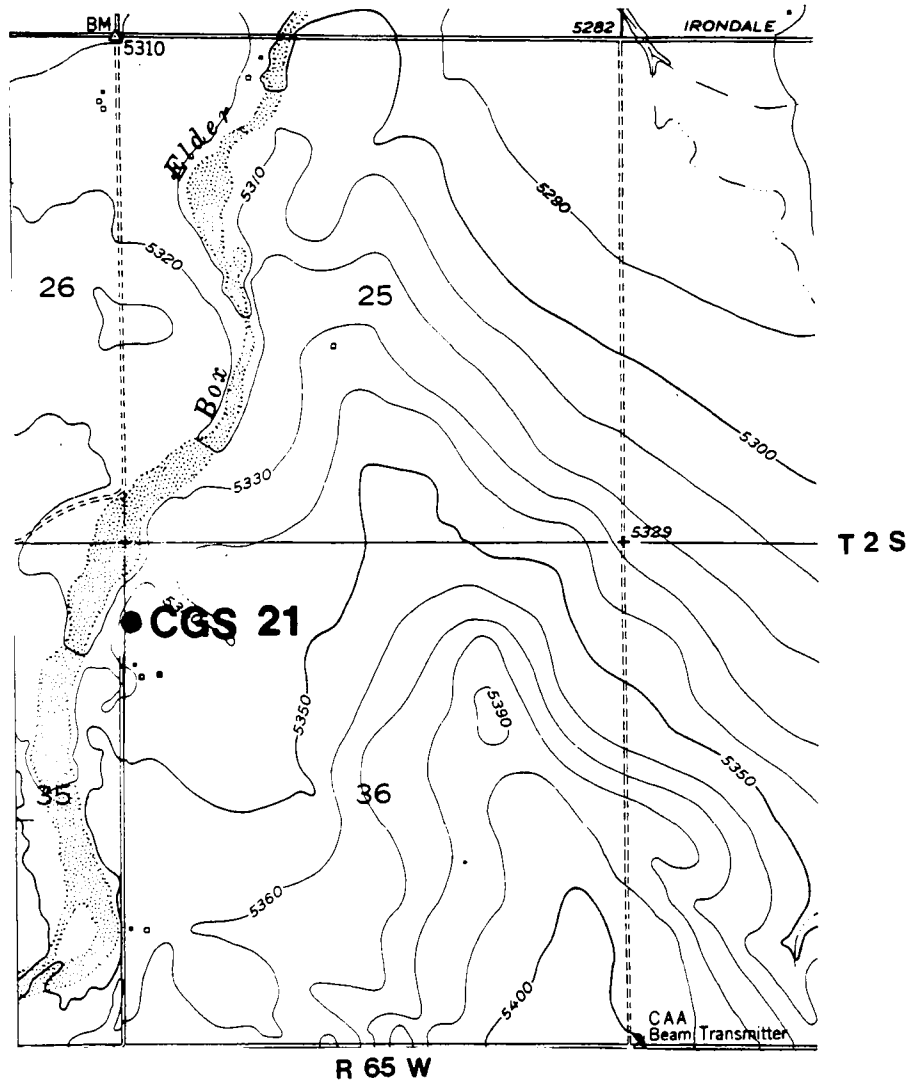


Figure 17.--Location of drill holes in the Manila quadrangle.

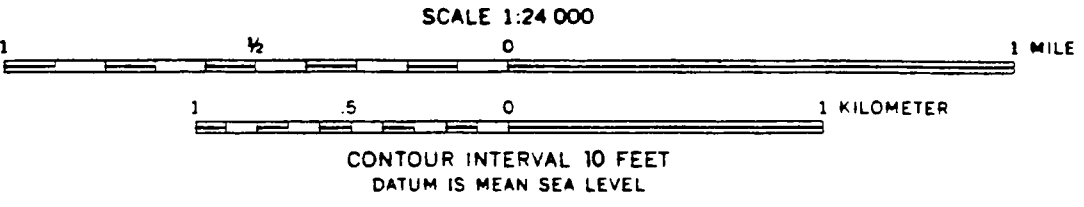
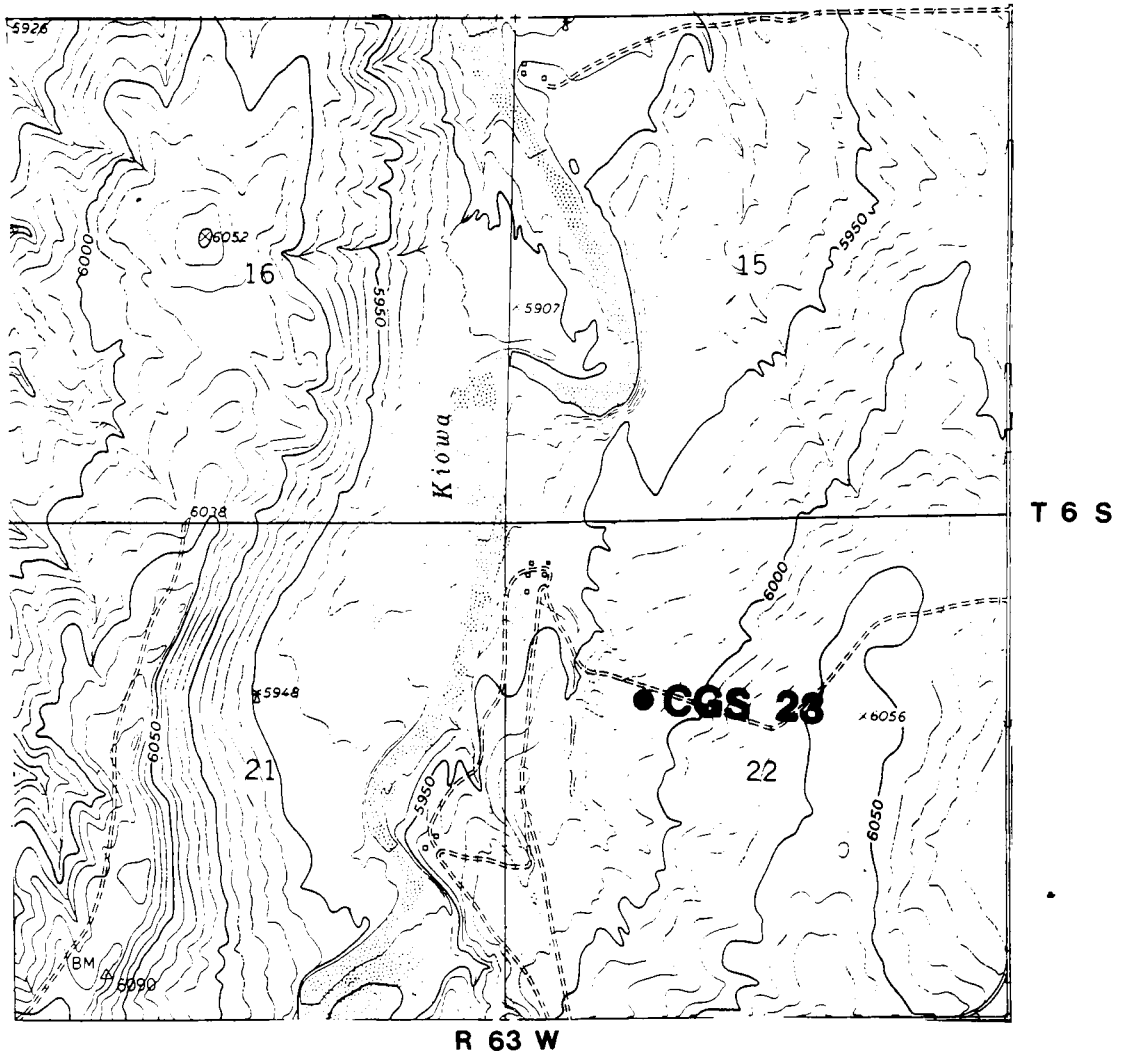


Figure 18.--Location of drill holes in the Strasburg SW quadrangle.

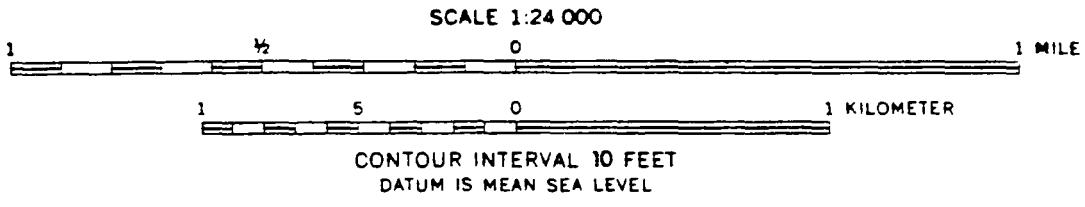
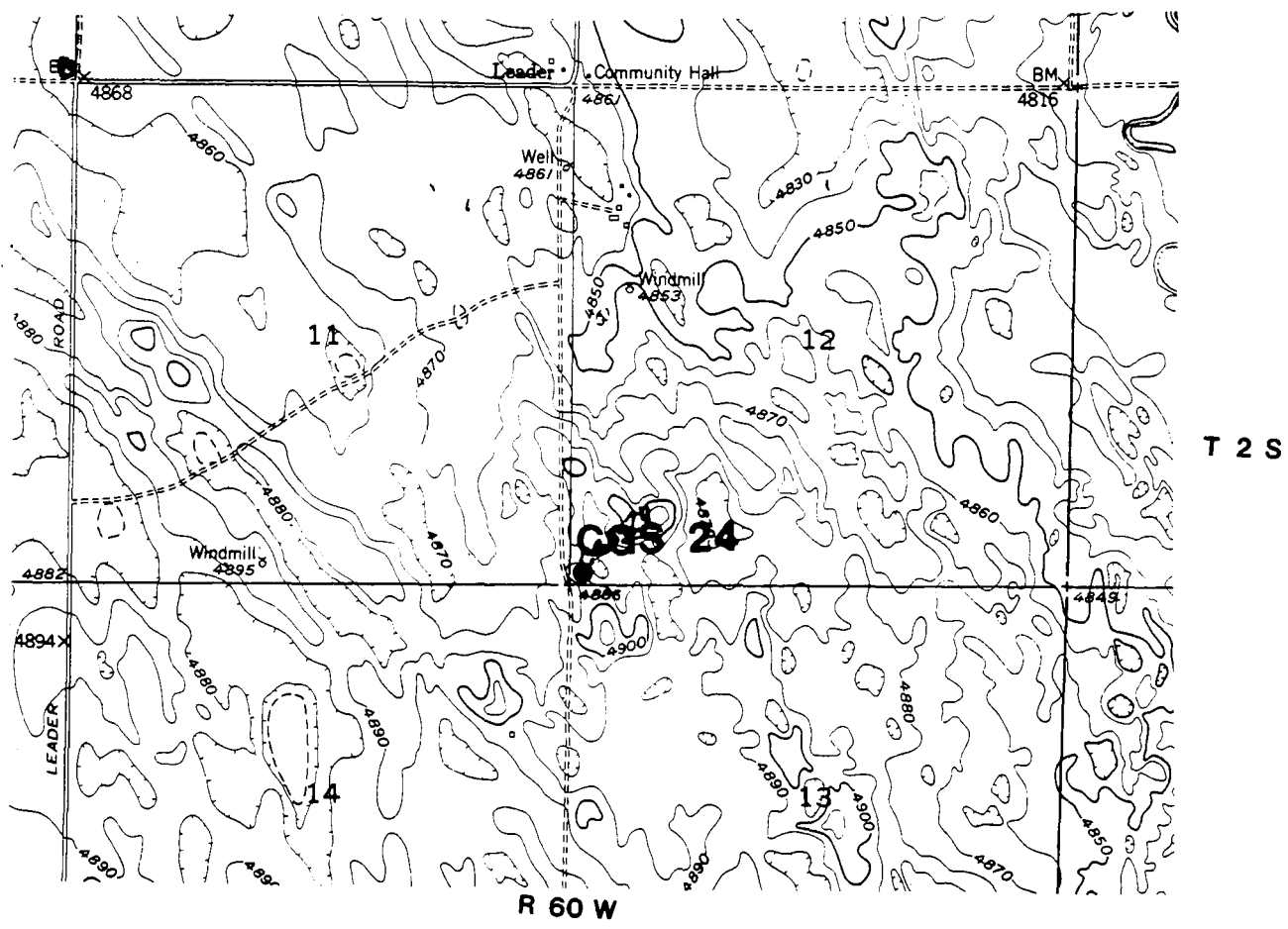


Figure 19.--Location of drill holes in the Leader quadrangle.

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-1 State Colorado County Adams Date logged 11/14/79 Elev. (ft) 4925

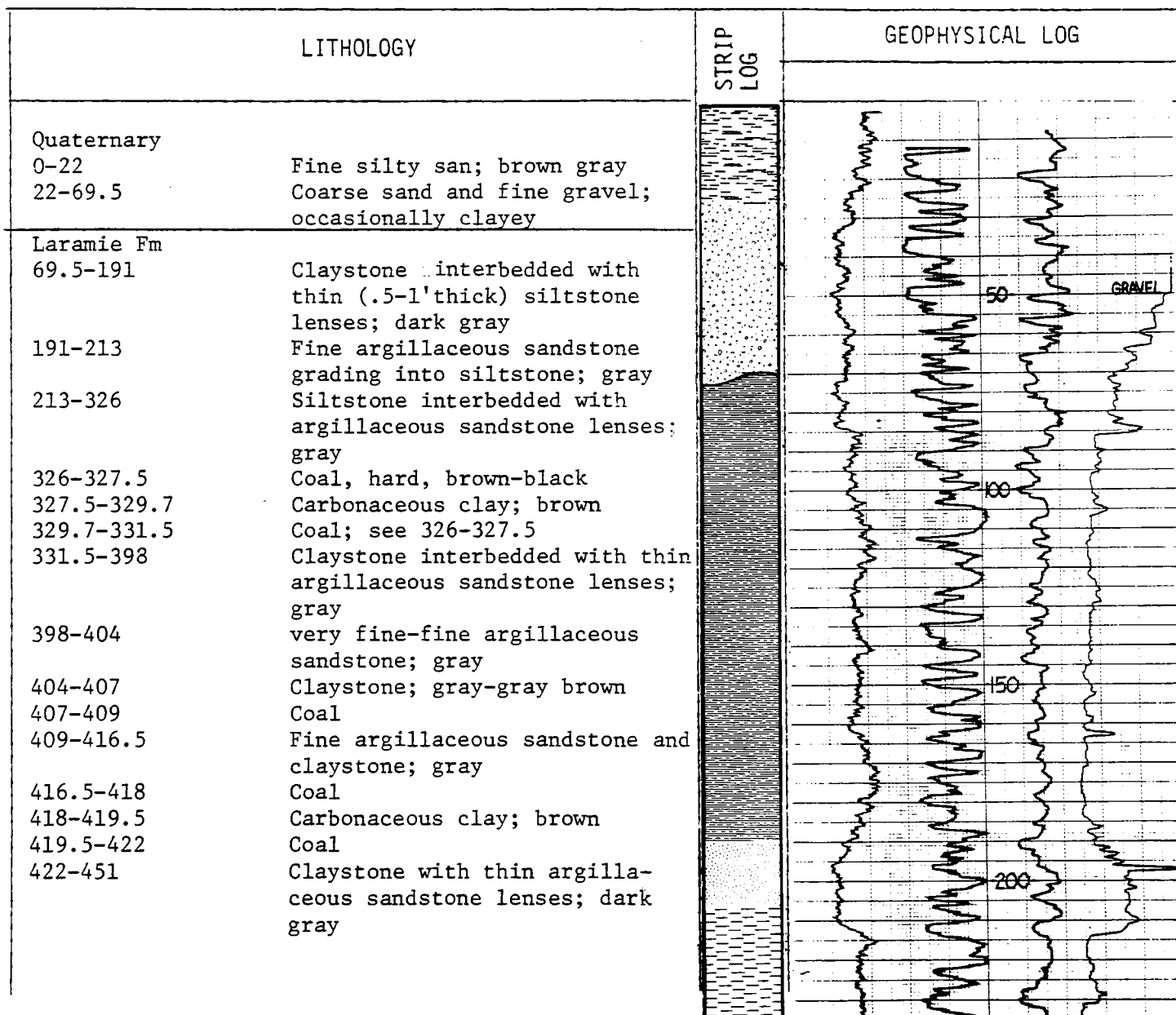
Location: T. 1 S., R. 62 W., secs. SWSE Cored: Yes No X

Drilled depth 500 Logged depth 498 Drilling Medium mud Fluid level 50

Geophysical logs:

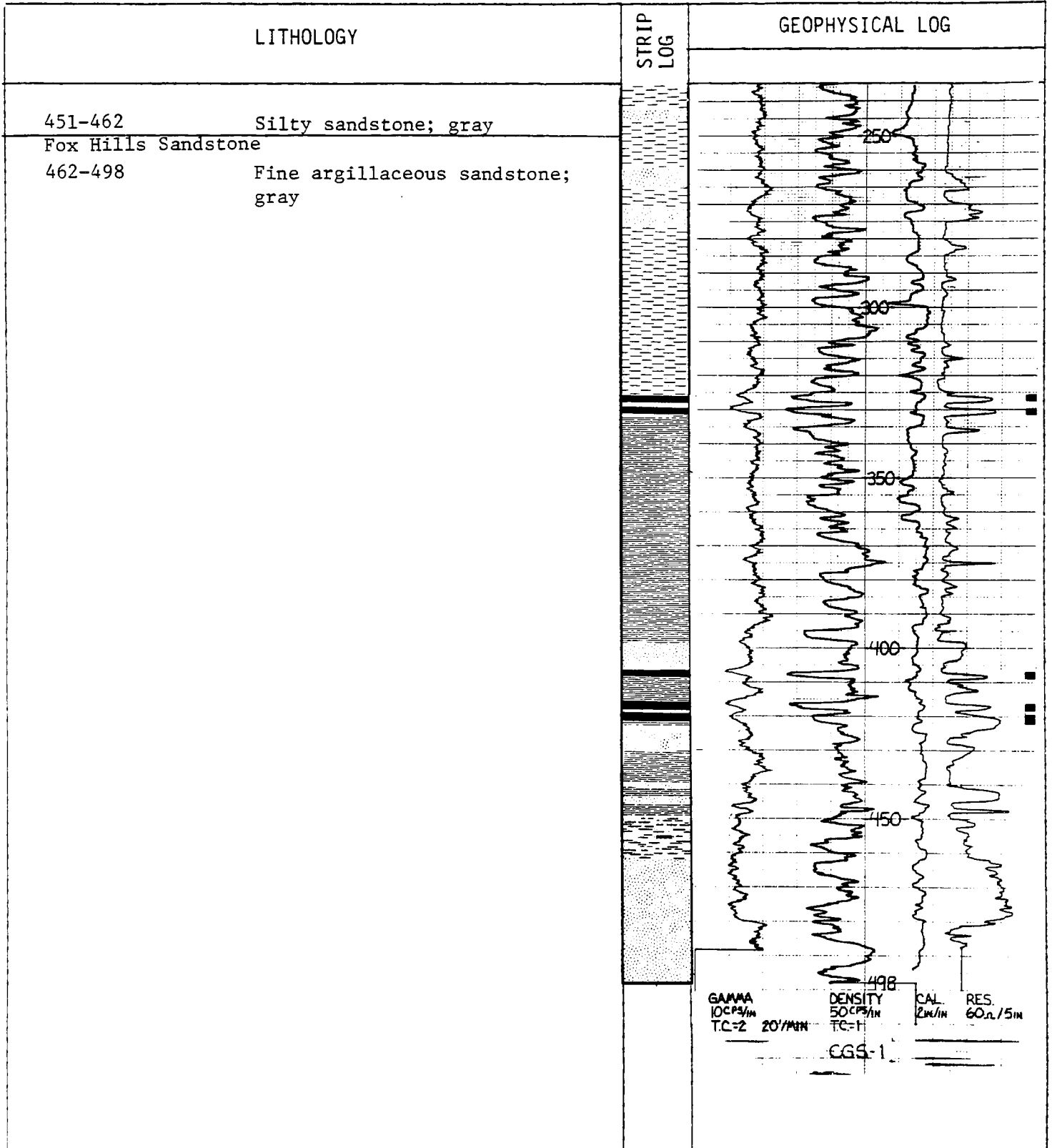
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 60 ohms/5in	Logging speed 20	fpm

Remarks: Living Springs Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-1 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-2 State Colorado County Adams Date logged 11/17/79 Elev.(ft) 5011

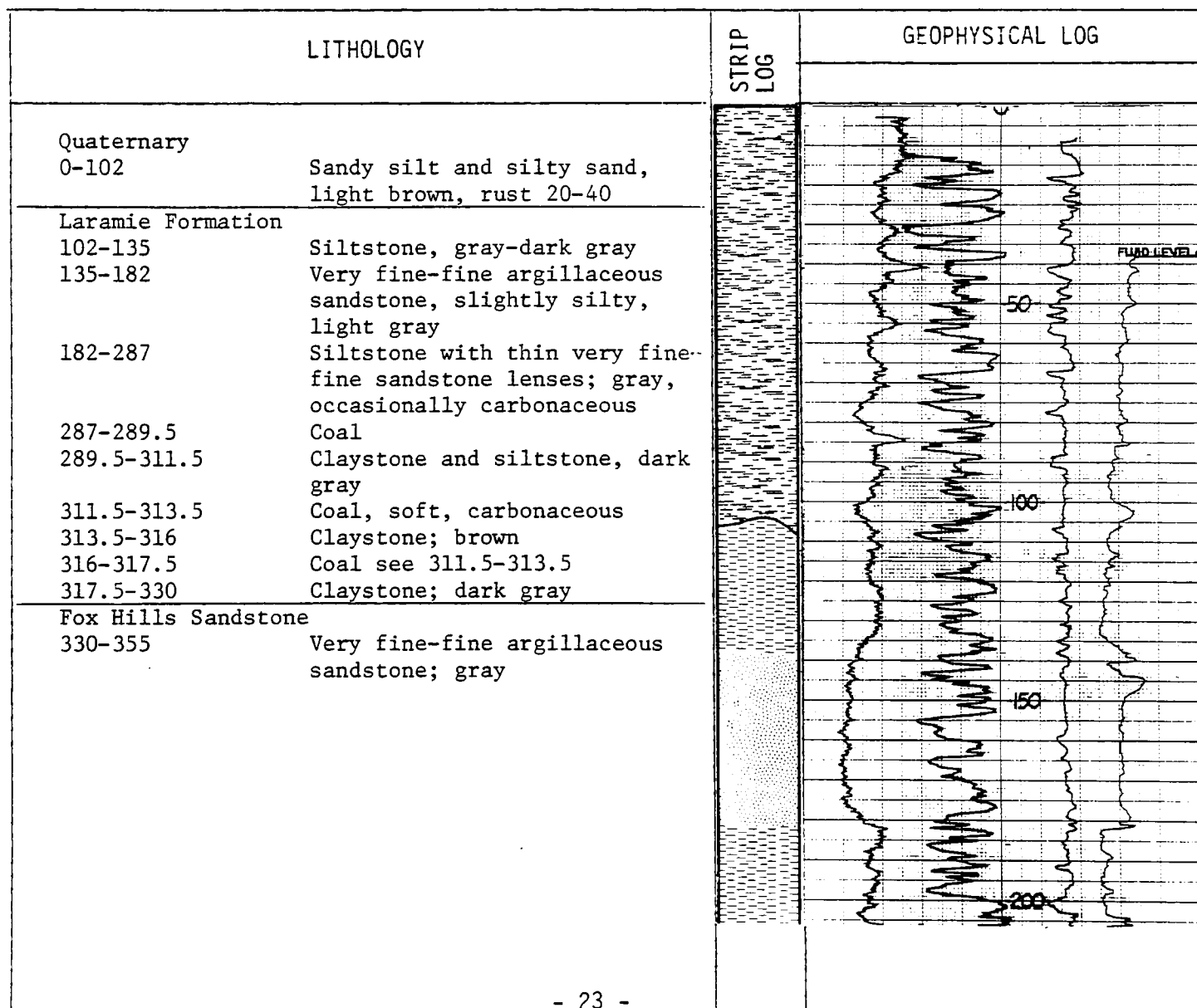
Location: T. 1 S., R. 61 W., secs. SESE 10 Cored: Yes No X

Drilled depth 355 Logged depth 355 Drilling Medium mud Fluid level 38

Geophysical logs:

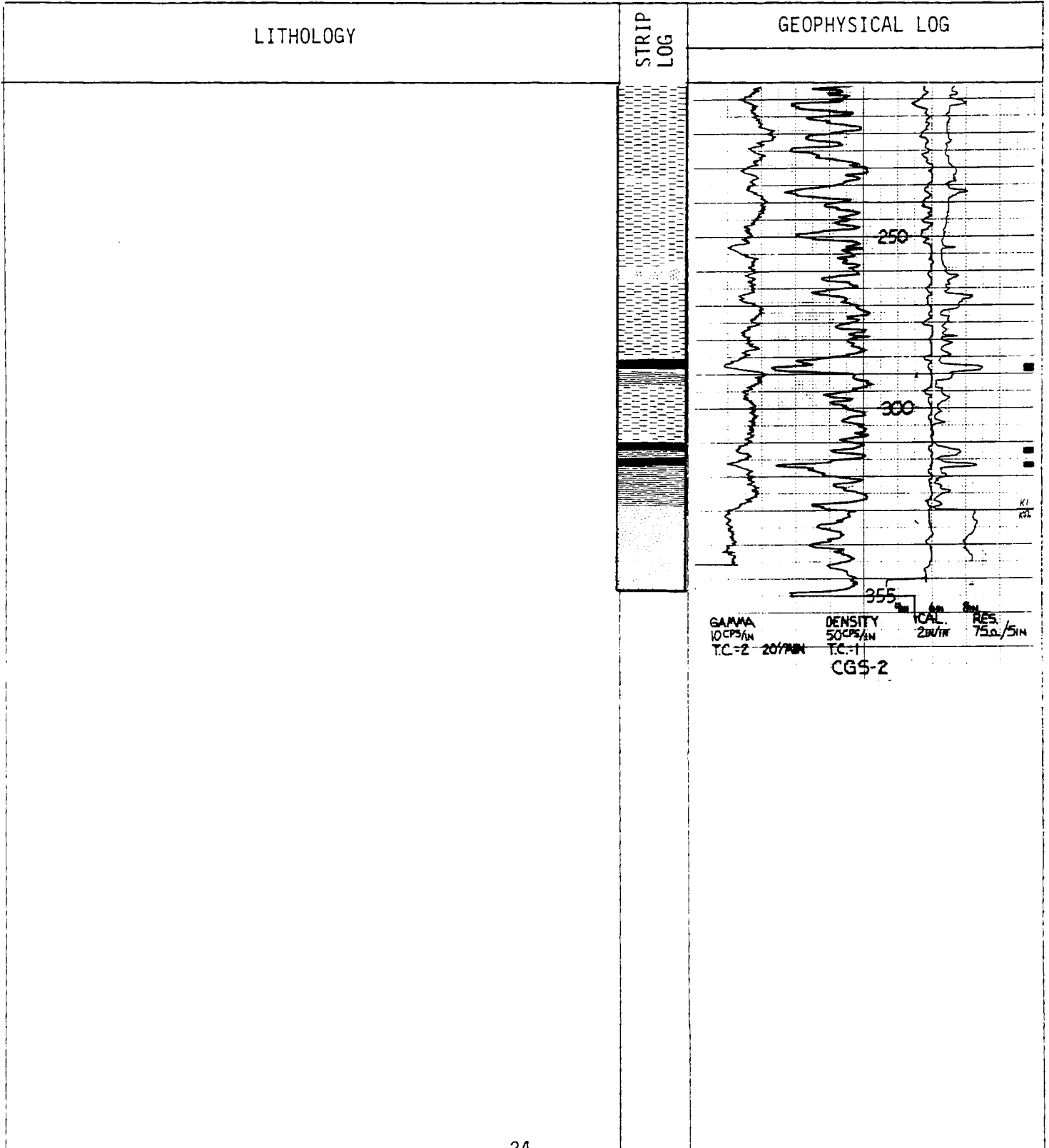
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 75 ohms/5in	Logging speed 20	fpm

Remarks: Leader NW Quadrangle



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-2 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-3 State Colorado County Adams Date logged 11/14/79 Elev.(ft) 4942

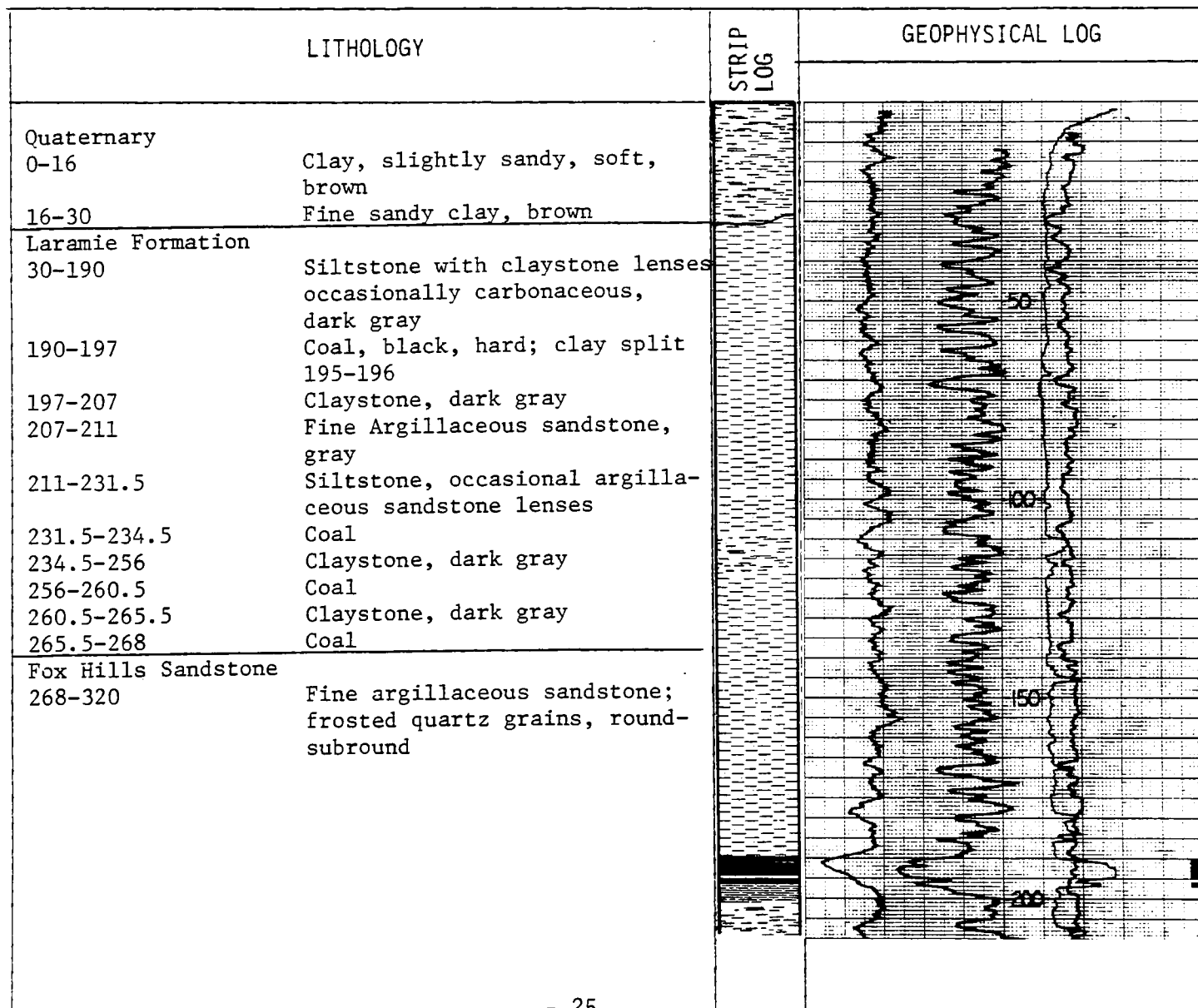
Location: T. 2 S., R. 61 W., secs. NWNW 14 Cored: Yes No X

Drilled depth 320 Logged depth 319 Drilling Medium mud Fluid level 2

Geophysical logs:

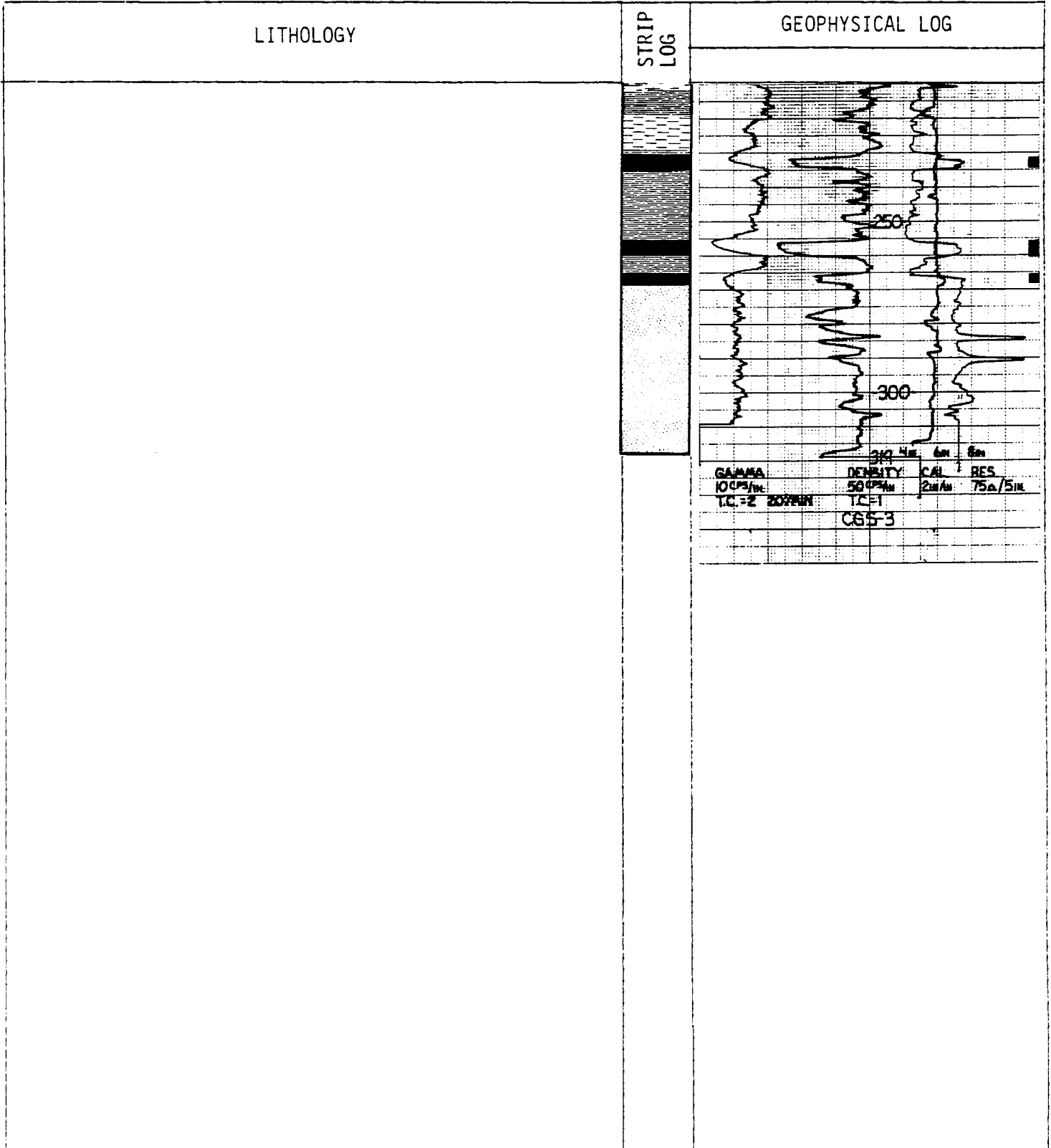
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 74 ohms/in	Logging speed 20	fpm

Remarks: Leader NW Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-3 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-4 State Colorado County Adams Date logged 11/15/79 Elev.(ft) 4975

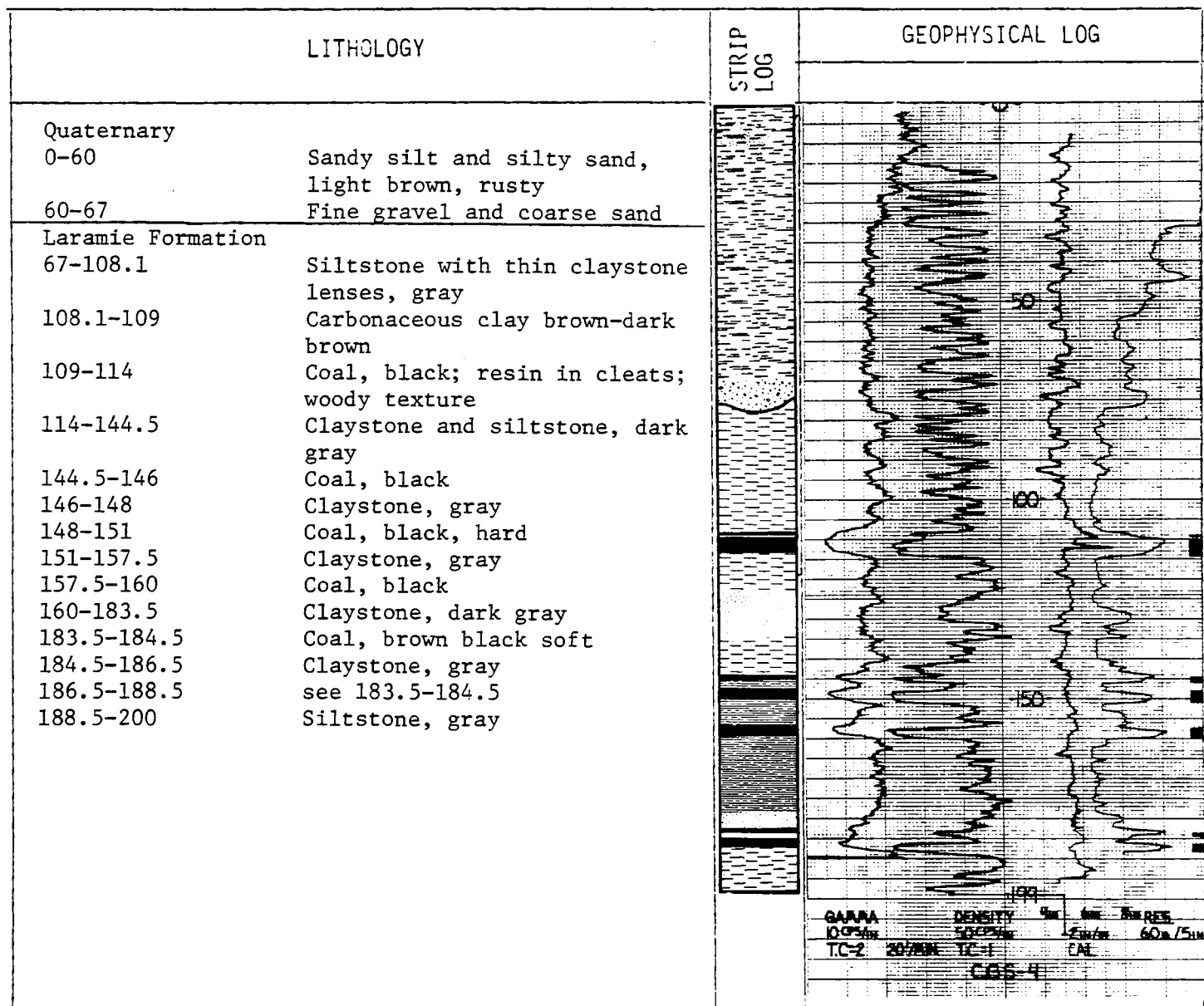
Location: T. 2 S., R. 60 W., secs. NENE 34 Cored: x Yes No

Drilled depth 200 Logged depth 199 Drilling Medium mud Fluid level 31

Geophysical logs:

Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 60 ohms/5in	Logging speed 20	fpm

Remarks: CGS-4_c Cored 108-117. Leader SE Quadrangle.



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-5 State Colorado County Adams Date logged 11/15/79 Elev.(ft) 5027

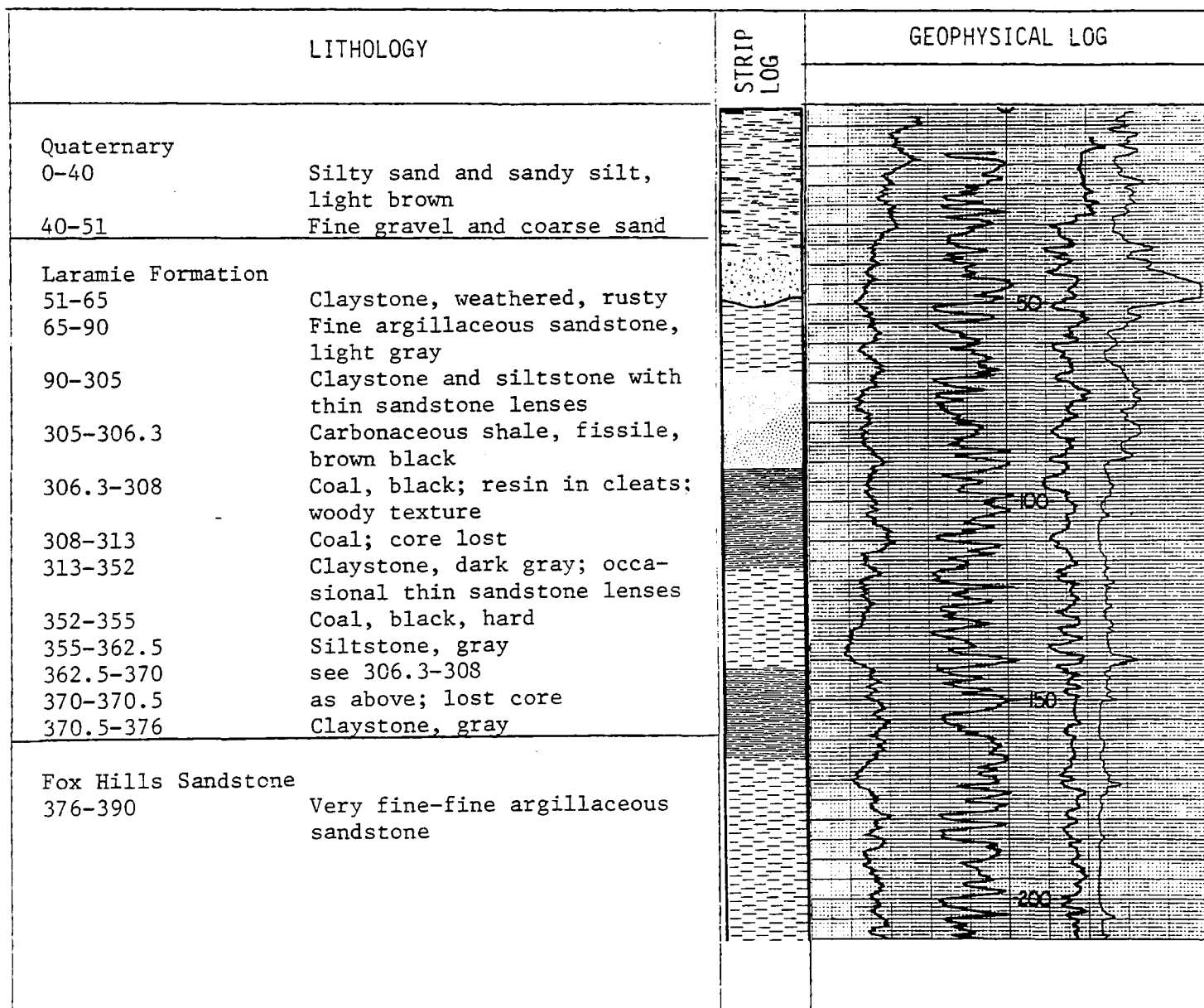
Location: T. 3 S., R.61 W., secs. NENE 4 Cored: X Yes No

Drilled depth 390 Logged depth 390 Drilling Medium mud Fluid level 2

Geophysical logs:

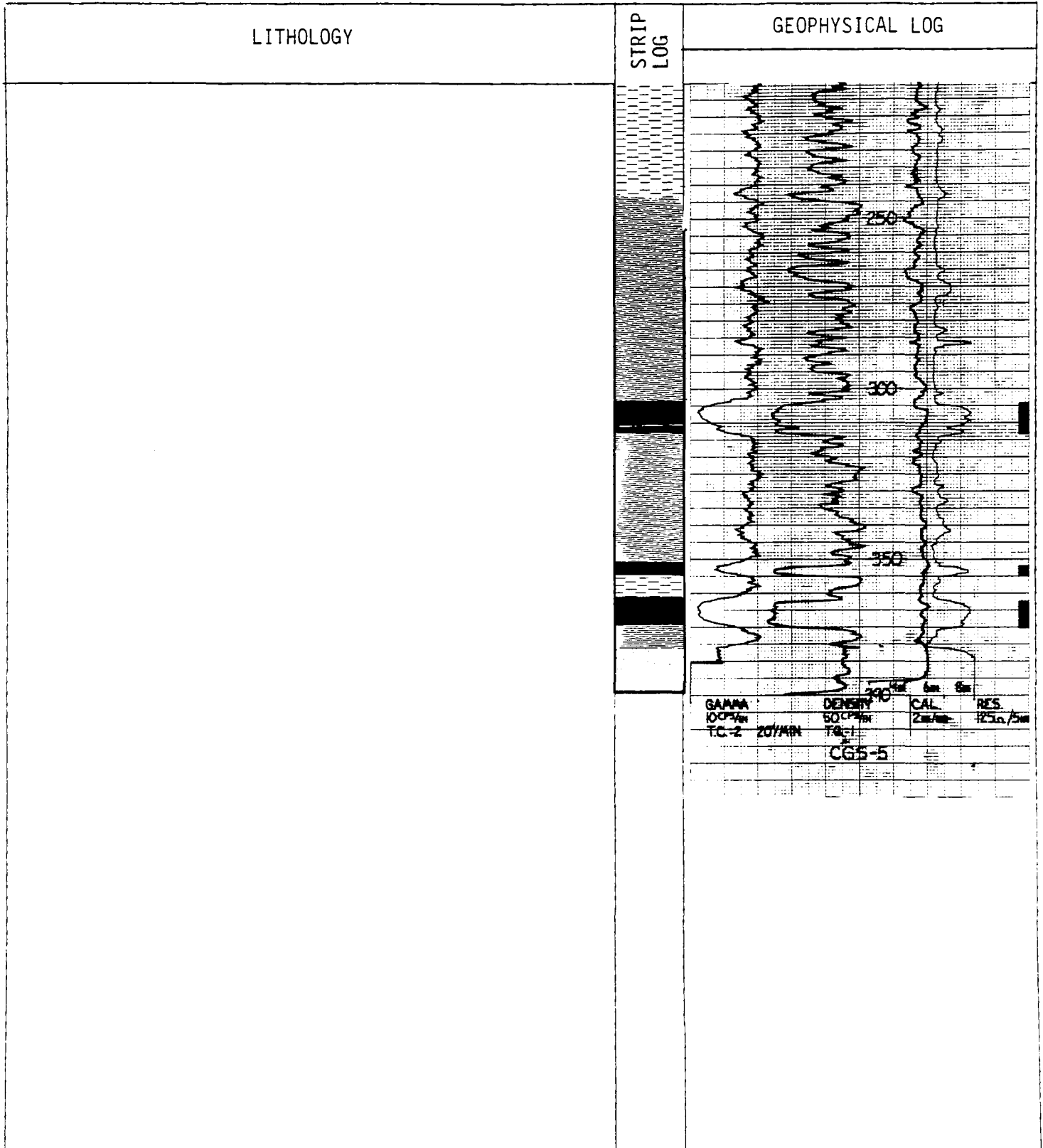
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 125 ohms/in	Logging speed 20	fpm

Remarks: CGS-5_c Cored 304-314 and 362-371. Leader SW Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-5 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-6 State Colorado County Arapahoe Date logged 11/17/79 Elev.(ft) 5046

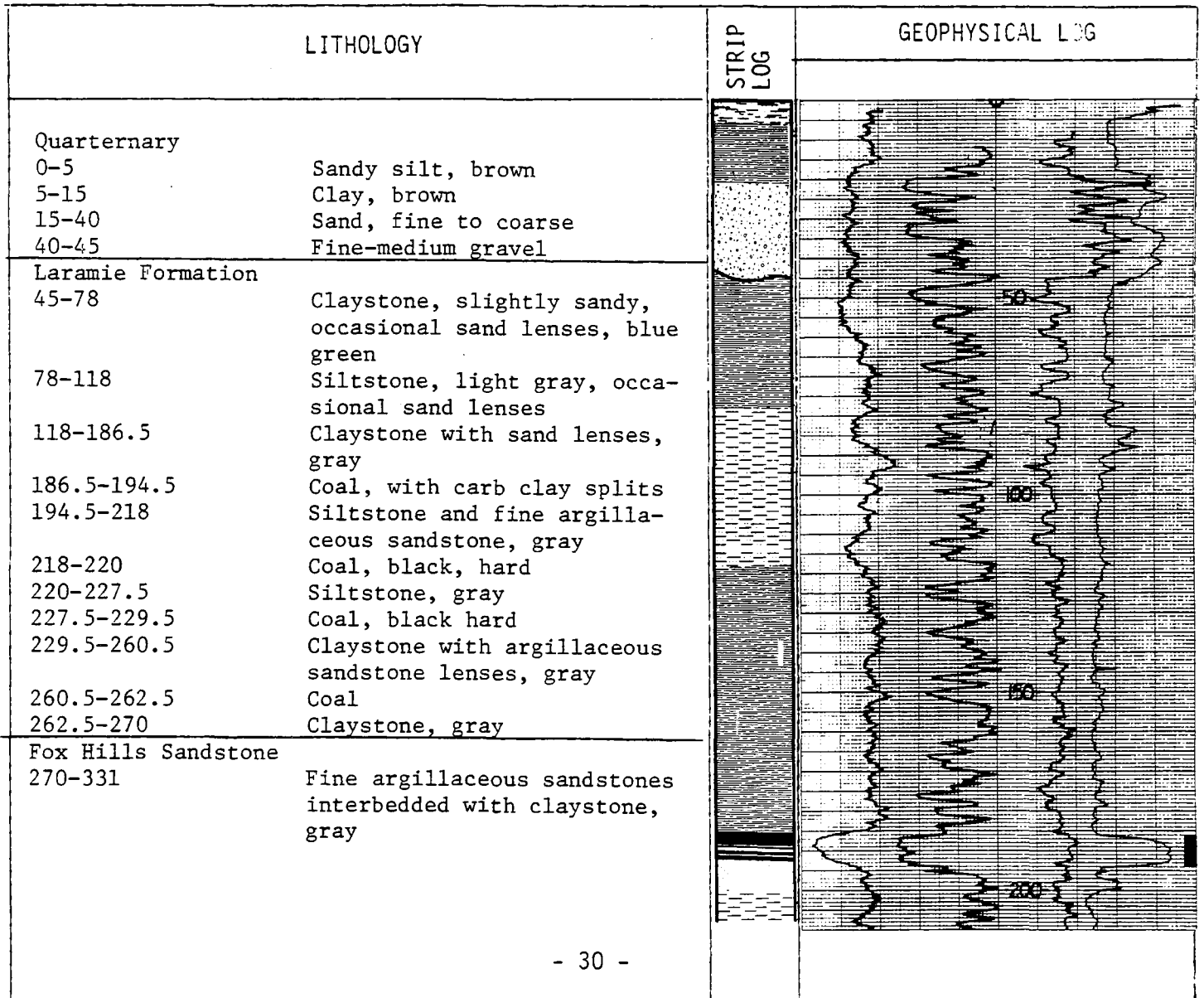
Location: T. 4 S., R. 60 W., secs. NENW 4 Cored: Yes No

Drilled depth 331 Logged depth 331 Drilling Medium mud Fluid level 2

Geophysical logs:

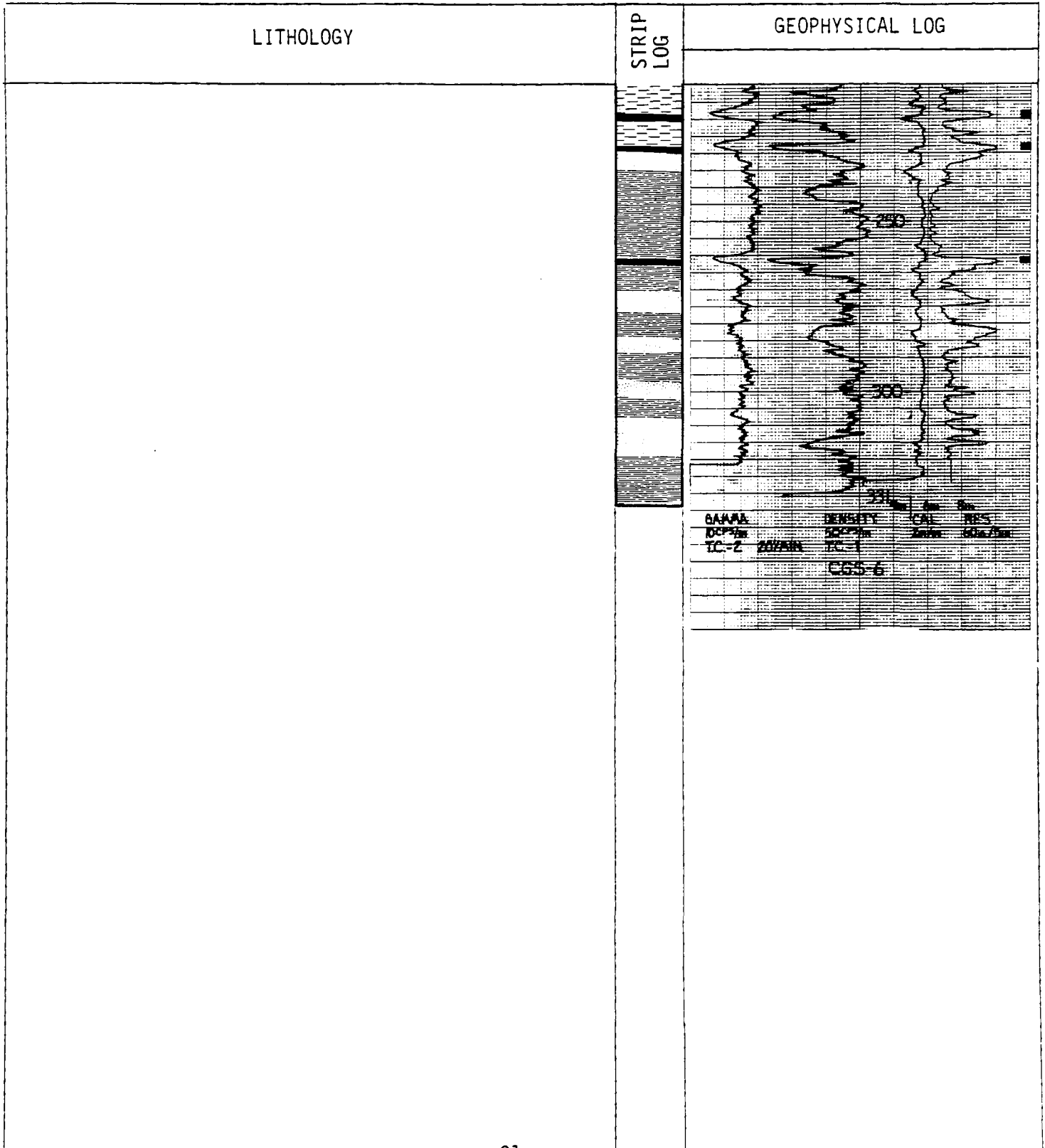
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Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 60 ohms/5in	Logging speed 20	fpm

Remarks: Peoria Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-6 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-7 State Colorado County Arapahoe Date logged 1/18/79 Elev. (ft) 5297

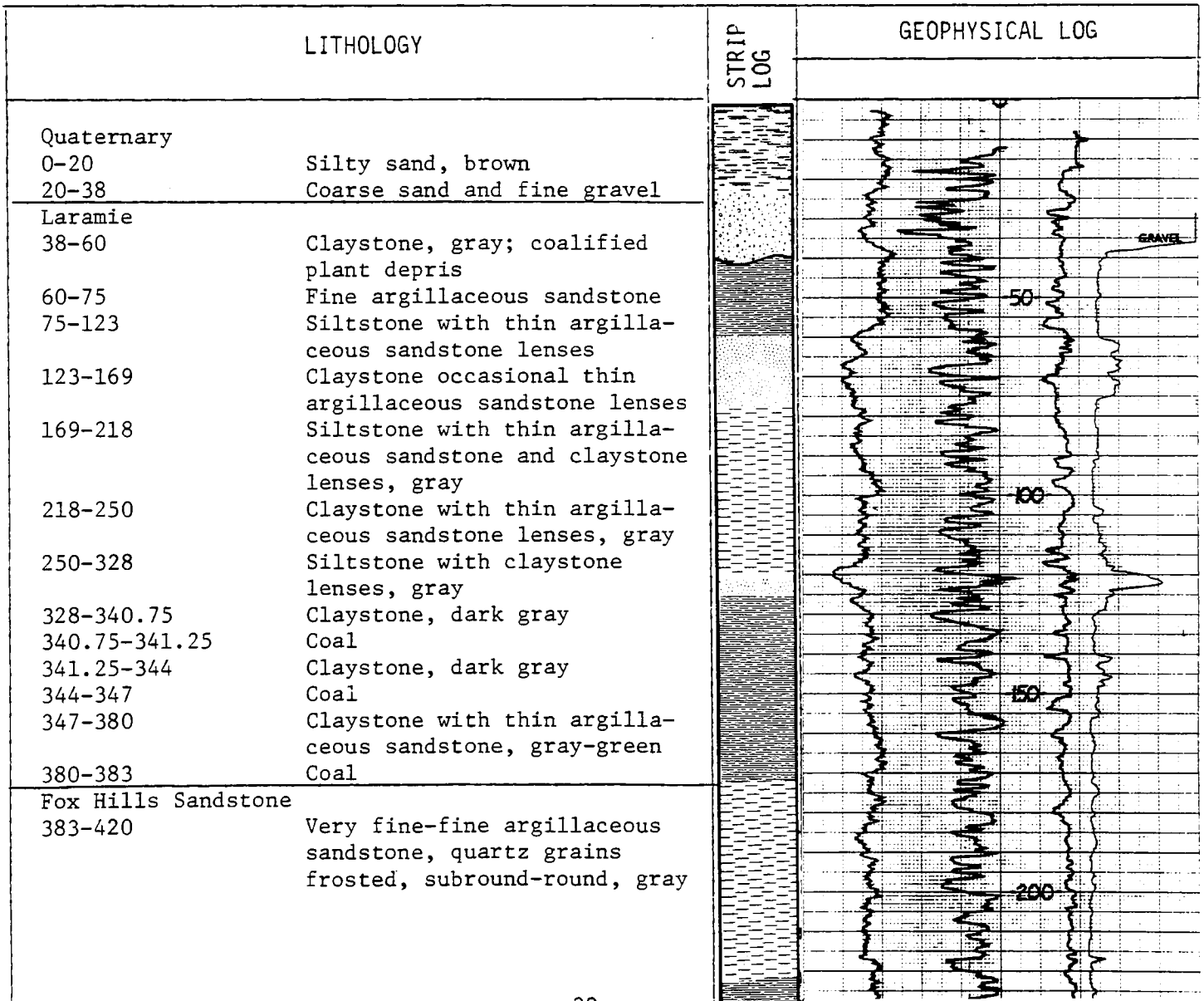
Location: T. 5 S., R. 60 W., secs. SWSE 14 Cored: Yes No x

Drilled depth 420 Logged depth 418 Drilling Medium mud Fluid level 36

Geophysical logs:

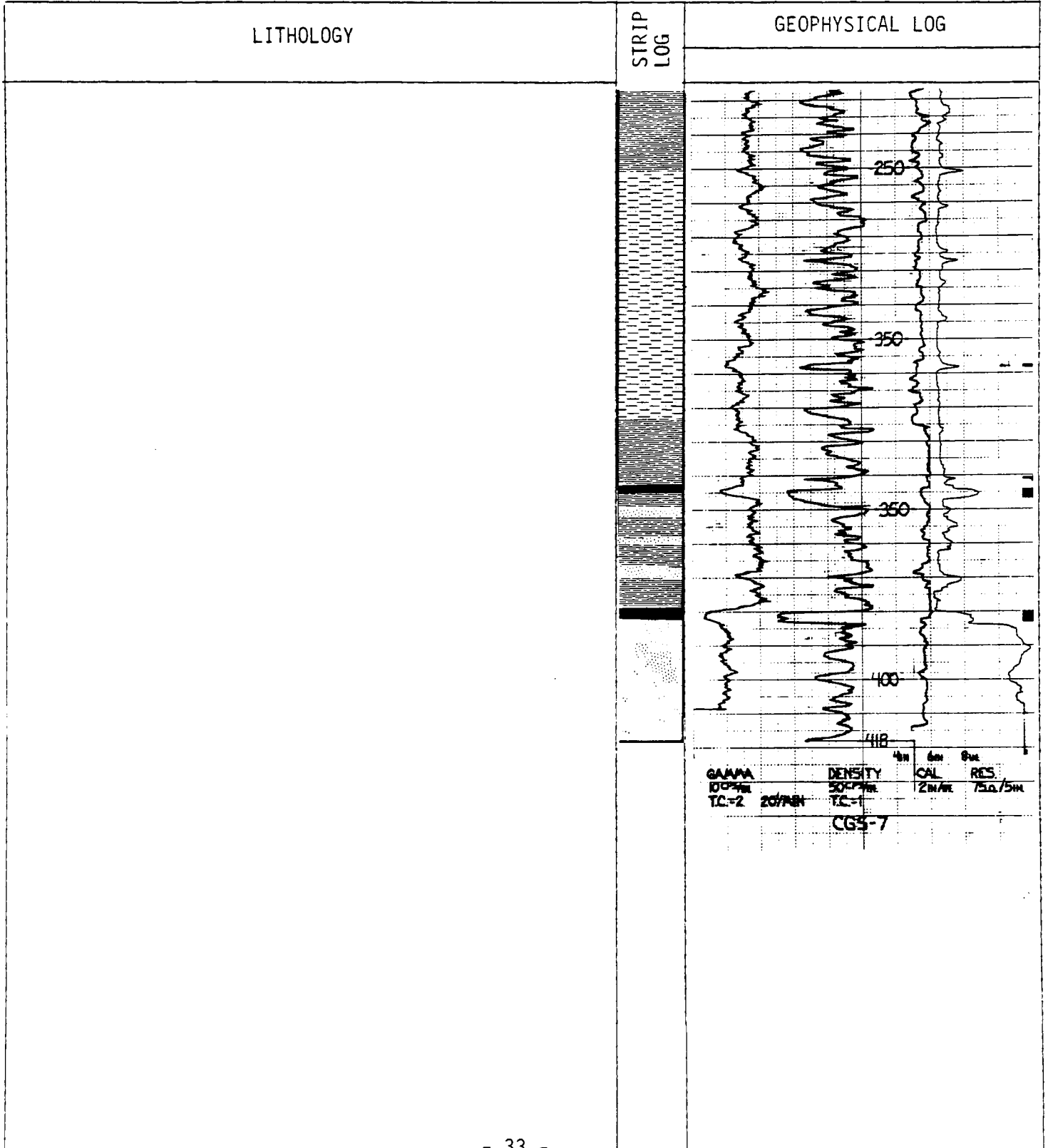
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	ftm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	ftm
Caliper (C):		Scale 2 in/in	Logging speed 20	ftm
Resistance (Res):		Scale 75 ohms/5in	Logging speed 20	ftm

Remarks: Deer Trail Quadrangle



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-7 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-8 State Colorado County Arapahoe Date logged 11/18/79 Elev.(ft) 5205

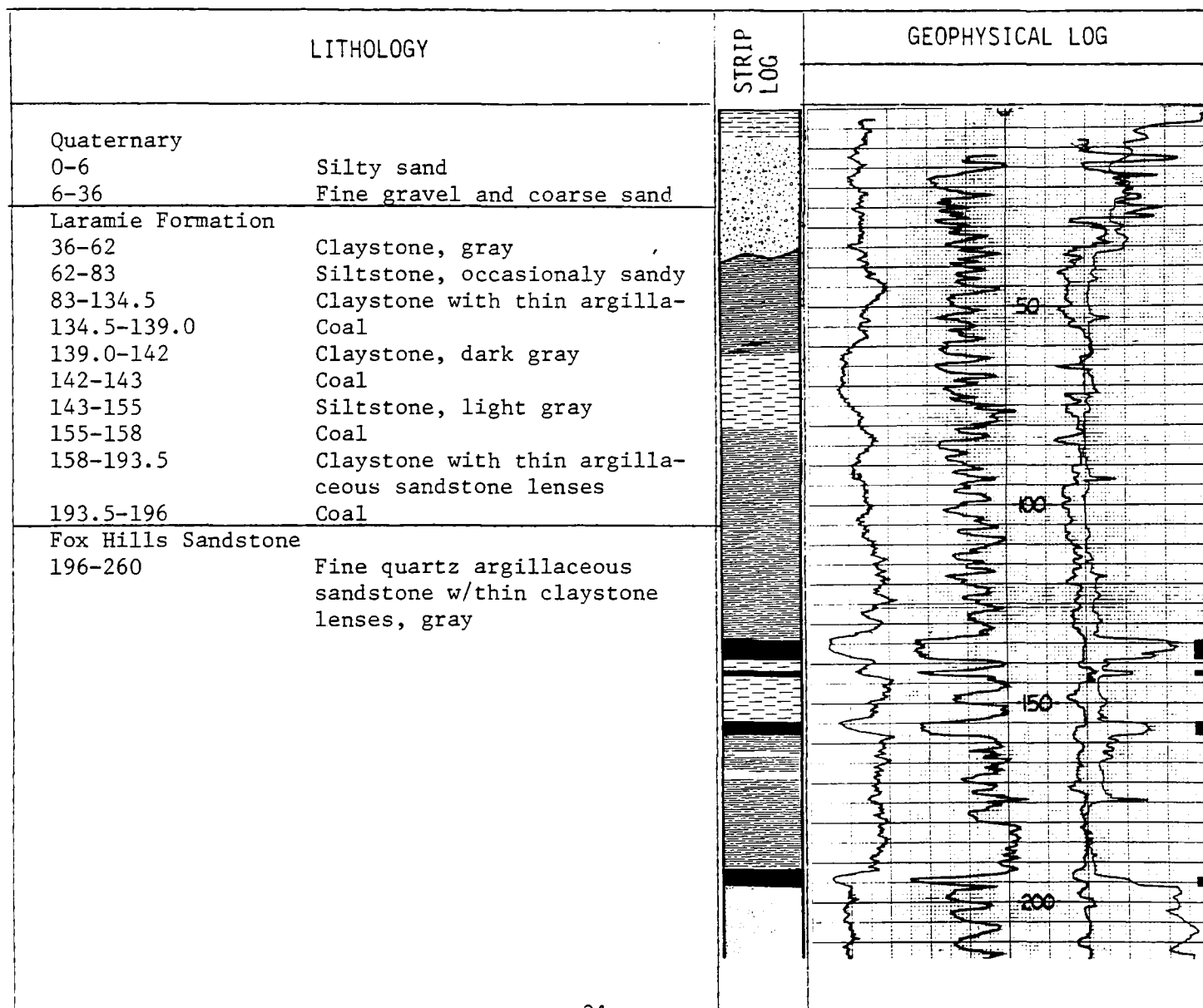
Location: T. 5 S., R. 60 W., secs. SESE Cored: Yes No x

Drilled depth 260 Logged depth 258 Drilling Medium mud Fluid level 3

Geophysical logs:

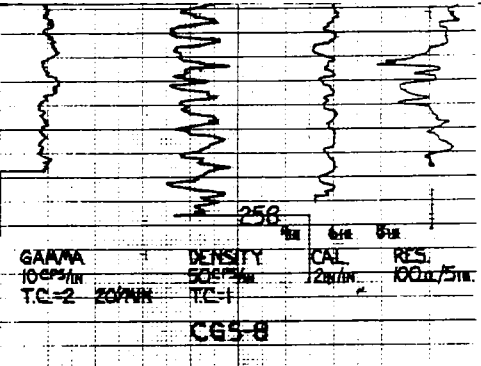
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Deer Trail Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-8 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG												
		 <table border="1"> <thead> <tr> <th>GAMA</th> <th>DENSITY</th> <th>CAL</th> <th>RES.</th> </tr> <tr> <th>100%/IN</th> <th>50%/IN</th> <th>120%/IN</th> <th>100%/5IN</th> </tr> <tr> <td>TC-2</td> <td>ZOPAN</td> <td>TC-1</td> <td></td> </tr> </thead> </table> <p>CGS-8</p>	GAMA	DENSITY	CAL	RES.	100%/IN	50%/IN	120%/IN	100%/5IN	TC-2	ZOPAN	TC-1	
GAMA	DENSITY	CAL	RES.											
100%/IN	50%/IN	120%/IN	100%/5IN											
TC-2	ZOPAN	TC-1												

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-9 State Colorado County Arapahoe Date logged 12/14/79 Elev. (ft) 5758

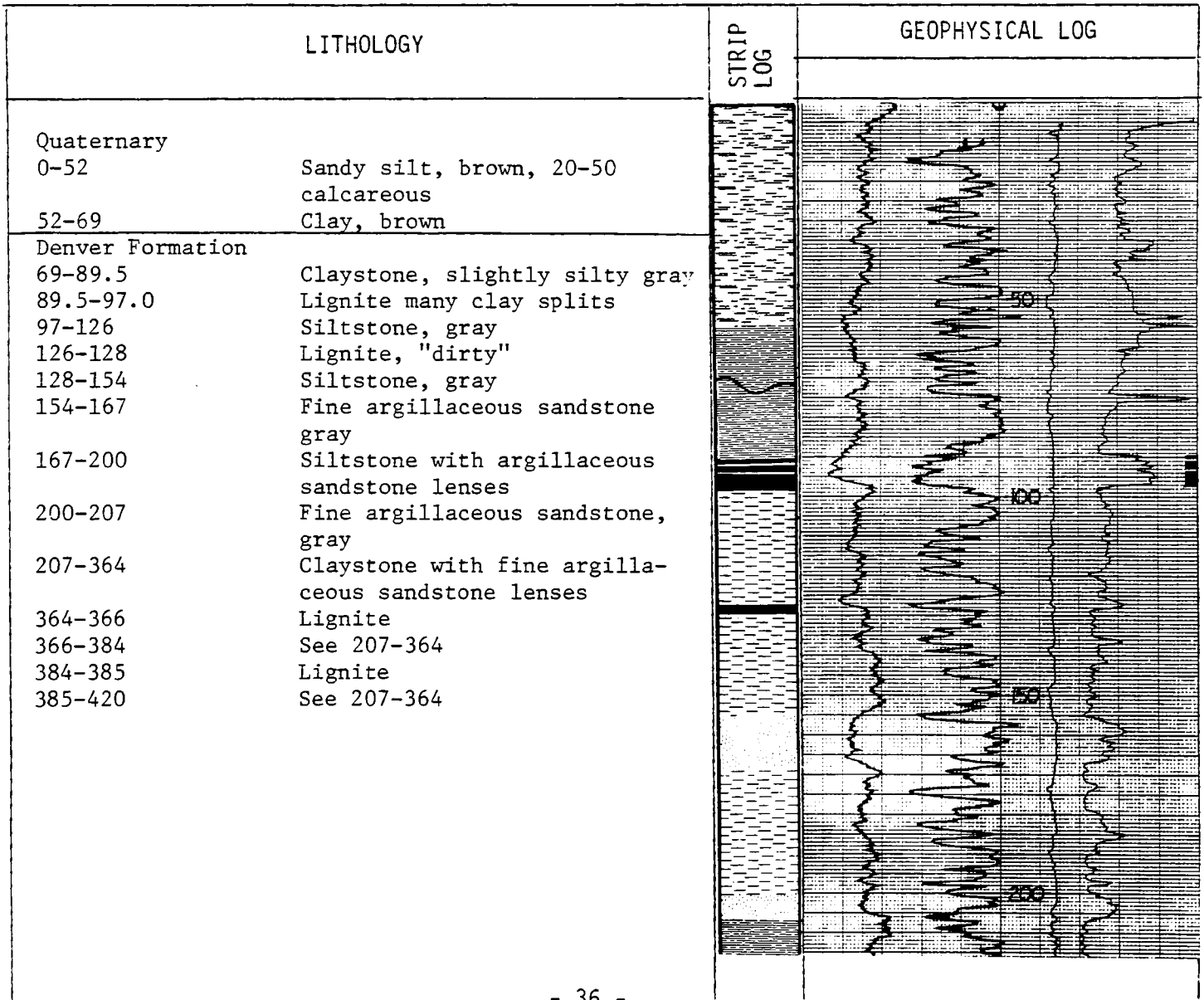
Location: T. 5 S., R. 63 W., secs. SWSW 11 Cored: Yes No X

Drilled depth 420 Logged depth 418 Drilling Medium mud Fluid level 5

Geophysical logs:

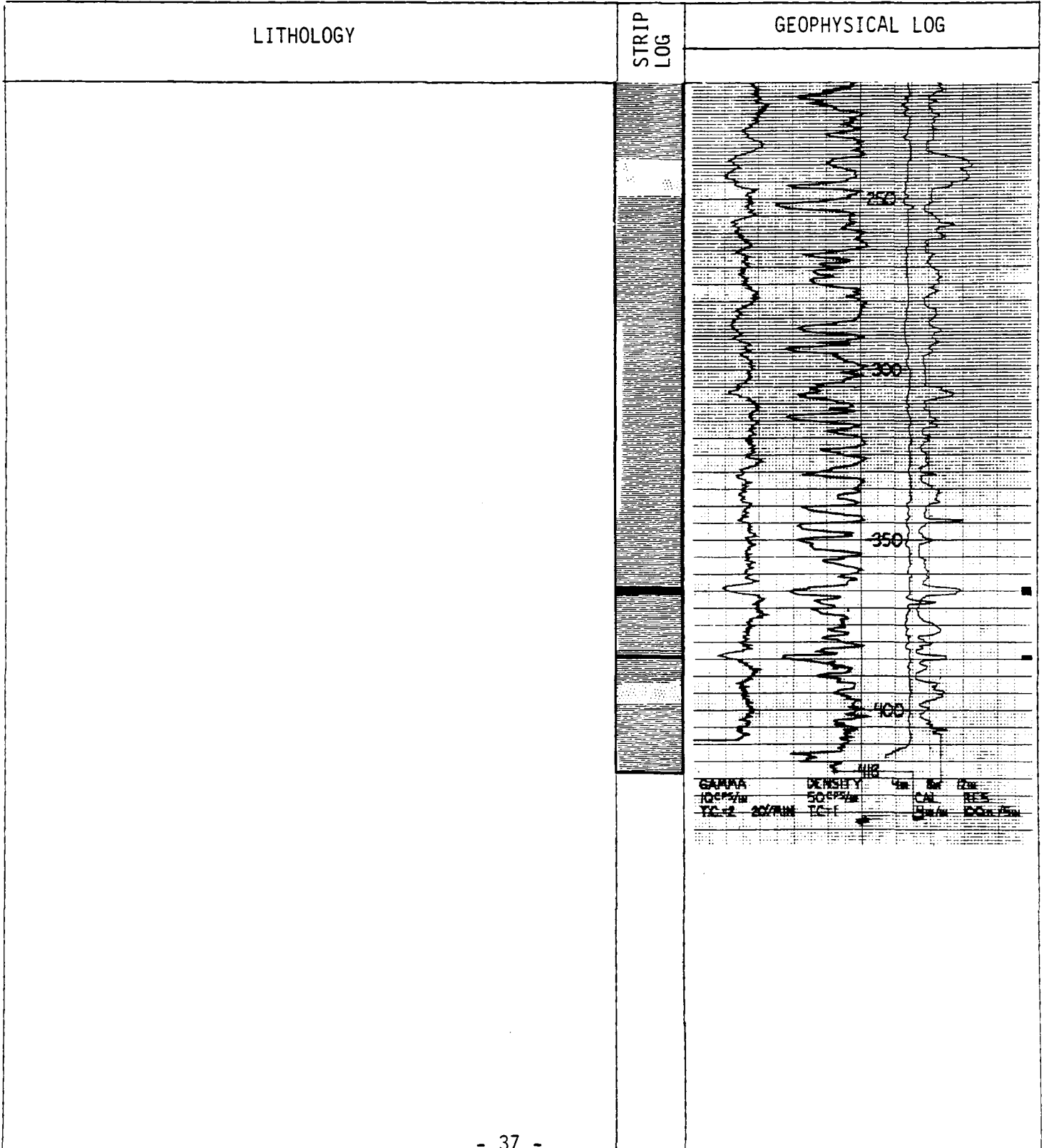
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Starsburg SW Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-9 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-10_c State Colorado County Arapahoe Date logged 12/4/79 Elev.(ft) 5857

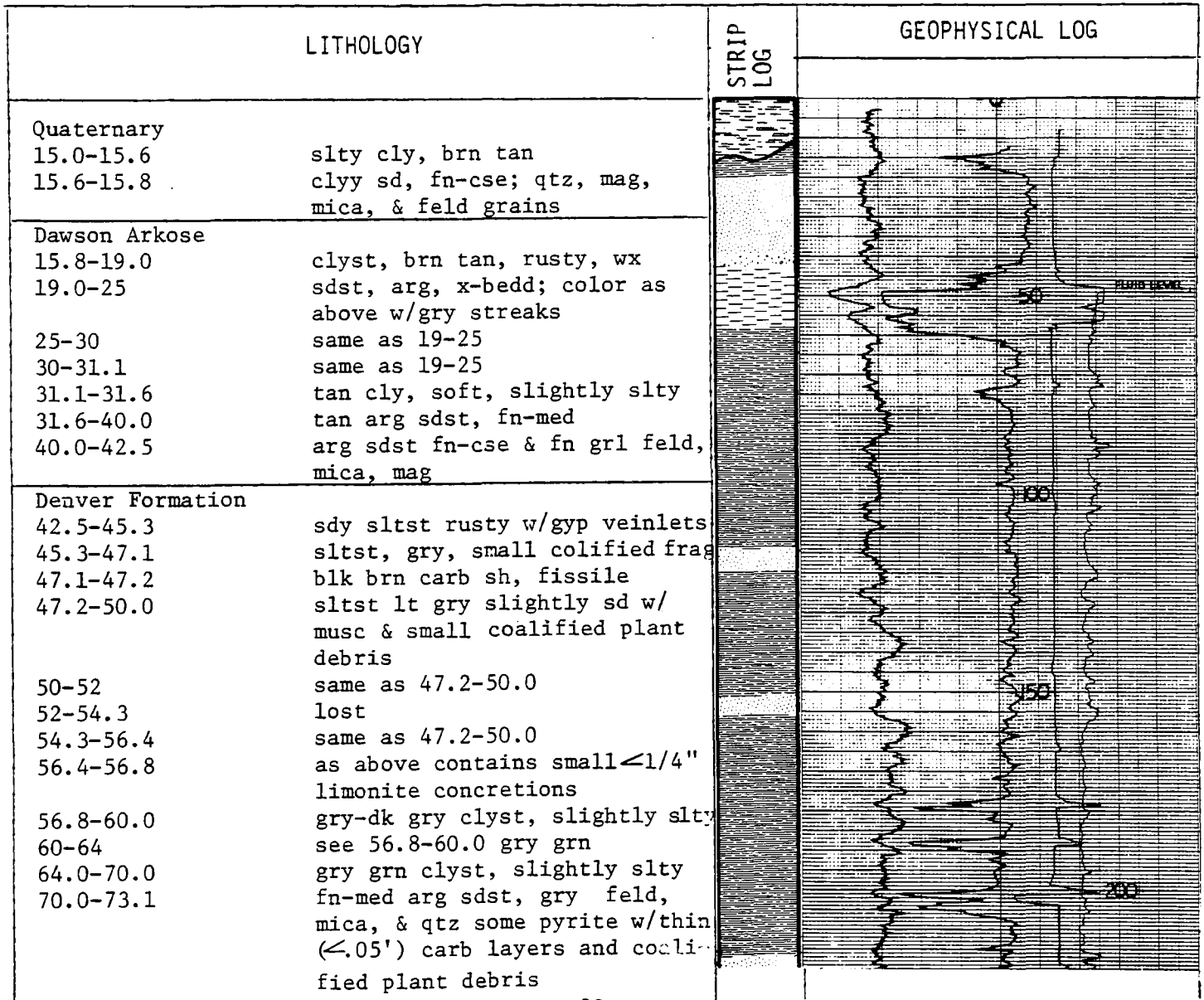
Location: T. 5 S., R. 65 W., secs. NWNE 8 Cored: X Yes No

Drilled depth Logged depth Drilling Medium Air Fluid level 49

Geophysical logs:

Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 125 ohms/in	Logging speed 20	fpm

Remarks: Cored 15'-382' and 384'-511.3'; Rotary 0-15', 382-384, and 511.3-620.
Surface casing to 15'. Coal Crk. Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10_c Continued

	LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
73.1-80.0	grn clyst blocky w/coalified plant debris increasing siltiness downward		
80.0-82.9	see 73.1-80.0		
82.9-83.9	as above, well fractured		
83.9-84.5	fn-med arg sd, gry well frac, micaceous		
84.5-86.5	gry grn clyst, slightly slty		
86.5-87.3	gry clyst, slightly slty		
87.3-91.4	fn-med arg sdst		
91.4-96.5	gry grn clyst, blocky texture lost		
96.5-103.1	lost		
103.1-106.5	see 91.4-96.5		
106.5-108.3	see 91.4-96.5 sdy gry		
108.3-109.8	clyst, slty, gry grn		
109.8-111.5	lost		
111.5-115.3	see 108.3-109.8		
115.3-116.9	brn carb cly w/grn clyst inclusions		
116.9-120.1	grn arg sdst fn-cse micaceous		
120.1-120.5	clyst slightly slty, gry		
120.5-125.8	see 120.1-120.5		
125.8-126.9	arg sdst, fn-cse, gry-grn becoming gry		
126.9-127.5	clyst, slty, gry		
127.5-127.7	lignite, greatly frac, hd blk		
127.7-130.8	clyst, slty, gry-gry grn		
130.8-135.6	see 127.7-130.8		
135.6-139.3	as above		
139.3-146.7	clyst, gry accas. slty		
146.7-152.6	gry grn, clyst occas slty		
152.6-155.5	arg sd fn-med, micaceous, grn		
155.5-156.0	grn clyst		
156.0-156.3	see 152.6-155.5		
156.3-157.0	grn clyst		
157.0-166.0	see 156.3-157 becoming gry, occas slty, well frac.		
166.0-166.4	see 157.0-166.0		
166.4-166.5	carb cly, dk brn contains coalified plant debris		
166.5-172.0	clyst slty gry grn		
172.0-172.6	clyst grn fissile		
172.6-173.2	brn carb clyst & coalified plt debris		
173.2-174.9	clyst w/slty lenses, grn		

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10c- Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG				
174.9-175.0	fn arg sdst, grn		STRIP LOG	520			
175.0-182.0	see 173.2-174.9	GAMMA 10 CPS/IN		DENSITY 50 CPS/IN	4 IN	8 IN	12 IN
182.0-183.7	clyst, grn	TC=2		20'/MIN.	TC=1	4 IN/IN	125 g/5IN
183.7-184.0	pulled off	CGS 10C					
183.7-184.0	clyst grn - picked up						
184.0-189.2	clyst grn						
189.2-190.2	fn arg sdst, grn						
190.2-190.7	clyst, grn						
190.7-193.7	pulled off						
190.7-192.7	clyst grn						
193.7-201.0	clyst grn						
201.0-208.8	clyst, grn, contains much coalified plant debris						
208.8-210.0	carb cly, brn						
210.0-210.7	see 208.8-210.0						
210.7-211.3	arg sdst, fn-cse w/coalified plant debris						
211.3-214.3	gry-gry brn clyst, slty much coalified plant debris						
214.3-216.7	gry grn clyst, slty much coalified plant debris						
216.7-218.3	carb cly, brn						
218.3-218.8	arg sdst, fn-cse, grn						
218.8-220.0	slty clyst, grn						
220.0-220.6	see 218.8-220.0						
220.6-222.5	arg sdst, feld qtz mica, fn-med						
222.5-224.9	clyst gry-grn coalified plant debris						
224.9-225.0	lignite, grd blk, attrital						
225.0-230	clyst, grn						
230.0-239.5	clyst, grn; lig .2' hd blk, carb cly; exact depth unknown						
239.5-245.0	gry grn clyst, slightly slty						
245.0-245.2	as above w/cpd						
245.2-250.0	arg sdst, fn-cse, gry; qtz, feld, mica						
250.0-254.3	see 245.2-250.0						
254.3-254.8	carb clyst, brn-drk brn						
254.8-255.2	see 245.2-250.0						
255.2-258.2	fn arg sdst, qtz w/thin clyst lenses containing cpd						
258.2-258.4	carb clyst, brn						
258.4-260	gry grn clyst, slty						
260.0-263.1	gry grn sltst						
263.1-263.2	carb cly, brn						
263.2-265.5	gry grn clyst						

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10_c- Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG
265.5-270.0	see 263.2-265.5 slty		
270.0-270.2	as above contains vfn-fn kaolin grains		
270.2-272.0	sltst w/clyst inclusion		
272.0-274.0	arg sdst, fn-cse, grn		
274.5-274.6	see 272.0-274.0		
274.6-274.9	lt brn sltst		
274.9-277.4	sltst, grn		
277.4-279.2	see 272.0-274.0		
279.2-279.8	lt brn, sltst		
279.8-284.0	see 272.0-274.0 contains coalified plant debris		
284.0-288.1	see 279.8-284.0		
288.1-288.4	lt brn sltst		
288.4-288.9	ucse sdst, qtz, feld, & mica		
288.9-290.5	arg sdst, qtz, gry grn		
290.5-291.4	sltst, slightly sdy, gry		
291.4-292.3	arg sdst, fn, gry grn, coalified plant debris		
292.3-294.0	lig, attrital, brn blk. badly		
294.0-297.7	see 292.3-294.0		
297.7-302	clyst, grn		
302.0-304.1	clyst, gry		
304.1-305.4	lignite, brn blk wood texture		
305.4-307.5	sdst, slightly slty gry		
307.5-308.8	lost		
308.8-312.6	slst, gry		
312.6-313.0	arg, sdst, qtz, vfn-med		
313.0-313.3	carb cly, brn		
313.3-314.0	clyst, slty lt gry		
314.0-318.2	clyst becoming less slty, becoming gry grn		
318.2-318.3	lig, hrd, brn blk, attrital		
318.3-323.6	clyst, gry grn		
323.6-324.0	arg sdst, fn-med, qtz, mica, & feld		
324.0-324.2	see 323.6-324.0		
324.2-328.0	gry grn clyst, blocky texture		
328.0-334.0	sltst, gry grn		
334.0-335.2	see 328.0-334.0		
335.2-336.4	sdst, vfn-fn, well cemented calc		
336.4-341.6	sltst, gry grn w/thin clyst lenses		
341.6-342.6	clyst gry grn		
342.6-344.0	arg sdst, fn-md, qtz		

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10_c- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
0-1.3		
1.3-2.5		
348-353.2		
353.2-354.6		
354.6-358.0		
358.0-359.0		
359.0-361.0		
361.0-361.2		
361.2-363.9		
363.9-367.5		
367.5-368.0		
368.0-368.3		
368.3-369.2		
369.2-375.9		
375.9-378.0		
378.0-382.0		
382-384		
384.0-385.6		
385.6-385.9		
385.9-391.0		
391.0-393.8		
393.8-395.1		
395.1-395.5		
395.5-395.7		
395.7-396.1		
396.1-398.0		
398.0-398.9		
398.9-399.5		
399.5-400.3		
400.3-401.1		
401.1-401.7		
401.7-405.0		
408.0-415.0		
415.0-416.9		
416.9-417.1		
417.1-417.6		
417.6-421.6		

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10_c- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
421.6-422.6 carb sh, lignitic, contains kaolin xtals		
422.6-425.0 see 416.9-417.1		
425.0-434.3 clyst, gry, blocky		
434.3-434.6 lig, reworked w/sdy carb cly		
434.6-434.9 lignite, hard, brn blk, attrital		
434.9-435.0 kaolin split w/ kao. frag (1mm)rd		
435.0-435.8 lignite, reworked w/carb cly brn & kaolin		
435.8-436.1 see 434.6-434.9		
436.1-436.9 reworked lig w/carb cly brn; kaolin		
436.9-437.9 reworked lig w/carb cly brn; kaolin		
437.9-438.8 lig hd blk frac woody texture "vitrinous"		
438.8-438.9 carb cly, brn		
438.9-438.9 see 436.1-436.9		
438.9-439.4 See 436.1-436.9 lignite		
439.4-439.6 see 436.1-436.9		
439.6-439.9 lignite brn blk frac attrital		
439.9-440.0 see 436.1-436.9 micaceous		
440.0-440.6 lig brn blk frac attrital		
440.6-441.9 see 436.1-436.9		
441.9-442.1 carb cly ligic dul brn		
442.1-445.0 lignite brn blk att. contains thin ($\leq 05'$) sdy kaol splits		
445.0-447.0 see 442.1-445.0		
447.0-447.2 lignite brn blk		
447.2-447.7 see 436.1-436.9 sdy		
447.7-448.0 lignite hard blk frac wood "vitrinous"		
448.0-448.2 lignite brn blk attrital		
448.2-449.9 lignite brn blk attrital frac		
449.9-450.1 see 436.1-436.9 sdy		
450.1-450.8 lignite brn blk att frac		
450.8-450.9 see 436.1-436.9		
450.9-452.4 lig hd blk well frac		
452.4-453.7 lignite interbed w/thin ($\leq 01'$) kaol & cly splits		
453.7-454.1 vfn sd slty gry		
454.1-454.2 pyrite & marcasite nodules (.1')		
454.2-455.0 clyst dk gry		
455.0-455.5 see 454.2-455.0		
455.5-456.1 vfn arg sd		
456.1-465.3 gry slst w/thin (.05') clyst lenses		

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10c- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
?-?		
475.0-484		
484.0-484.5		
484.5-487.4		
487.4-488.3		
488.3-488.9		
488.9-488.95		
488.95-489.3		
489.3-494.0		
494.0-497.0		
497.0-507.3		
503.4-504.1		
507.3-511.1		
511.1-511.3		

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-11 State Colorado County Arapahoe Date logged 12/14/79 Elev. (ft) 5867

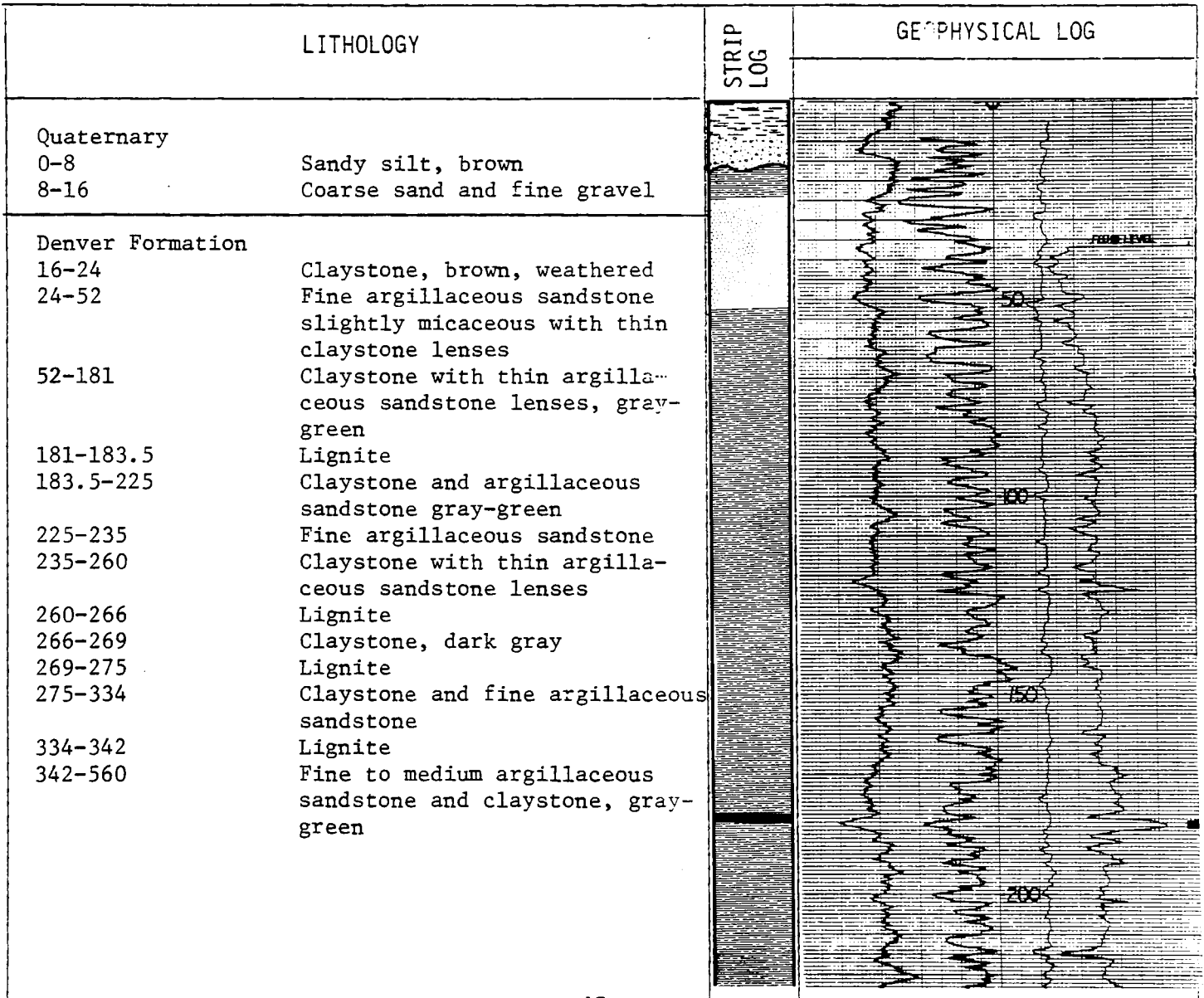
Location: T. 5 S., R. 64 W., secs. SESE 16 Cored: Yes No X

Drilled depth 560 Logged depth 558 Drilling Medium mud Fluid level 37

Geophysical logs:

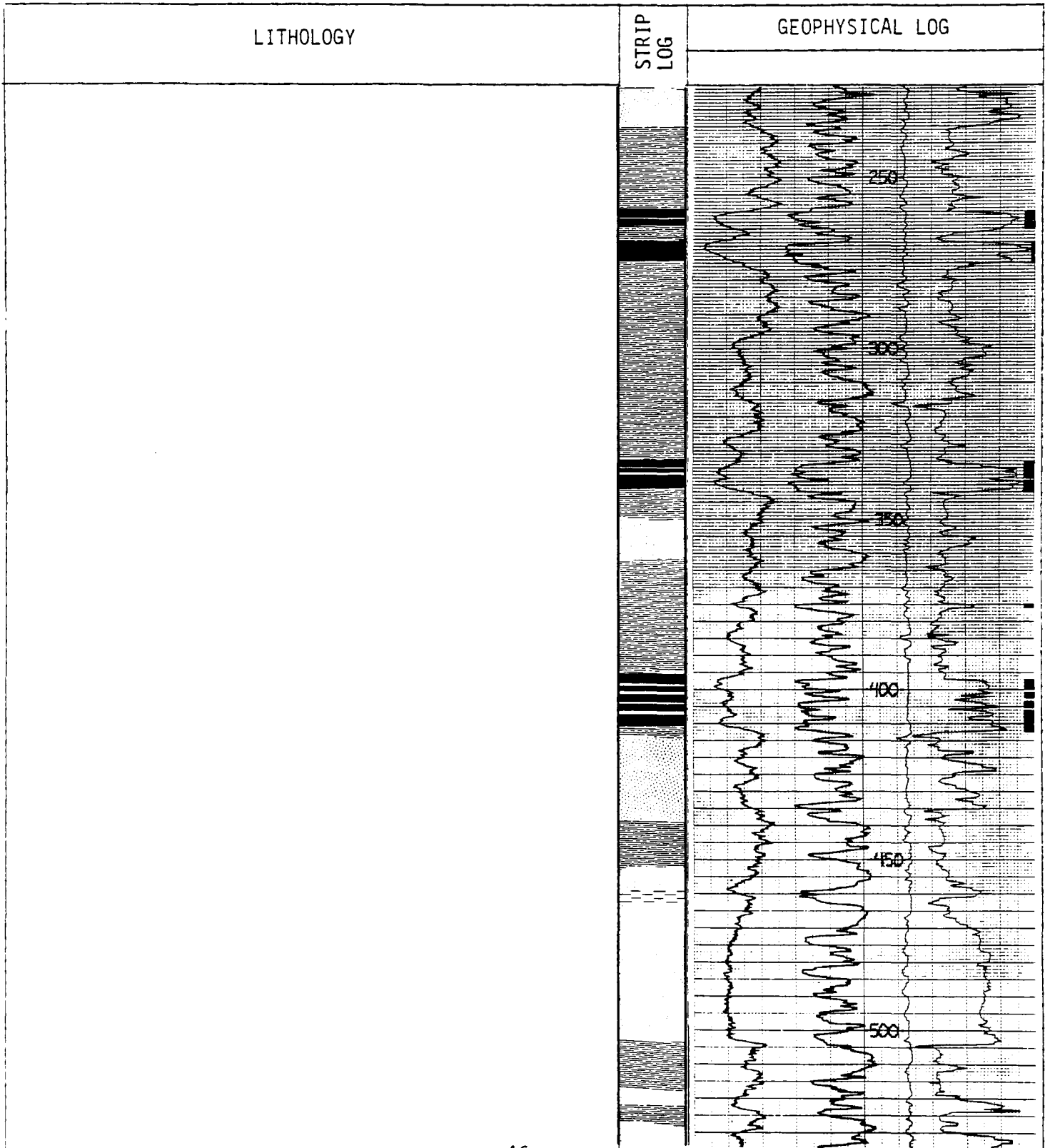
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle



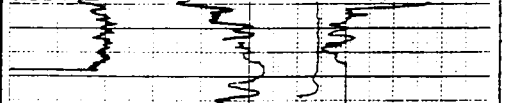
COLORADO GEOLOGICAL SURVEY

Hole No. CGS-11- Continued



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-11 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		 <p> GAMMA 10 CPS/IN TC: 2 20%/MIN DENSITY 50 CPS/IN TC: 1 CAL 4 IN 4 IN RES 100 IN 5 IN </p> <p>CGS-11</p>

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-13 State Colorado County Elbert Date logged 12/13/79 Elev.(ft) 6057

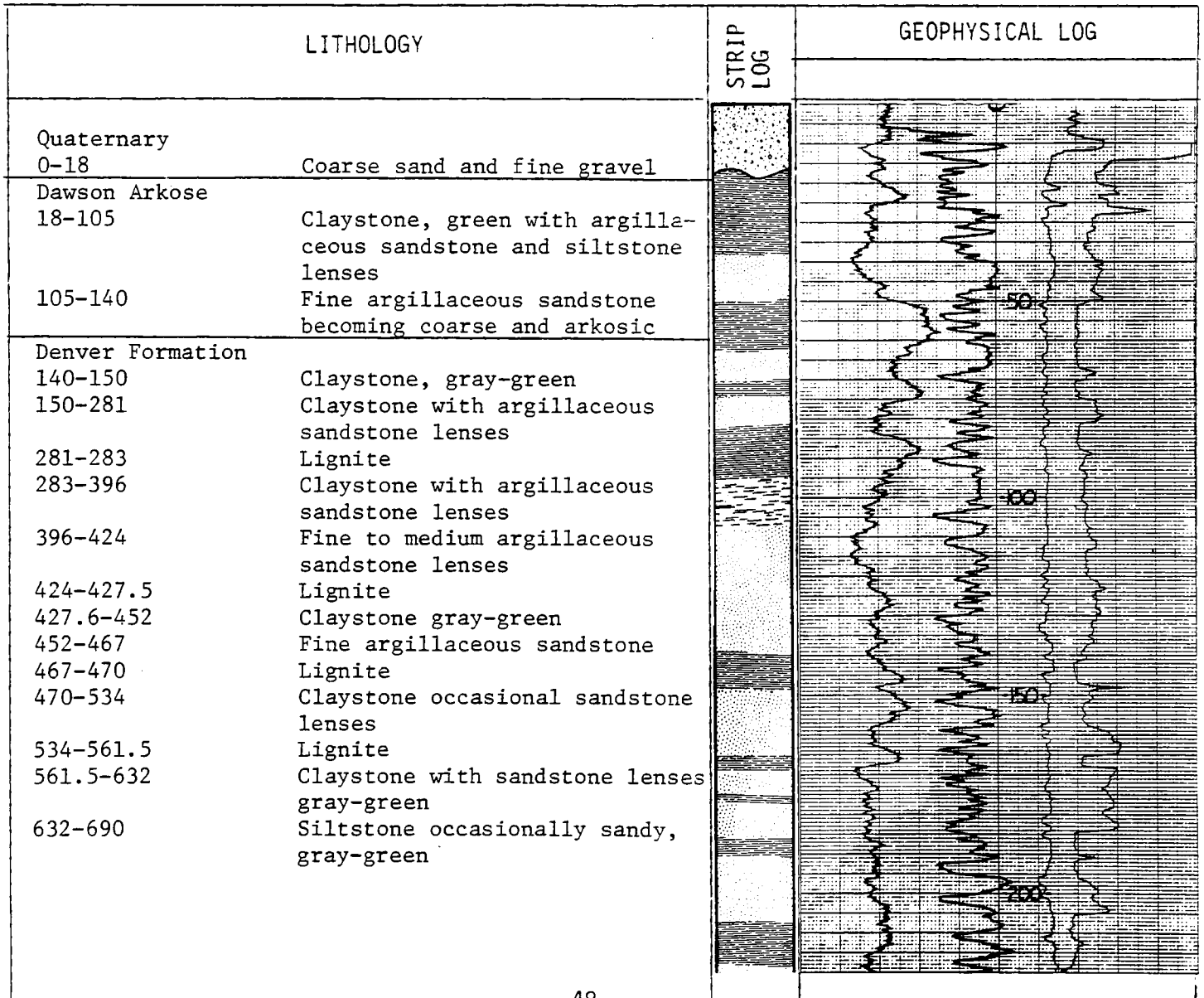
Location: T. 6 S., R. 64 W., secs. NWSW 15 Cored: Yes No X

Drilled depth 690 Logged depth 690 Drilling Medium mud Fluid level 13

Geophysical logs:

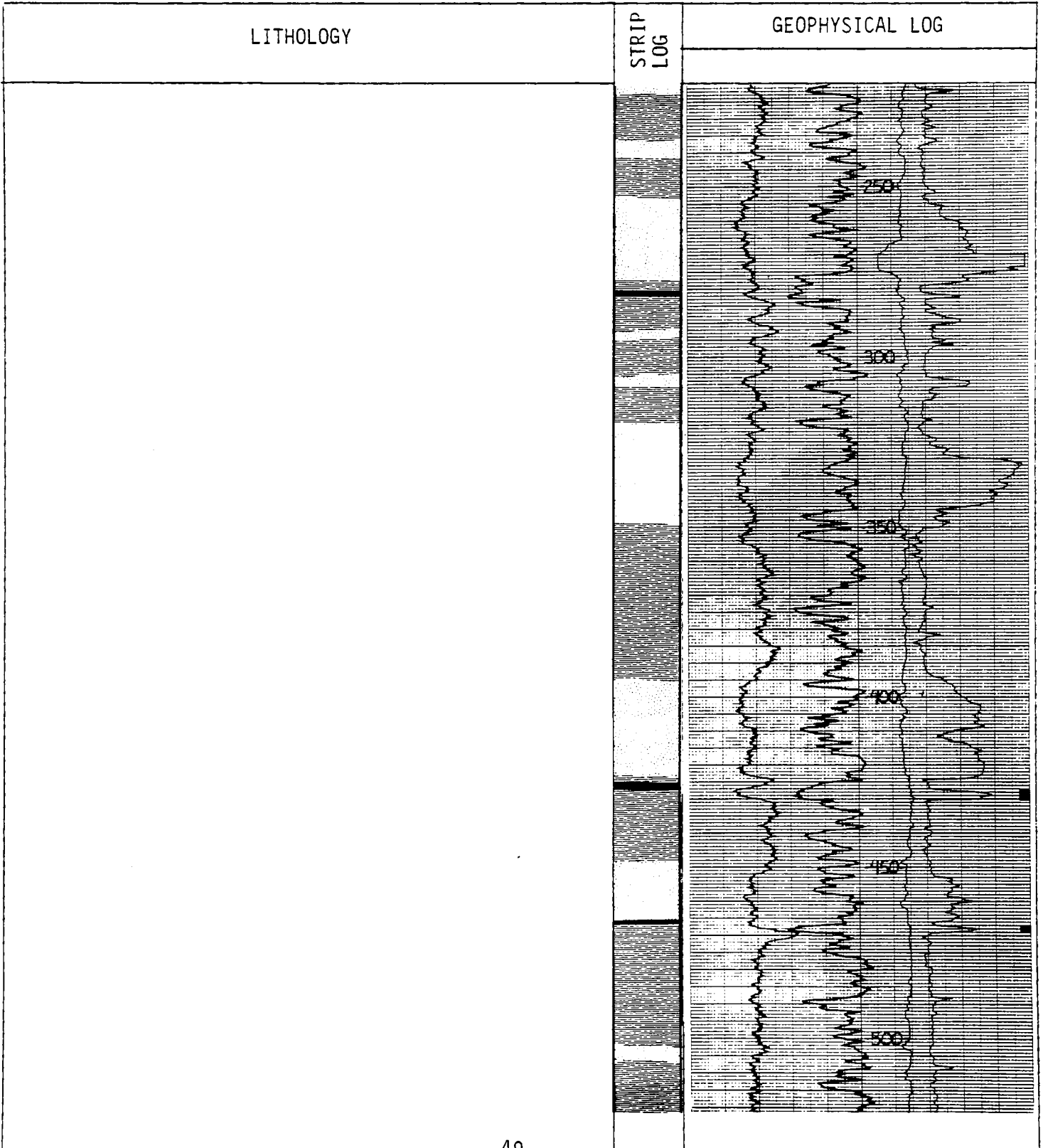
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-13- Continued



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-13 - Continued

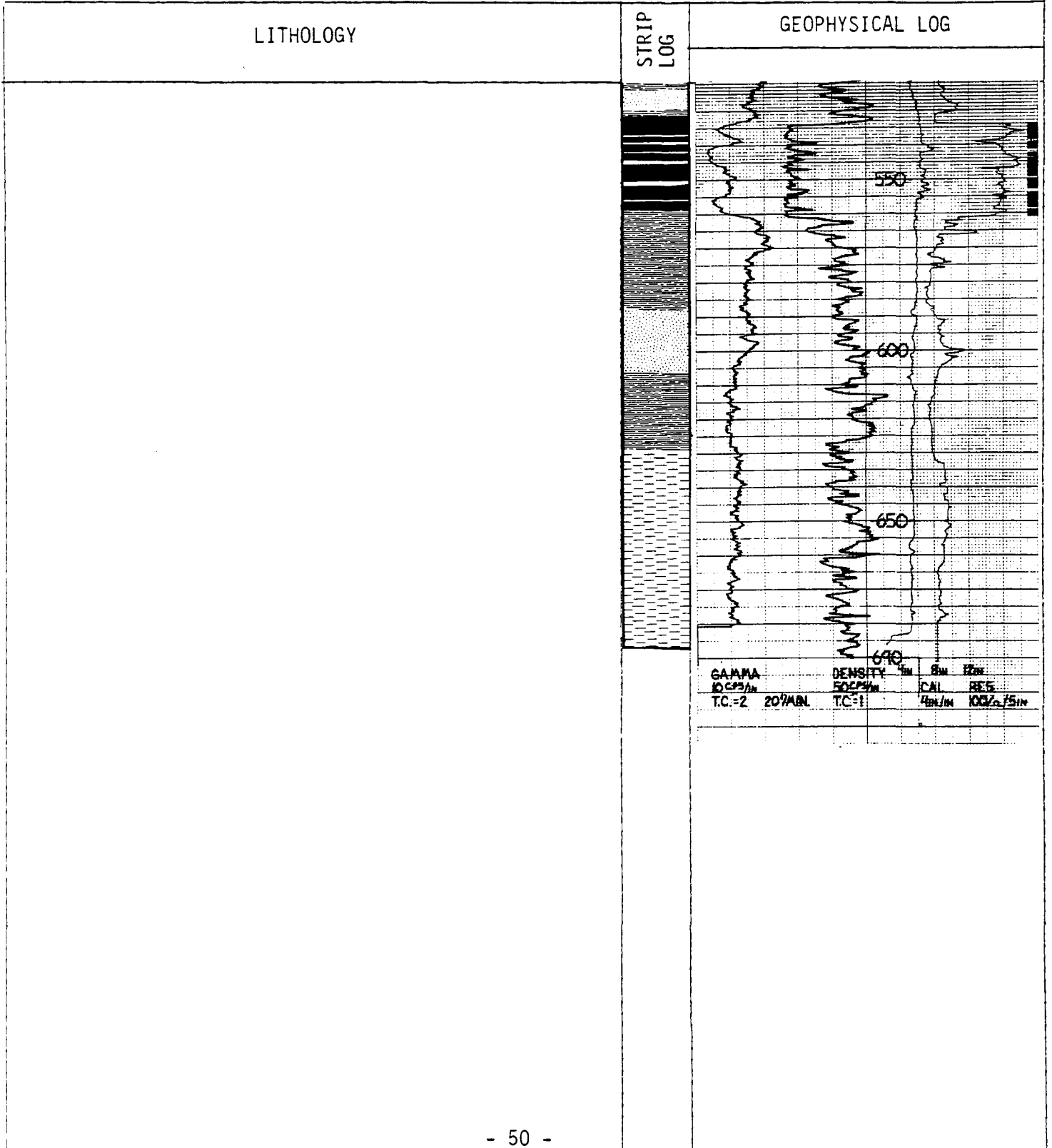


TABLE 5

LIQUID PERMEABILITY DATA
CGS-10_c

Type of Liquid: De-ionized Water

Viscosity, cp.: 0.93 at 74°F

<u>Sample Number</u>	<u>Depth</u>	<u>Porosity</u>	<u>Permeability, Millidarcys</u>				<u>Liquid/Air Permeability Ratio</u>
			<u>To Air</u>		<u>To Liquid</u>		
				<u>K</u>		<u>K</u>	
2	247.5	35.7	515	9.27	138	2.48	0.267
3	285	33.3	165	2.97	31	0.56	0.188
4	411	31.8	209	3.76	21	0.38	0.100

1 darcy = 18.2K

Each core plug was leached of salt with methyl alcohol, and dried at 180°F. Air permeabilities and porosities were determined on the clean and dried core plugs. The core plugs were evacuated and pressure saturated with de-ionized water. Water permeability was then measured.

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-14b State Colorado County Elbert Date logged 12/12/79 Elev.(ft) 6085

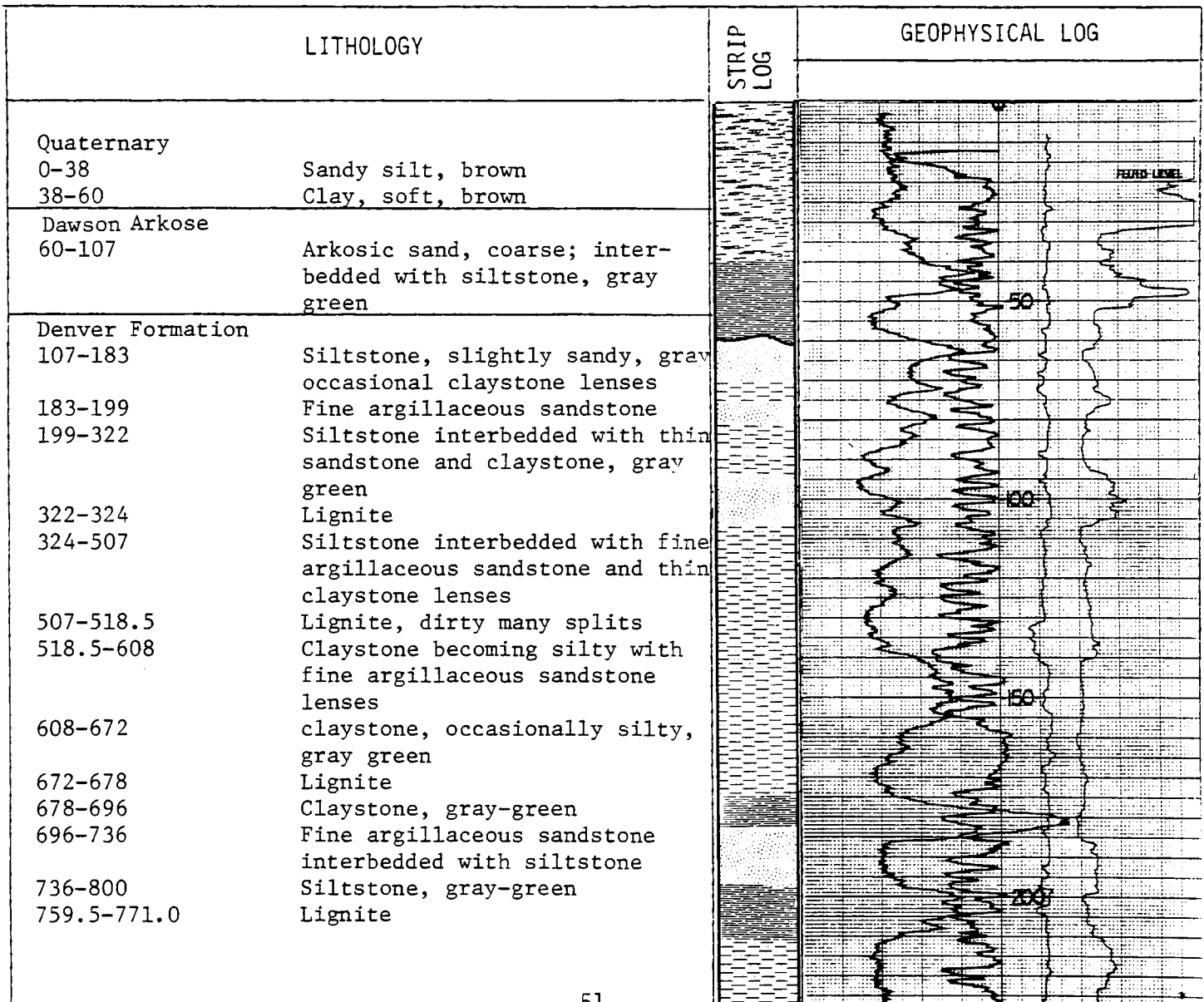
Location: T. 6 S., R. 65 W., secs. SWSE 12 Cored: Yes No X

Drilled depth 800 Logged depth 798 Drilling Medium mud Fluid level 19

Geophysical logs:

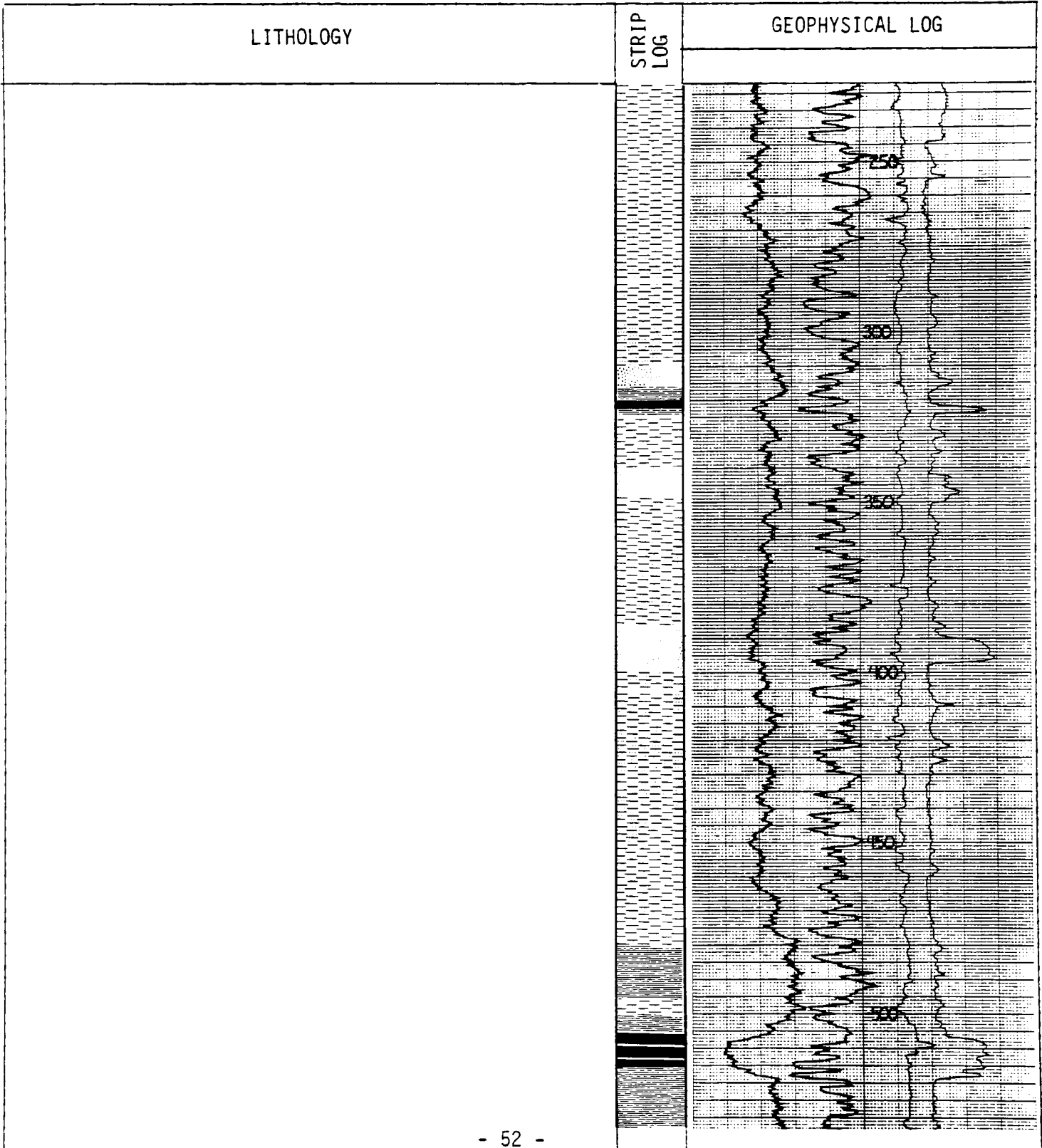
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: CGS 14a drilled with air; hole failed. Watkins SE Quadrangle.



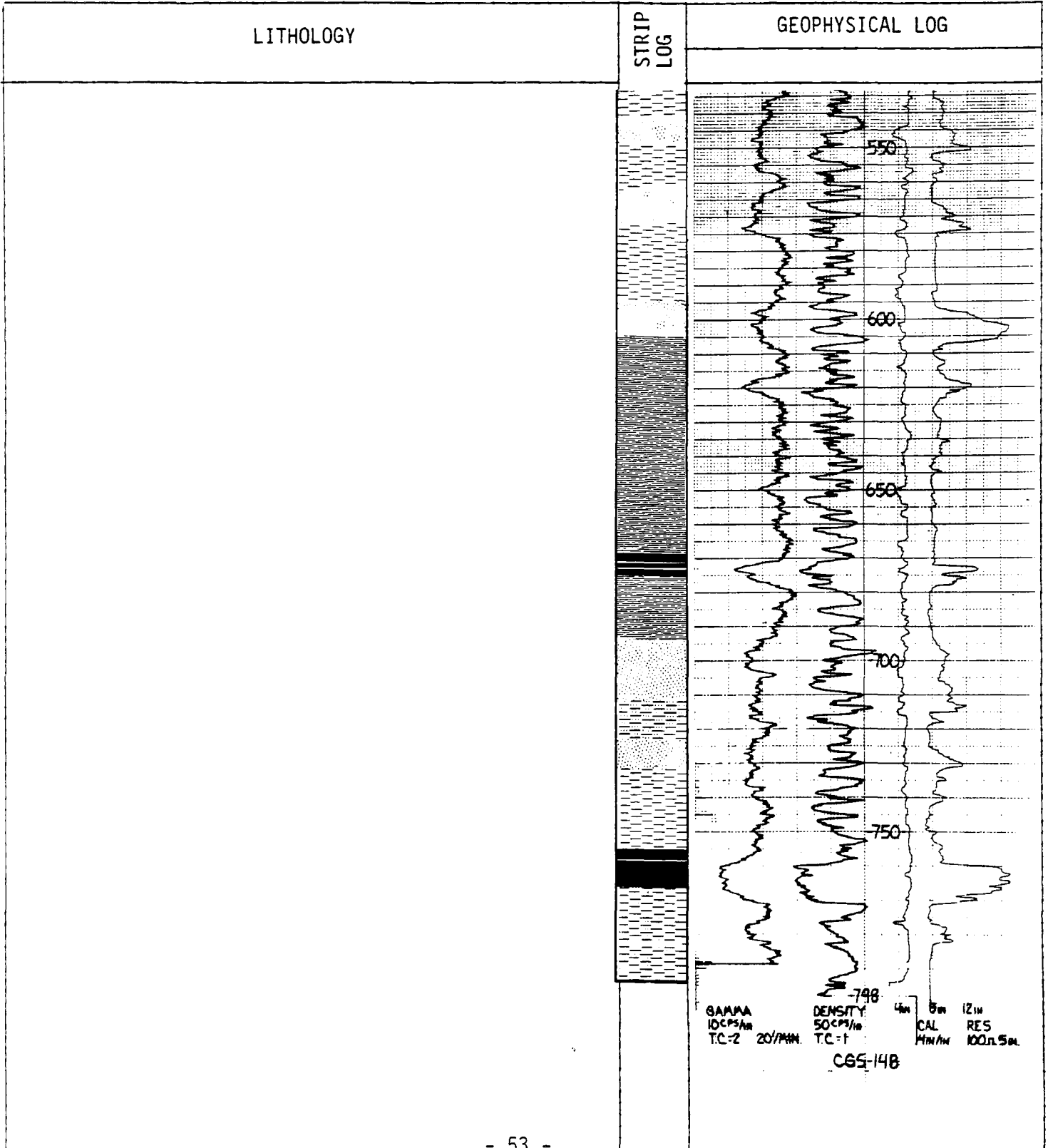
COLORADO GEOLOGICAL SURVEY

Hole No. CGS-14b- Continued



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-14b- Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-15 State Colorado County Arapahoe Date logged 12/15/79 Elev.(ft) 5937

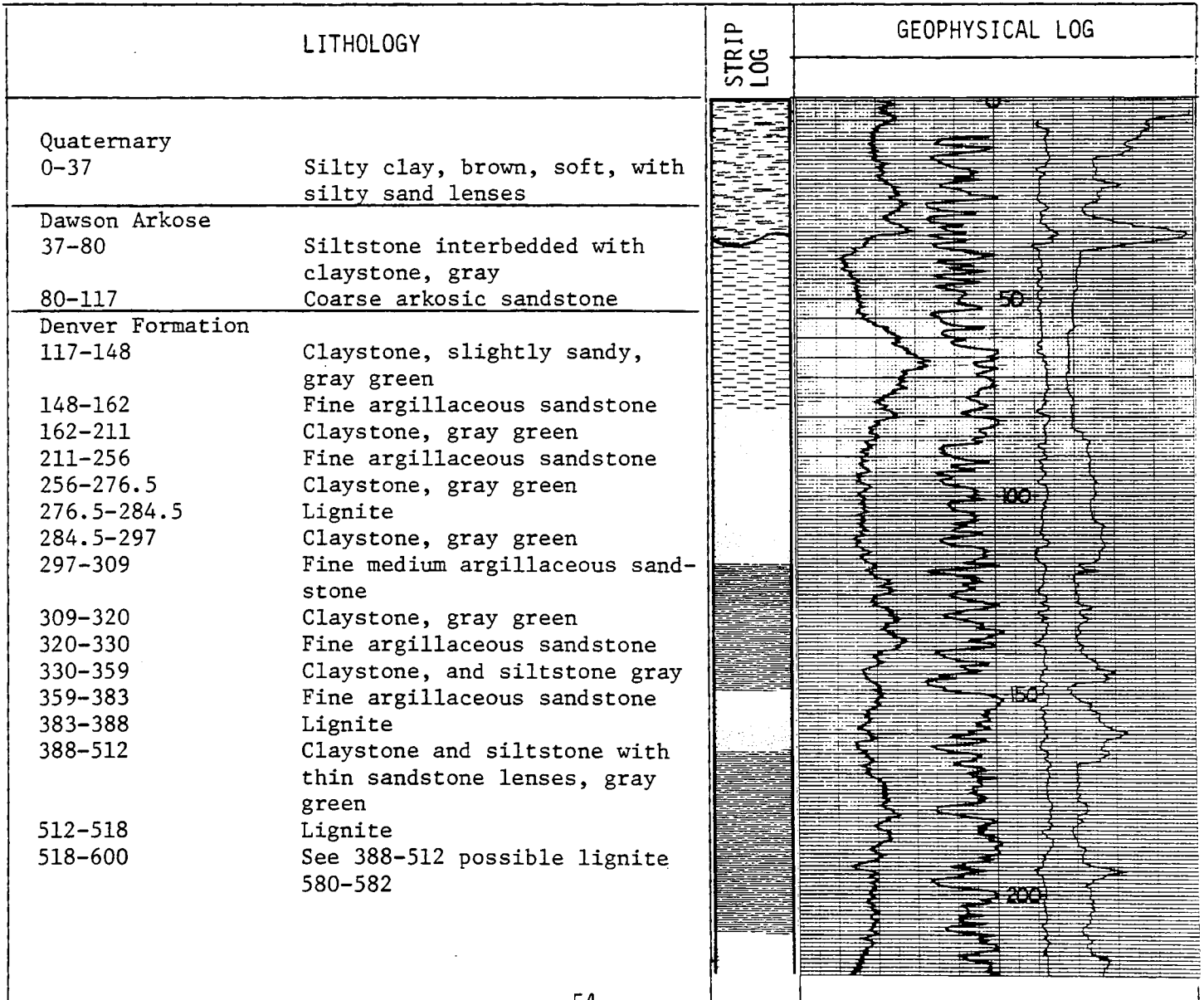
Location: T. 5 S., R. 64 W., secs. SWSE 25 Cored: Yes NoX

Drilled depth 600 Logged depth 594 Drilling Medium mud Fluid level 4

Geophysical logs:

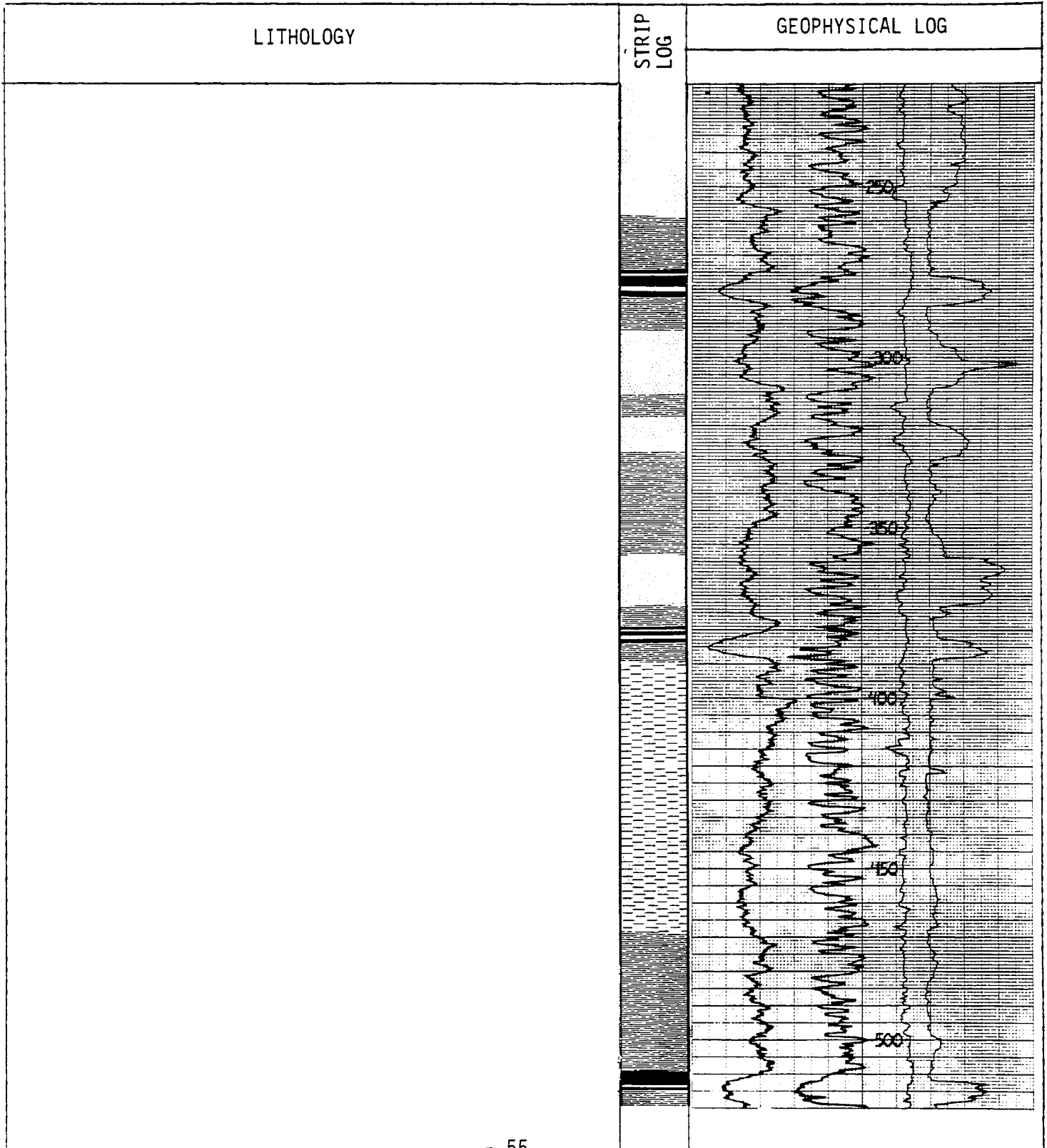
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-15 - Continued



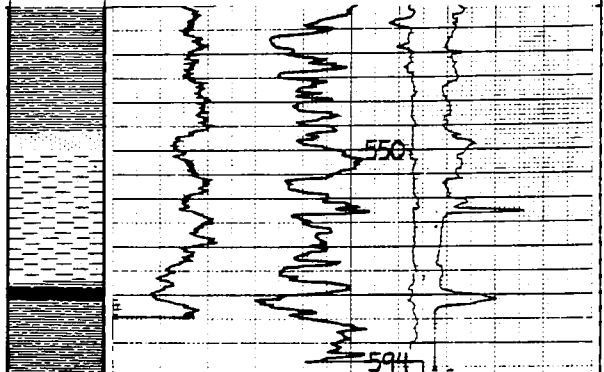
COLORADO GEOLOGICAL SURVEY

Hole No. CGS-15 - Continued

LITHOLOGY

STRIP
LOG

GEOPHYSICAL LOG



GAMMA	DENSITY	4in	8in	12in
10 CPS/IN	50 CPS/IN		CAL.	RES.
T.C.=2	20/MIN	T.C.=1	4in/IN.	100.00/5IN.

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-16 State Colorado County Arapahoe Date logged 12/16/79 Elev. (ft) 5543

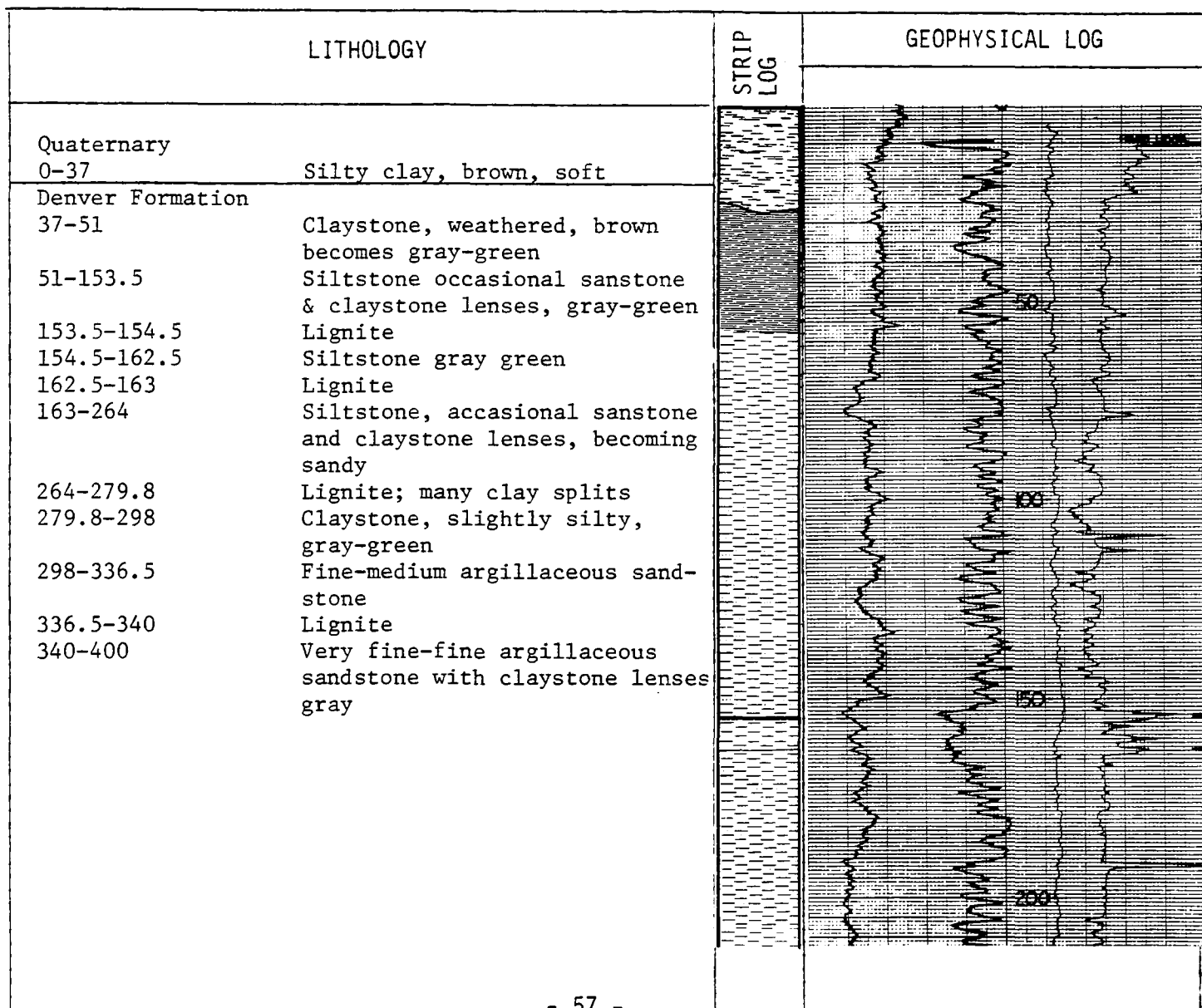
Location: T. 4 S., R. 66 W., secs. SENE 12 Cored: Yes No X

Drilled depth 400 Logged depth 399 Drilling Medium mud Fluid level 11

Geophysical logs:

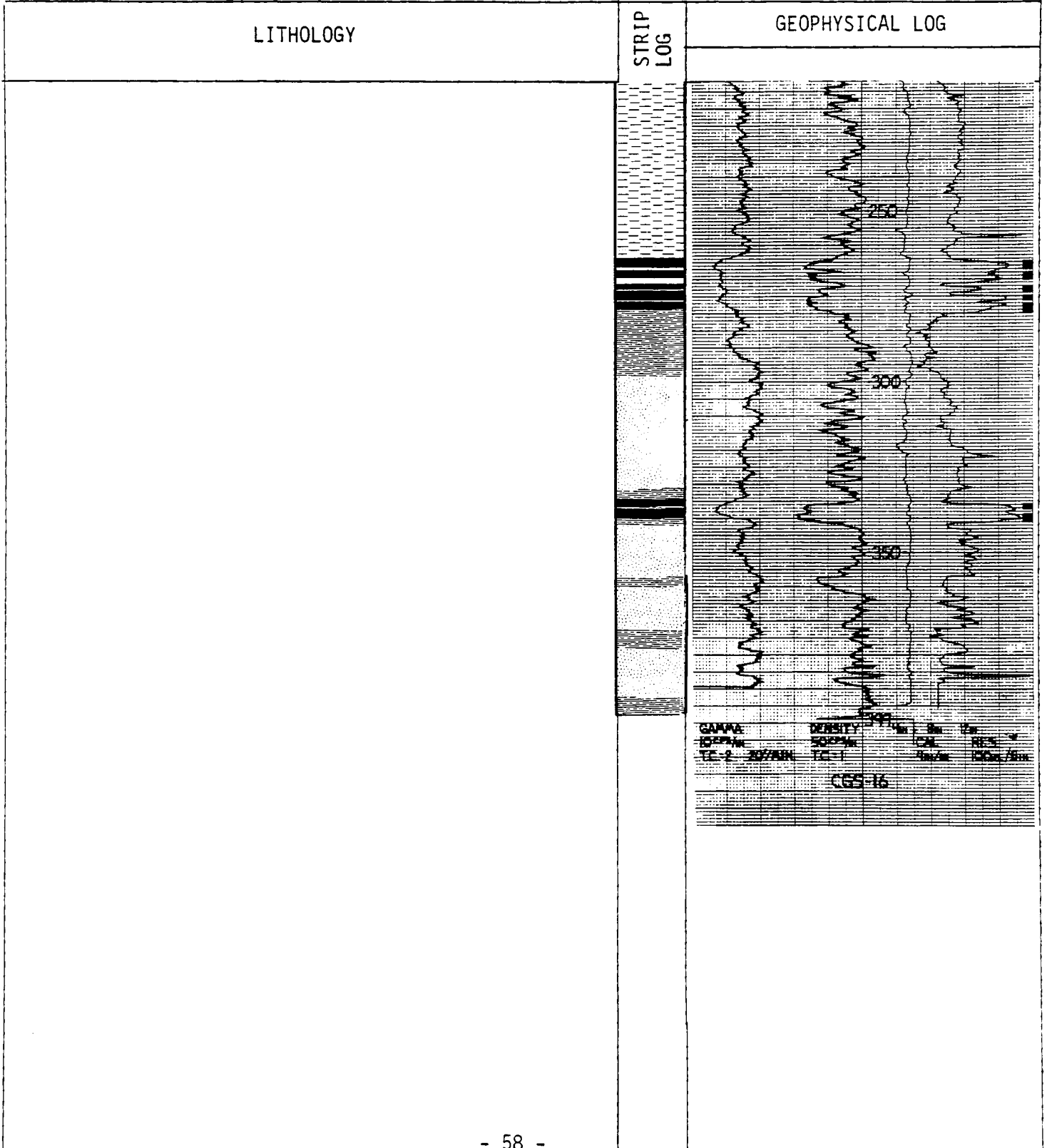
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Coal Creek Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-16 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-18 State Colorado County Arapahoe Date logged 12/15/79 Elev.(ft) 5826

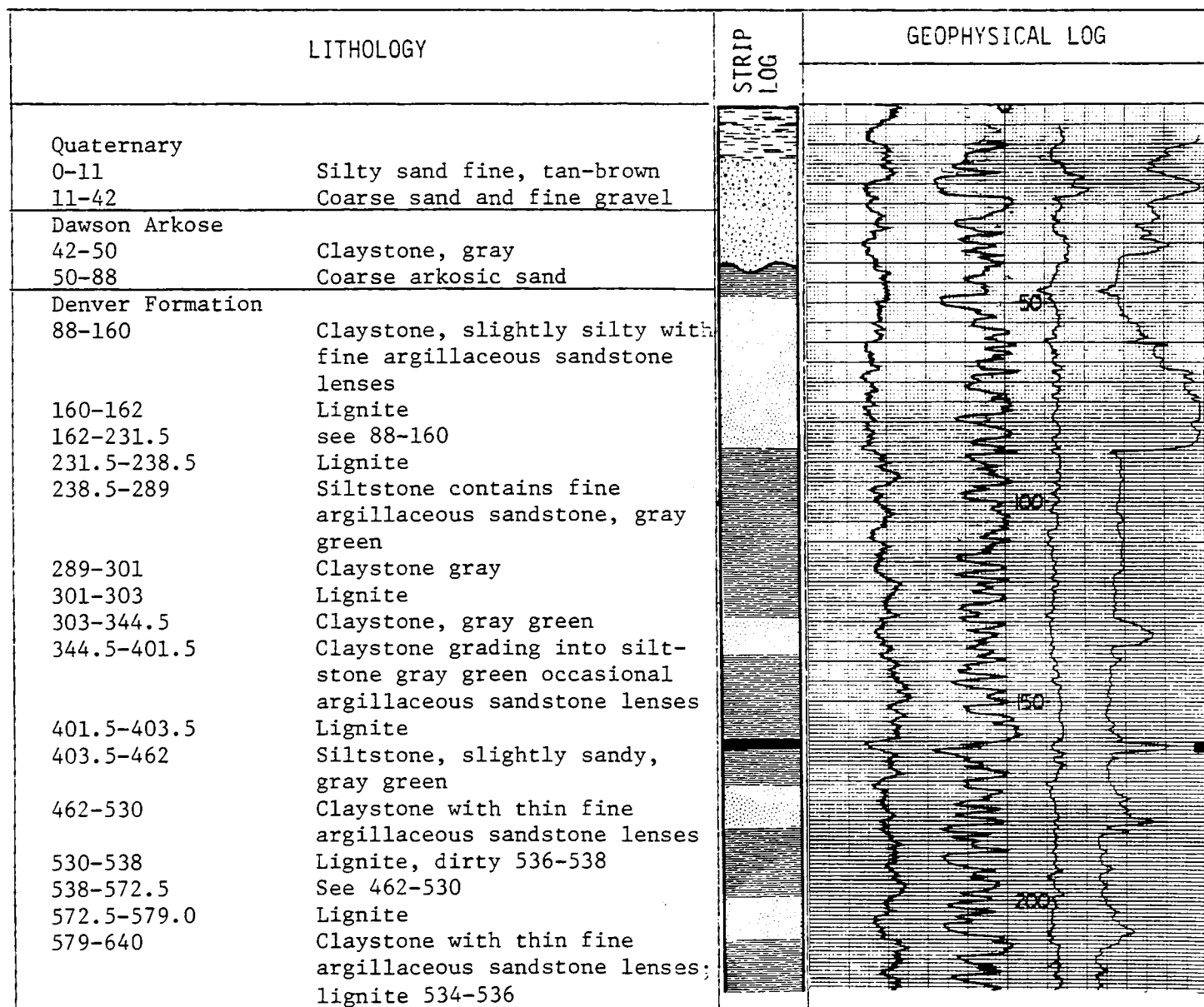
Location: T. 5 S., R. 65 W., secs. SWNW 13 Cored: Yes No X

Drilled depth 640 Logged depth 638 Drilling Medium mud Fluid level 9

Geophysical logs:

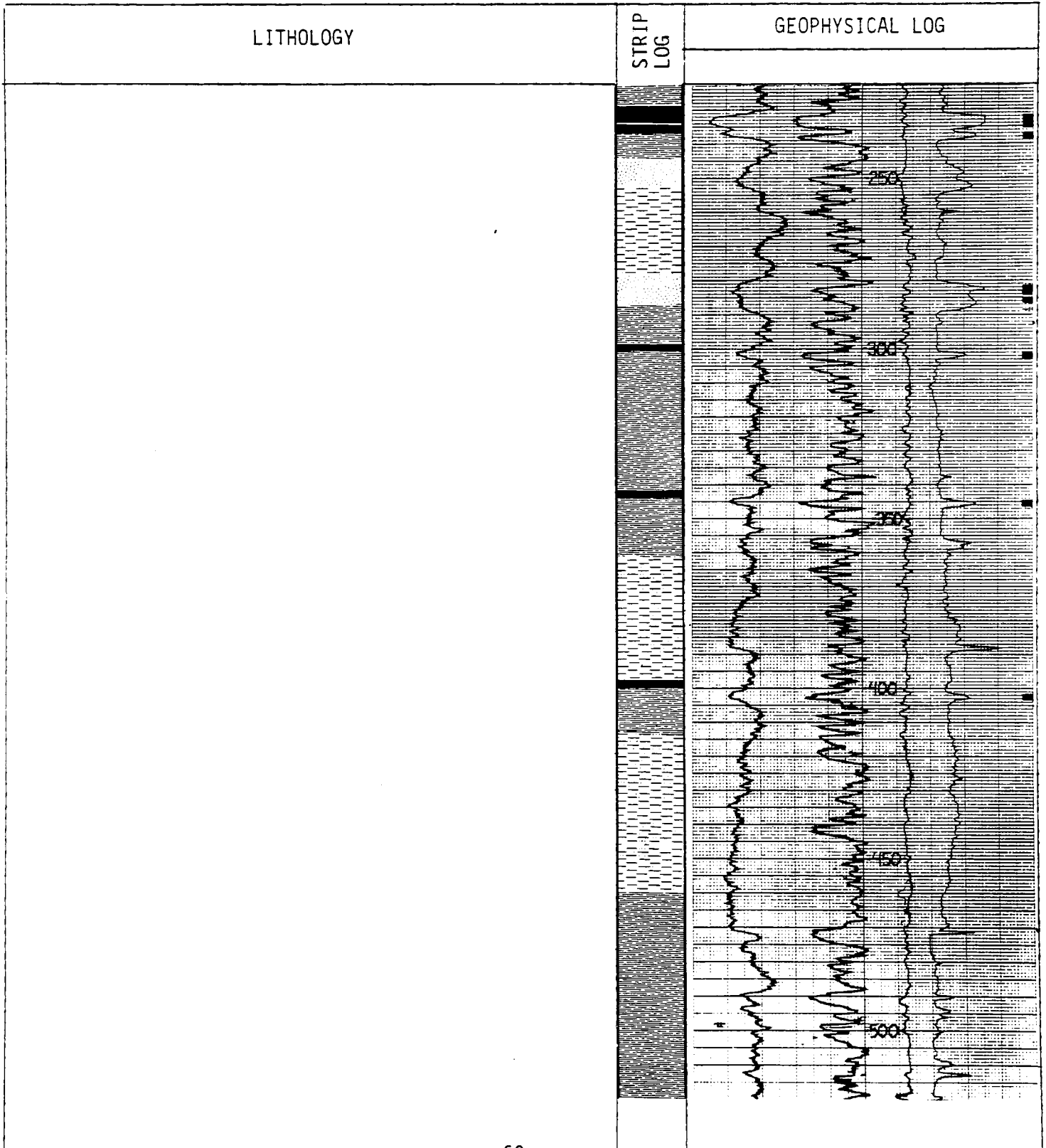
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. L	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle.



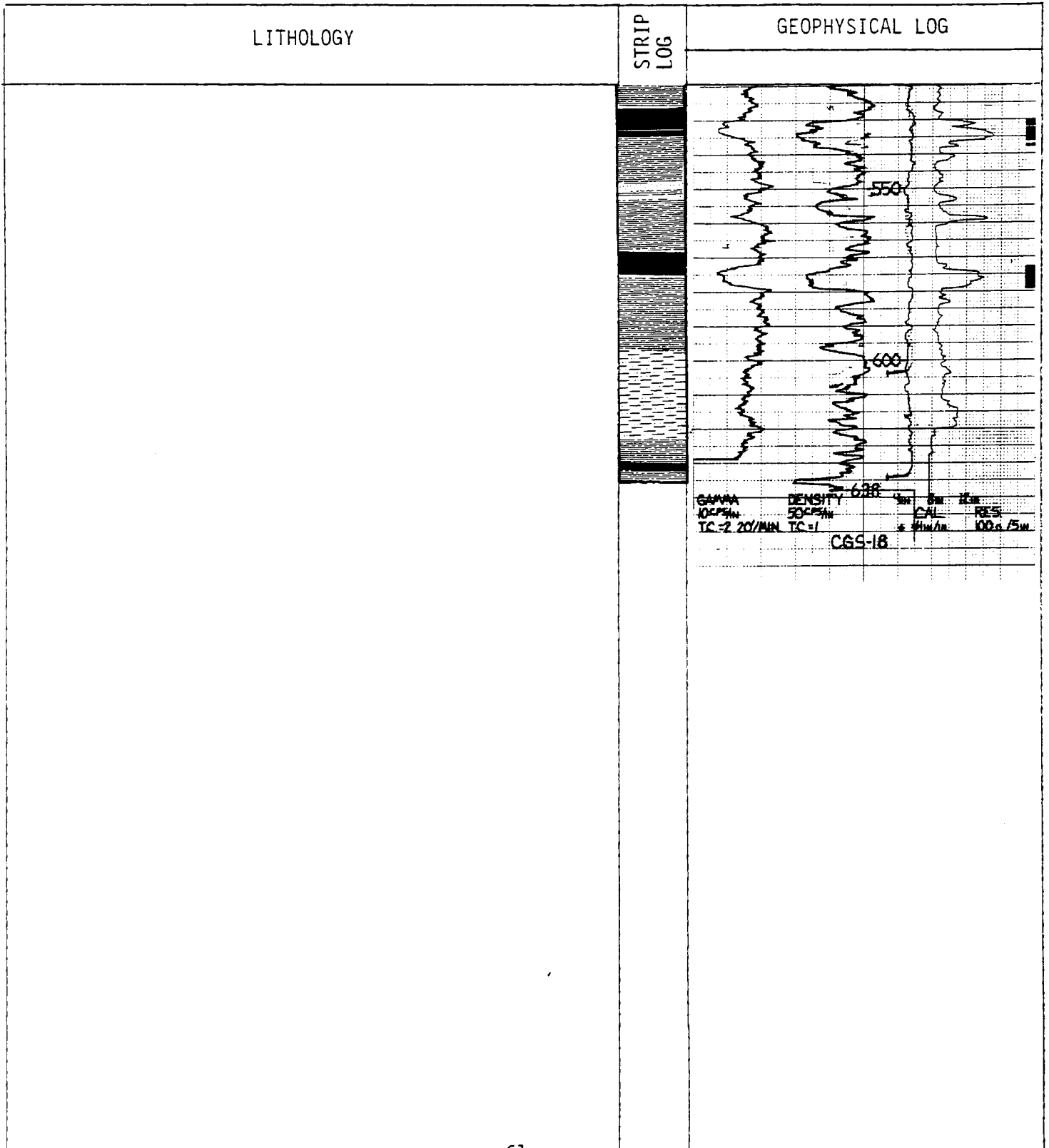
COLORADO GEOLOGICAL SURVEY

Hole No. CGS-18- Continued



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-18- Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-19 State Colorado County Adams Date logged 12/17/79 Elev.(ft) 5290

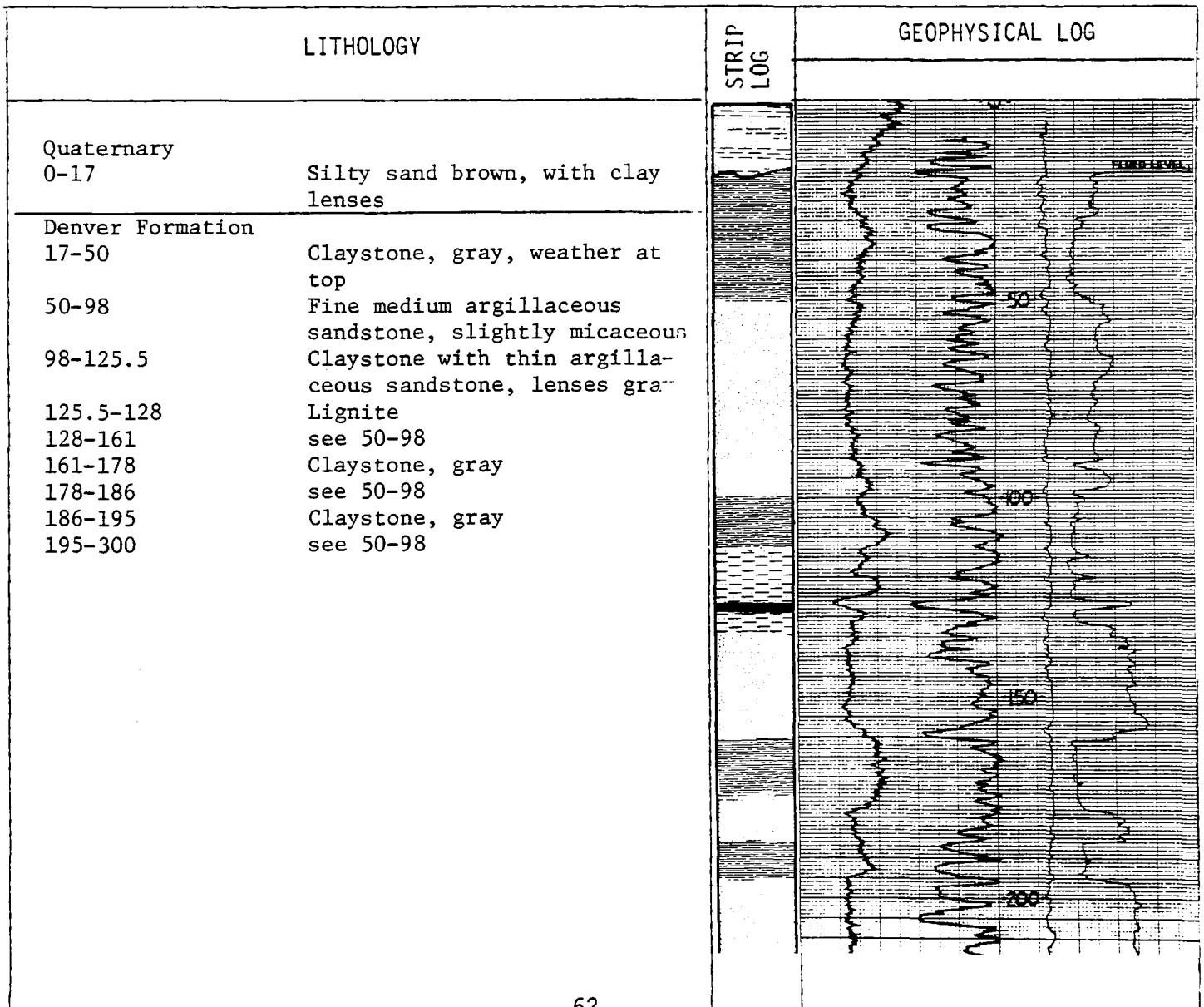
Location: T. 2 S., R. 65 W., secs. SWSE 20 Cored: Yes No X

Drilled depth 30 Logged depth 299 Drilling Medium mud Fluid level 18

Geophysical logs:

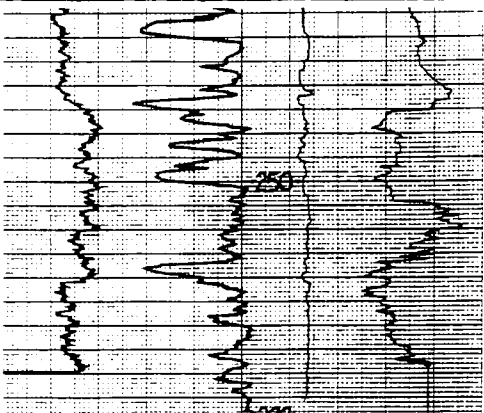
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Box Elder School Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-19 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		 <p> <small> GAMMA DENSITY RESISTIVITY TC-2 ZEPHYRUS TC-1 CAL RES CGS-19 </small> </p>

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-21 State Colorado County Adams Date logged 12/17/79 Elev. (ft) 5343

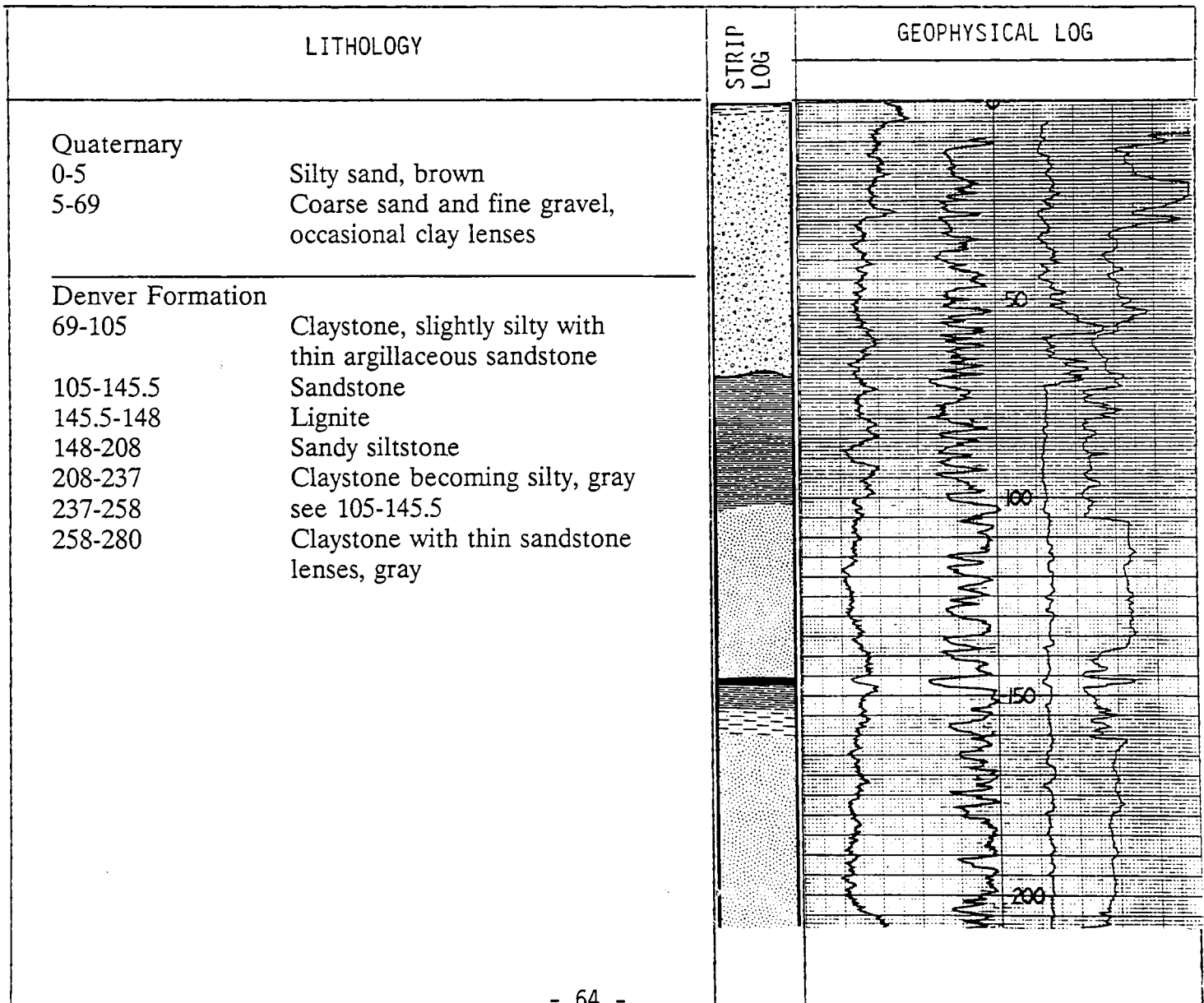
Location: T. 2 S., R. 65 W., secs. NWNW 36 Cored: Yes No X

Drilled depth 280 Logged depth 279 Drilling Medium mud Fluid level 9

Geophysical logs:

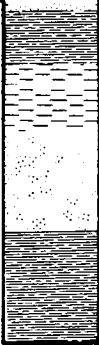
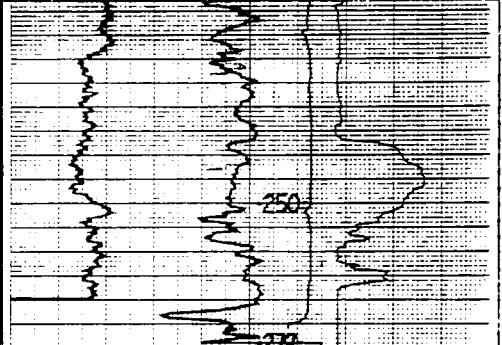
Gamma (G):	T.C. 2	Scale	10 cps/in	Logging speed	20	fpm
Density (DEN)	T.C. 1	Scale	50 cps/in	Logging speed	20	fpm
Caliper (C):		Scale	4 in/in	Logging speed	20	fpm
Resistance (Res):		Scale	100 ohms/5in	Logging speed	20	fpm

Remarks: Manila Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-21- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG			
					
		GAMMA KC-2 TC-2 207MIN	DENSITY 502 TC-1	4m 5m 12m CAL 4m/1m	RES 100m/5m
		CGS-21			

COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-23 State Colorado County Elbert Date logged 11/18/79 Elev. (ft) 5985

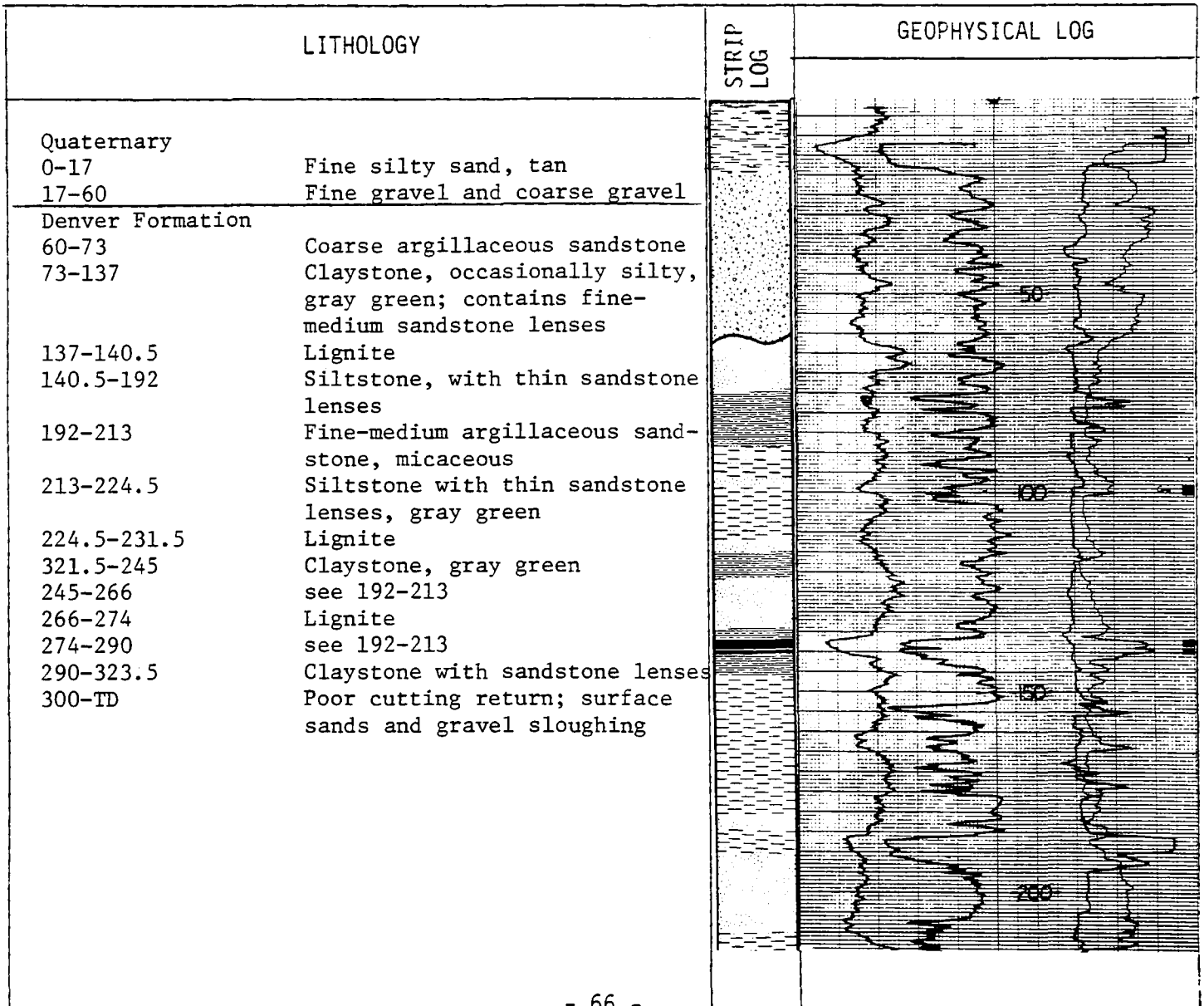
Location: T. 6 S., R. 63 W., secs. SENW 22 Cored: Yes No X

Drilled depth 495 Logged depth 489 Drilling Medium Air Fluid level 12

Geophysical logs:

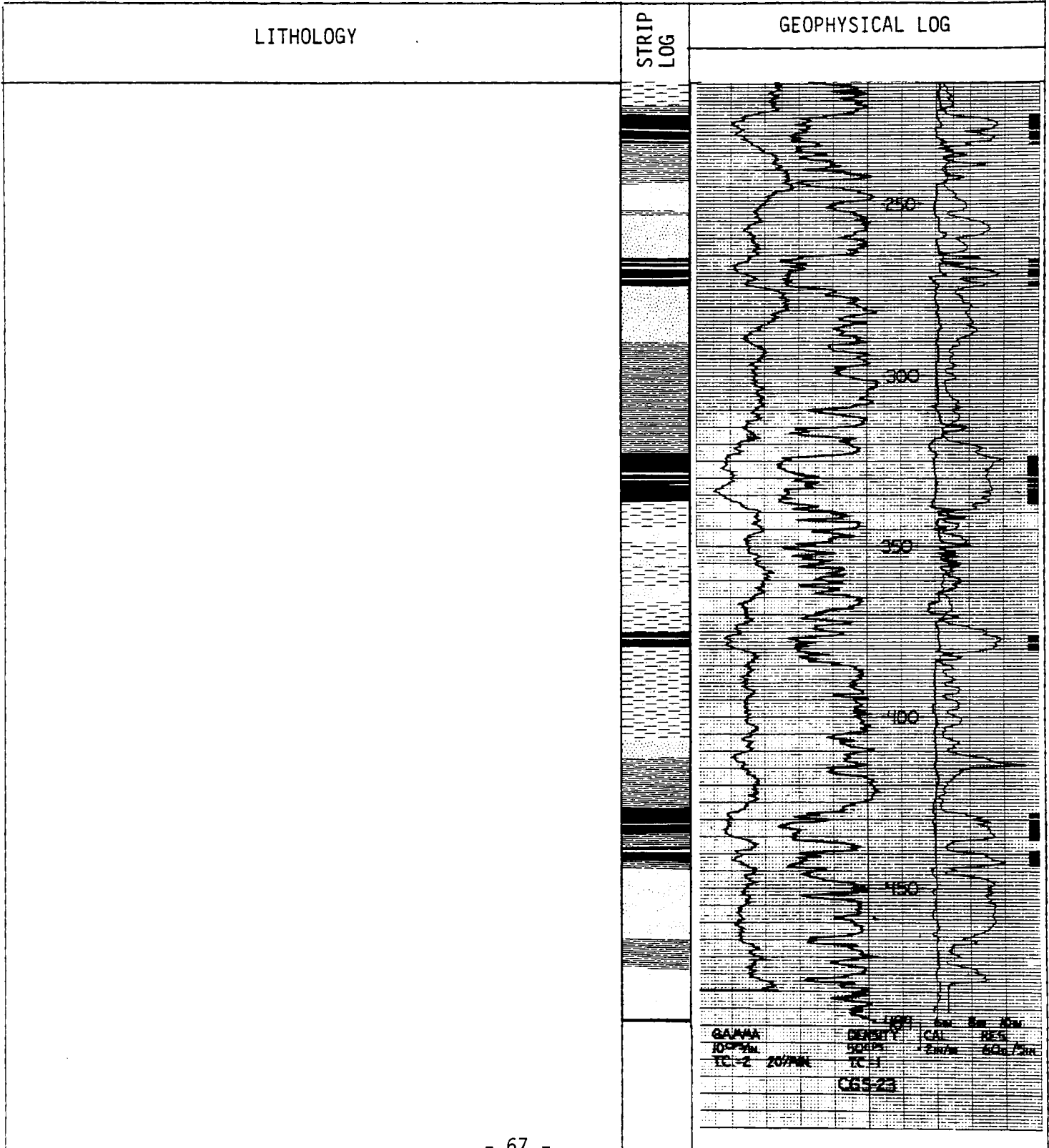
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 60 ohms/5in	Logging speed 20	fpm

Remarks: Filled with mud prior to logging. Poor cutting return below 300 feet.
Strasburg SW Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-23 - Continued



COLORADO GEOLOGICAL SURVEY

DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

Hole No. CGS-24 State Colorado County Adams Date logged 11/16/79 Elev.(ft) 4892

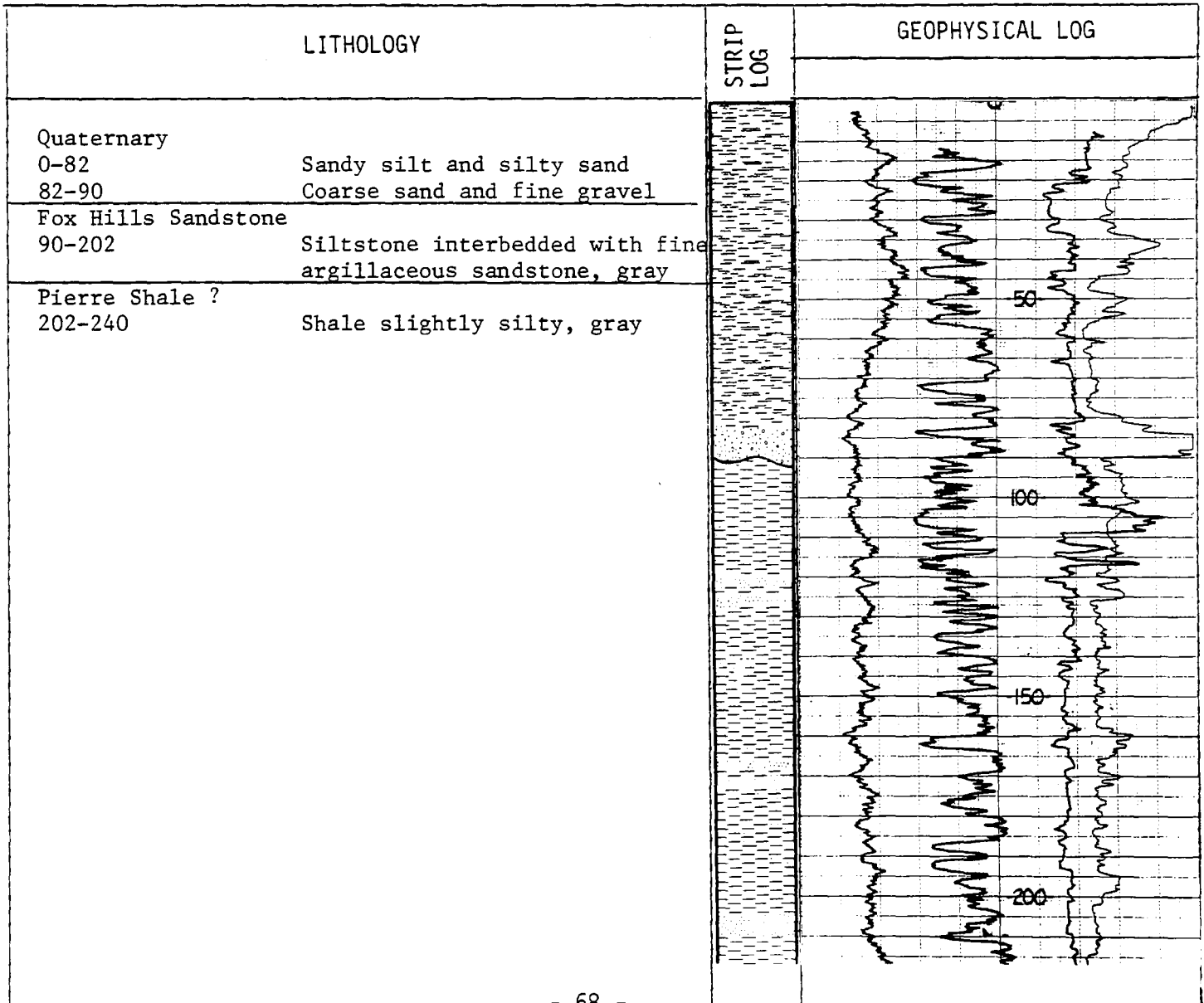
Location: T. 2 S., R.60 W., secs. SWSW12 Cored: Yes No X

Drilled depth 240 Logged depth 240 Drilling Medium mud Fluid level 4

Geophysical logs:

Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 75 ohms/5in	Logging speed 20	fpm

Remarks: Leader Quadrangle



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-24 - Continued


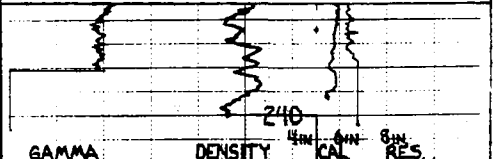
LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG			
					
		GAMMA <small>10 CPS/IN</small> T.C.-2	DENSITY <small>50 CPS/IN</small> T.C.-1	<small>4 IN</small> CAL <small>8 IN</small> RES. <small>12 IN</small> RES. <small>15 IN</small> RES.	
		CGS-24			

TABLE 1

COAL-ANALYSIS REPORT

LAB NO. K99284

ORGANIZATION: USGS, DENVER
 SAMPLE ID: USGS(D), CGS-4C-1, CORE SAMPLE, COAL
 D221579

CAN NO: -

OPR: LARAMIE FMTN, CRETACEOUS AGE
 STATE: CO COUNTY: ADAMS
 TOWN: -

MINE: DRILL HOLE, UNNAMED BED
 BED: DEPTH INT. 108.3 TO 114.0 FT

DATE OF SAMPLING: 12-14-79
 COLLECTOR: RONALD H. AFFOLTER

DATE RECEIVED: 1-29-78

DATE OF REPORT: 2-13-80

AIR DRY LOSS	30.6	COAL AS RECD.	COAL MOIST FREE	COAL MOIST, ASH FREE
PROXIMATE ANALYSIS				
MOISTURE	.....	35.5	.....	N/A
MOD				
VOLATILE MATTER	.....	28.1	.....	43.5
FIXED CARBON	.....	26.9	.....	41.8
ASH	.....	9.5	.....	14.7
				N/A
ULTIMATE ANALYSIS				
HYDROGEN	.....	6.9	.....	4.5
CARBON	.....	40.3	.....	62.4
NITROGEN	.....	.9	.....	1.4
SULFUR	.....	.5	.....	.7
OXYGEN IND	.....	42.1	.....	16.3
ASH	.....	9.5	.....	14.7
				N/A
HEATING VALUE	BTU/LB	.....	6912	.....
				10719
			
				12561
ASH - INITIAL DEFORMATION		2110 F		
SOFTENING TEMP		2220 F		
FLUID TEMP		2340 F		
SULFUR FORMS				
SULFATE	.....	.00	.....	.01
PYRITIC	.....	.07	.....	.11
ORGANIC	.....	.38	.....	.59
			
				.01
				.13
				.69
FREE SWELLING INDEX	.....		0.0	
MOIST, MINERAL MATTER FREE, BTU		7697		
APPARENT RANK LIGNITE		A		

NOTE: ANALYSIS INCLUDES ALL CLAY PARTINGS

COAL-ANAYSIS REPORT

LAB NO.

K99285

ORGANIZATION: USGS, DENVER
 SAMPLE ID: USGS(D), CGS-5C-1, CORE SAMPLE, COAL
 D221580

CAN NO: -

OPR: LARAMIE FMTN, CRETACEOUS AGE
 STATE: CO COUNTY: ADAMS
 TOWN:

MINE: DRILL HOLE, UNNAMED BED
 BED: DEPTH INT. 305.2 to 308.0 FT

DATE OF SAMPLING: 12-14-79
 COLLECTOR: RONALD H. AFFOLTER

DATE RECEIVED: 1-29-78

DATE OF REPORT: 2-13-80

	COAL AS RECD	COAL MOIST FREE	COAL MOIST, ASH FREE
AIR DRY LOSS	34.2		
PROXIMATE ANALYSIS			
MOISTURE	38.3	N/A	N/A
MOD			
VOLATILE MATTER	25.2	40.8	53.0
FIXED CARBON	22.3	36.3	47.0
ASH	14.2	22.9	N/A
ULTIMATE ANALYSIS			
HYDROGEM	6.8	4.1	5.3
CARBON	34.7	56.3	73.0
NITROGEN	.9	1.4	1.8
SULFUR	.4	.6	.8
OXYGEN IND	43.2	14.7	19.1
ASH	14.2	22.9	N/A
HEATING VALUE BTU/LB	5926	9608	12469
ASH - INITIAL DEFORMATION	2310 F		
SOFTENING TEMP	2420 F		
FLUID TEMP	2500 F		
SULFUR FORMS			
SULFATE	.00	.01	.01
PYRITIC	.04	.06	.08
ORGANIC	.33	.54	.70
FREE SWELLING INDEX	0.0		

MOIST, MINERAL MATTER FREE, BTU = 6994

APPARENT RANK LIGNITE A

NOTE: ANALYSIS INCLUDES ALL CLAY PARTINGS

TABLE 3

COAL-ANALYSIS REPORT

LAB NO. K99286

ORGANIZATION: USGS, DENVER
 SAMPLE ID: USGS(D), CGS-5C-2, CORE SAMPLE, COAL
 D221581

CAN NO: -

OPER: LARAMIE FMTN, CRETACEOUS AGE
 STATE: CO COUNTY: ADAMS
 TOWN: -

MINE: DRILL HOLE, UNNAMED BED
 BED: DEPTH INT. 362.4 TO 370.5 FT

DATE OF SAMPLING: 12-14-79 DATE RECEIVED: 1-29-78 DATE OF REPORT: 2-13-80
 COLLECTOR: RONALD H. AFFOLTER

AIR DRY LOSS	26.5	COAL AS RECD.	COAL MOIST FREE	COAL MOIST, ASH FREE
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PROXIMATE ANALYSIS

MOISTURE	31.2	N/A	N/A
MOD						
VOLATILE MATTER	24.4	35.5	46.7
FIXED CARBON	27.9	40.5	53.3
ASH	.....	16.5	.....	24.0	.....	N/A

ULTIMATE ANALYSIS

HYDROGEN	.....	6.1	.....	3.8	.....	5.0
CARBON	.....	38.9	.....	56.5	.....	74.4
NITROGEN	.....	.9	.....	1.3	.....	1.7
SULFUR	.....	.3	.....	.4	.....	.5
OXYGEN IND	.....	37.3	.....	13.9	.....	18.4
ASH	.....	16.5	.....	24.0	.....	N/A

HEATING VALUE	BTU/LB	6564	9546	12568
---------------	--------	-------	------	-------	------	-------	-------

ASH - INITIAL DEFORMATION	2150 F
SOFTENING TEMP	2260 F
FLUID TEMP	2380 F

SULFAR FORMS

SULFATE000101
PYRITIC040608
ORGANIC243546

FREE SWELLING INDEX	0.0
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MOIST, MINERAL MATTER FREE, BTU 7985.12

APPARENT RANK LIGNITE A

NOTE: ANALYSIS INCLUDES ALL CLAY PARTINGS

TABLE 4

COAL-ANALYSIS REPORT

LAB NO. K99287

ORGANIZATION: USGS, DENVER
 SAMPLE ID: USGS(D), CGS-10C-1, CORE SAMPLE, COAL
 D221582

CAN NO: -

OPR: DENVER FMTN, PALEOCENE AGE
 STATE: CO COUNTY: ADAMS
 TOWN: -

MINE: DRILL HOLE, UNNAMED BED
 BED: DEPTH INT. 439.5 TO 449.5 FT

DATE OF SAMPLING: 12-14-79 DATE RECEIVED: 1-29-78 DATE OF REPORT: 2-13-80
 COLLECTOR: RONALD H. AFFOLTER

		COAL AS RECD.		COAL MOIST FREE		COAL MOIST, ASH FREE	
AIR DRY LOSS	25.6						
PROXIMATE ANALYSIS							
MOISTURE	.....	30.9	.....	N/A	.....	N/A
MOD							
VOLATILE MATTER	.....	25.3	.....	36.6	.....	52.7
FIXED CARBON	.....	22.8	.....	32.0	.....	47.3
ASH	.....	21.0	.....	30.5	.....	N/A
ULTIMATE ANALYSIS							
HYDROGEN	.....	6.1	.....	3.9	.....	5.6
CARBON	.....	33.6	.....	48.7	.....	70.0
NITROGEN	.....	.7	.....	1.0	.....	1.5
SULFUR	.....	.3	.....	.5	.....	.7
OXYGEN IND	.....	38.2	.....	15.4	.....	22.2
ASH	.....	21.0	.....	30.5	.....	N/A
HEATING VALUE	BTU/LB	5754	8333	11986
ASH - INITIAL DEFORMATION		2800 ^{+F}					
SOFTENING TEMP		2800 ^{+F}					
FLUID TEMP		2800 ^{+F}					
SULFUR FORMS							
SULFATE	.....	.00	.....	.01	.....	.01
PYRITIC	.....	.19	.....	.28	.....	.40
ORGANIC	.....	.13	.....	.19	.....	.27
FREE SWELLING INDEX	.....		0.0			
MOIST, MINERAL MATTER FREE, BTU		7438					
APPARENT RANK LIGNITE A							

NOTE: ANALYSIS INCLUDES ALL CLAY PARTINGS

TABLE 5

LIQUID PERMEABILITY DATA
CGS-10_c

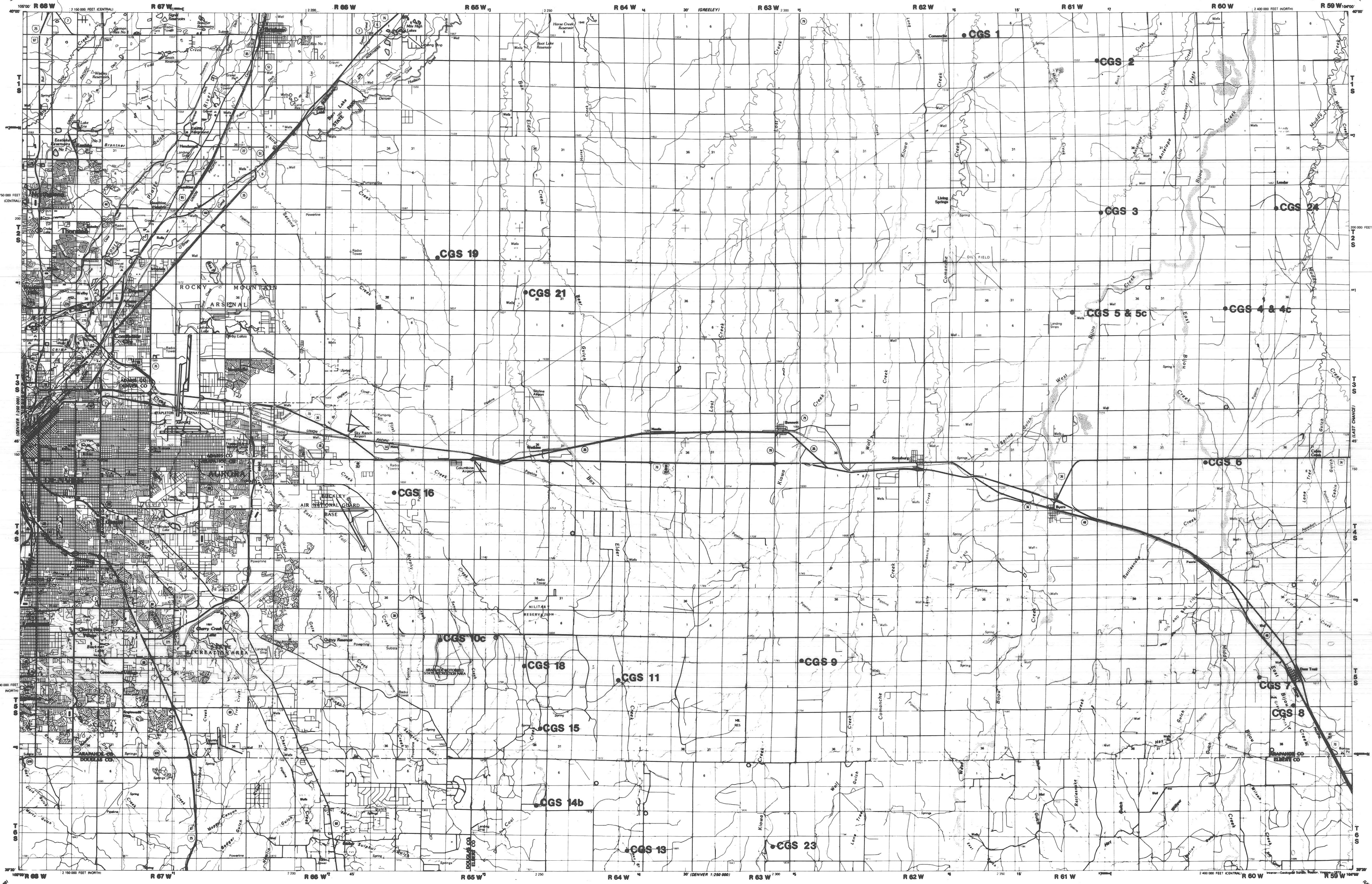
Type of Liquid: De-ionized Water

Viscosity, cp.: 0.93 at 74°F

<u>Sample Number</u>	<u>Depth</u>	<u>Porosity</u>	<u>Permeability, Millidarcys</u>				<u>Liquid/Air Permeability Ratio</u>
			<u>To Air</u>		<u>To Liquid</u>		
				<u>K</u>		<u>K</u>	
2	247.5	35.7	515	9.27	138	2.48	0.267
3	285	33.3	165	2.97	31	0.56	0.188
4	411	31.8	209	3.76	21	0.38	0.100

1 darcy = 18.2K

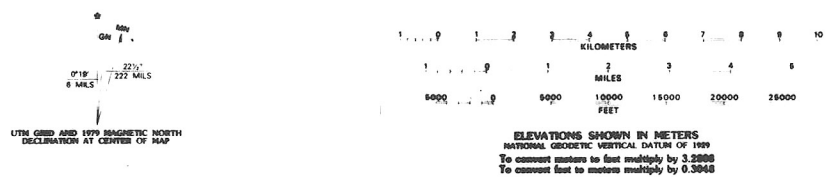
Each core plug was leached of salt with methyl alcohol, and dried at 180°F. Air permeabilities and porosities were determined on the clean and dried core plugs. The core plugs were evacuated and pressure saturated with de-ionized water. Water permeability was then measured.



Produced by the Geological Survey
 in cooperation with the Soil Conservation Service
 Compiled from USGS 1:50,000-scale topographic maps
 dated 1949-1959. See notes for dates of individual maps.
 Partially revised from aerial photographs taken 1972-76
 and other source data. Revised information not field checked
 May 1979.

Projection used is 80 000-meter grid, zone 13.
 Universal Transverse Mercator
 80 000-foot grid ticks based on Colorado coordinate
 system, north and central zones. 1967 North American datum.

- Completed CGS Drill Hole Location
- Proposed CGS Drill Hole Location



LEGEND

- Perennial stream, lake
- Intermittent stream, lake
- Village or locality
- Landmark structure
- Public park or recreation area
- Forest or game land area
- Other public area or Military or Indian reservation

ROAD CLASSIFICATION

- Primary highway, hard surface
- Secondary highway, hard surface
- Light-duty road, hard or improved surface
- Shoulder or other road
- Trail
- Interstate route
- U.S. route
- State route

DENVER EAST, COLORADO
 DENVER NE 4 (N 13-2) 1:50,000 SCALE MAP