

# CGS BULLETIN

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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Open File Report 80-1  
1980

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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<sub>c</sub> 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<sub>c</sub>, CGS-5<sub>c</sub> and 10<sub>c</sub> 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<sub>c</sub> 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.

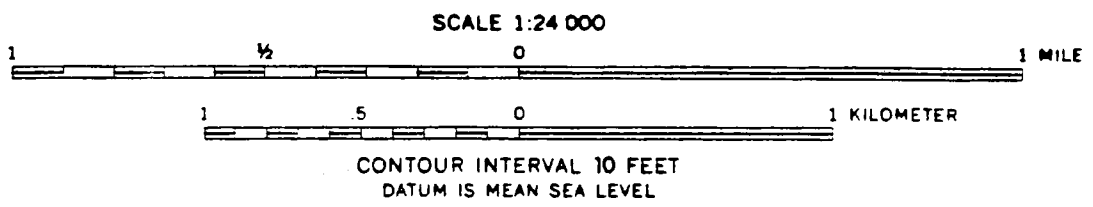
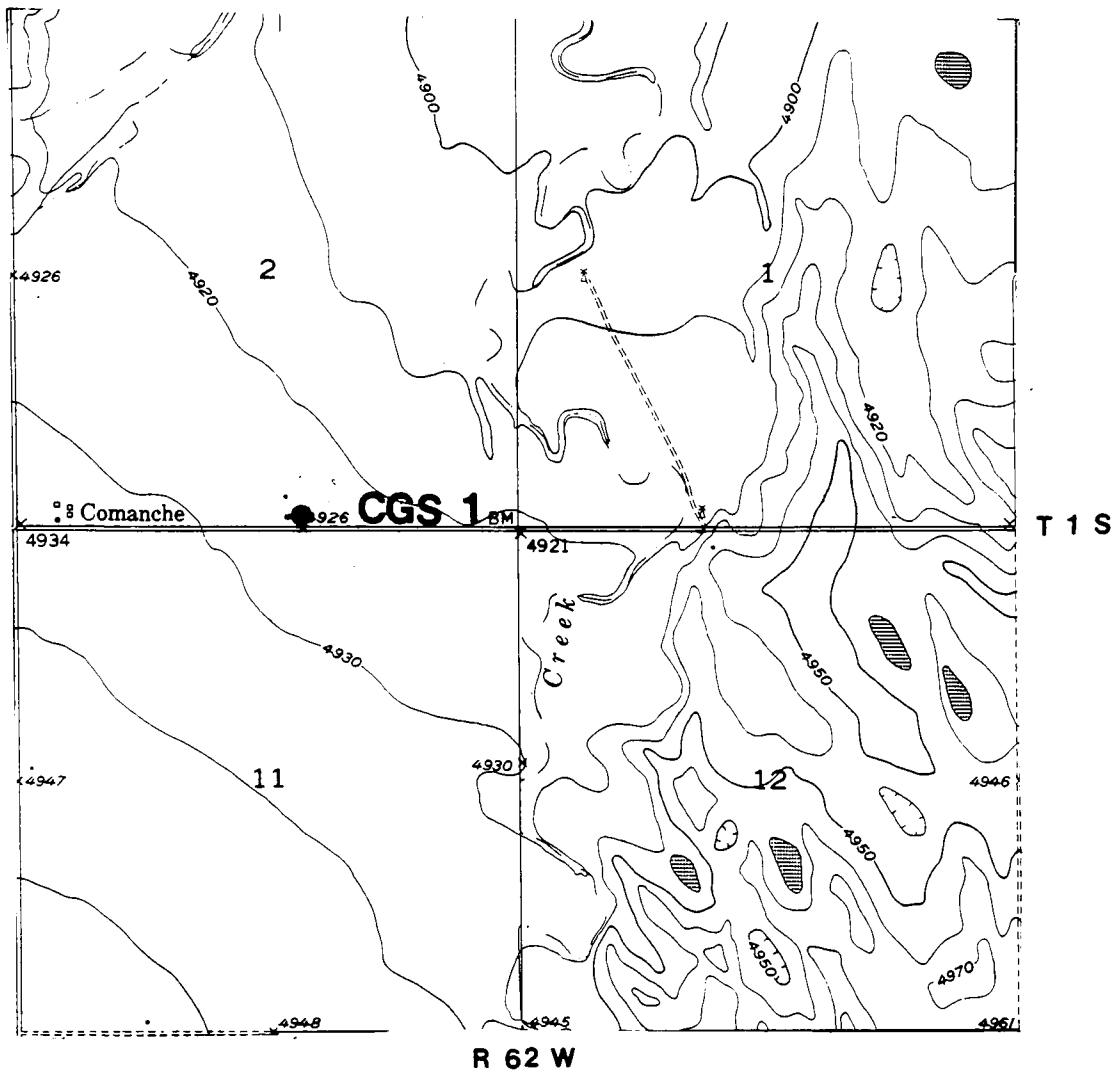


Figure 1.-- Location of drill holes in the Living Springs quadrangle.

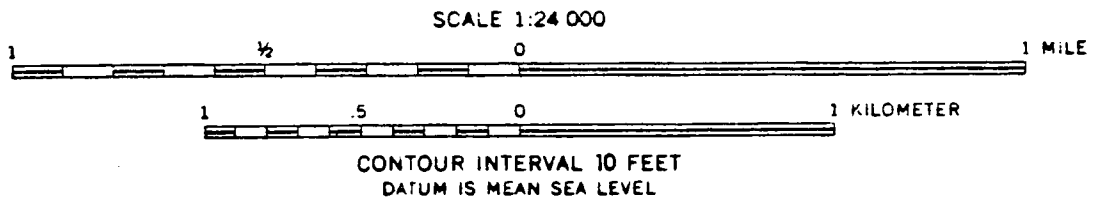
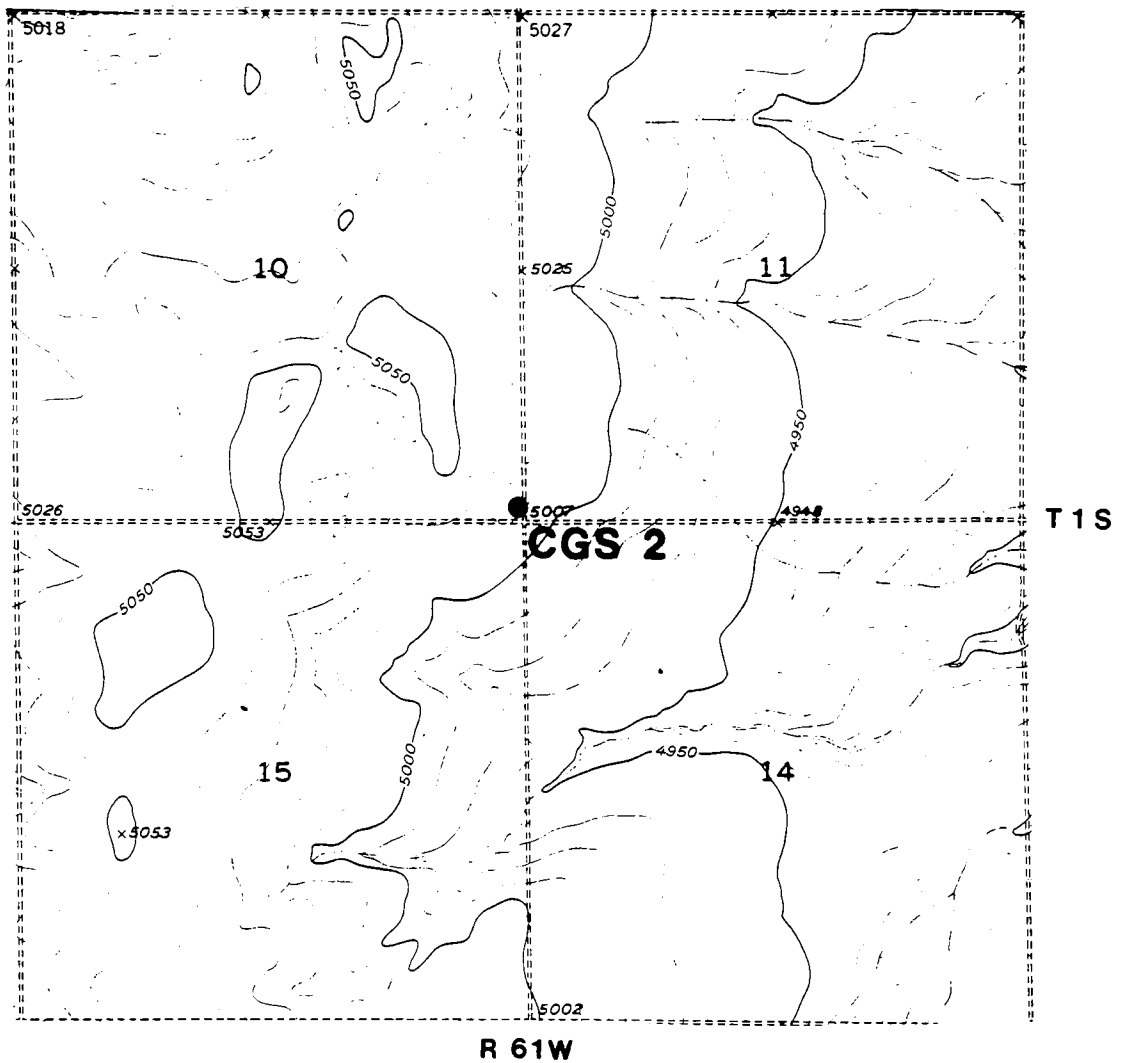


Figure 2.-- Location of drill holes Leader NW quadrangle.

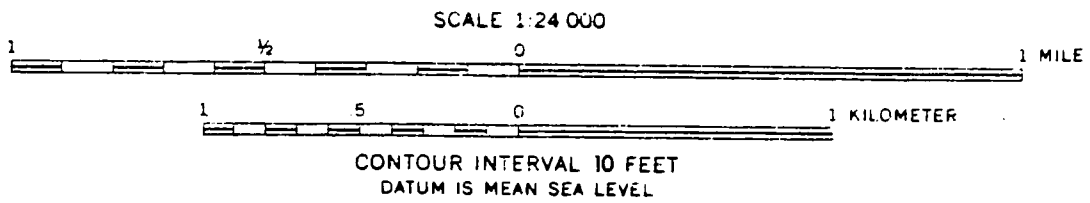
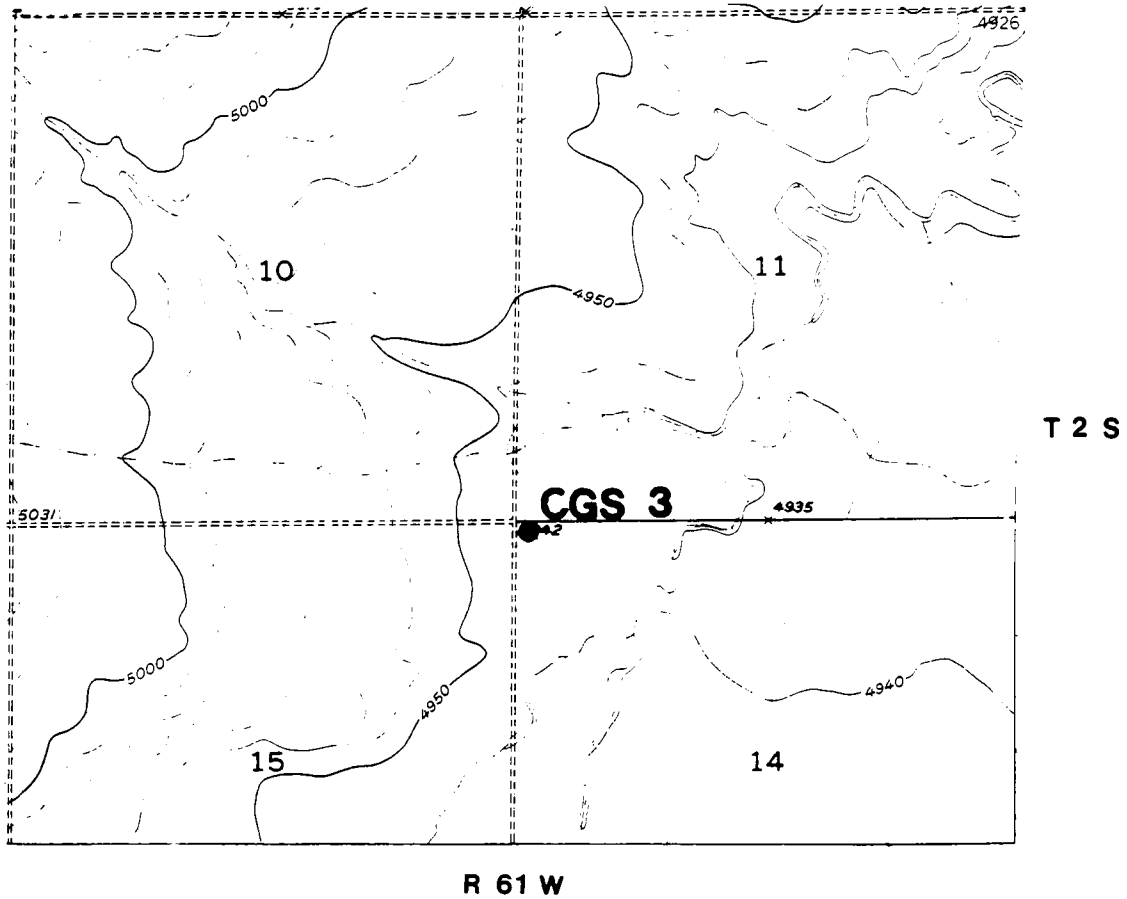


Figure 3.-- Location of drill holes in the Leader NW quadrangle.

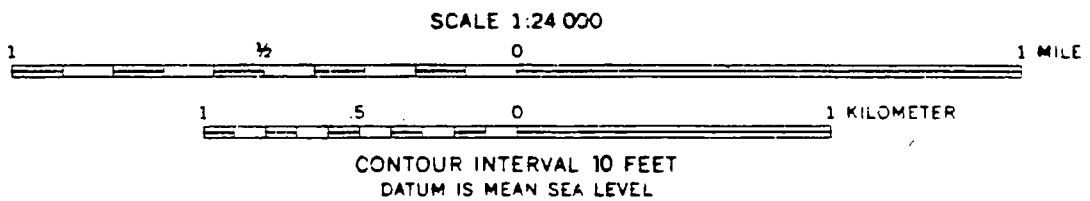
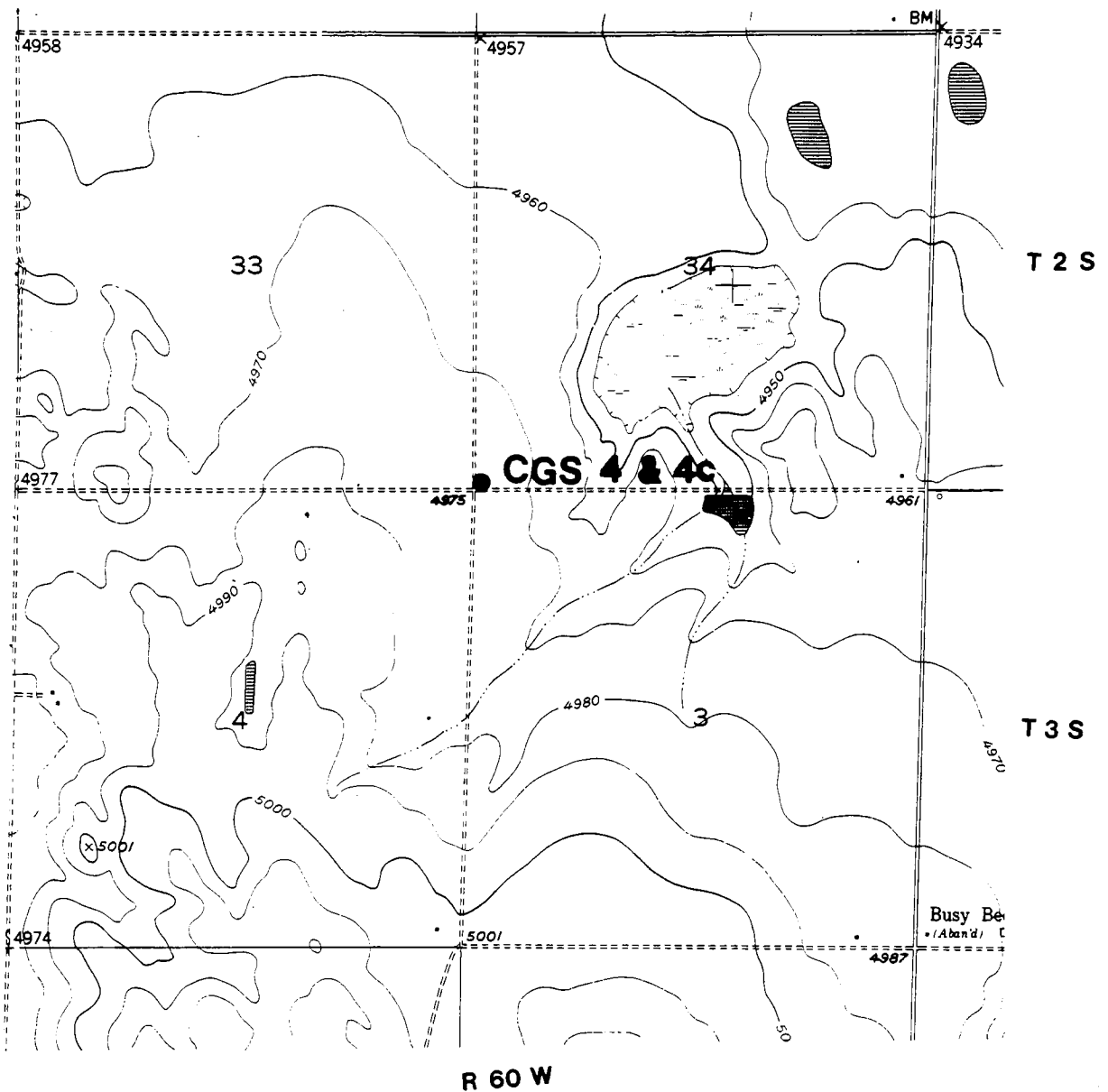


Figure 4.--Location of drill holes in the Leader SE quadrangle.

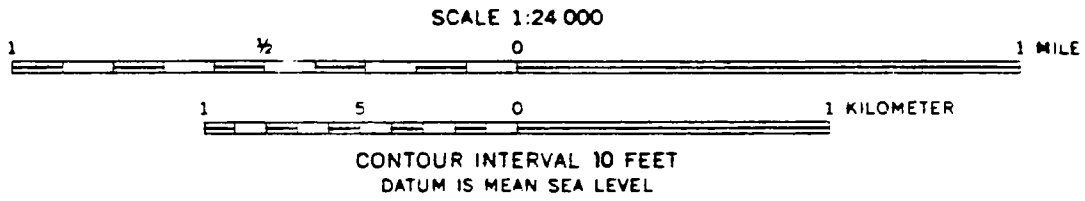
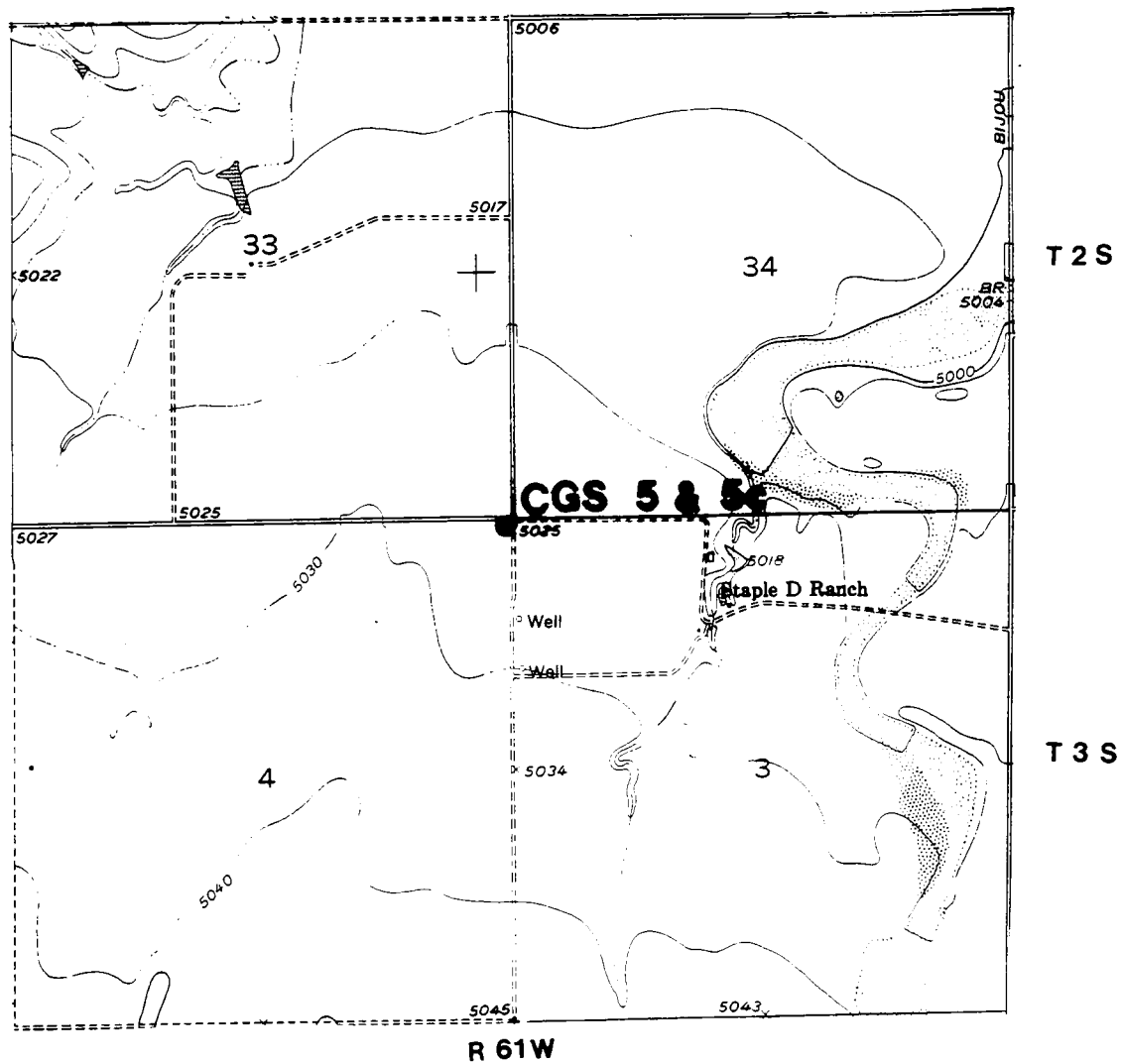


Figure 5.--Location of drill holes in the Leader SW quadrangle.



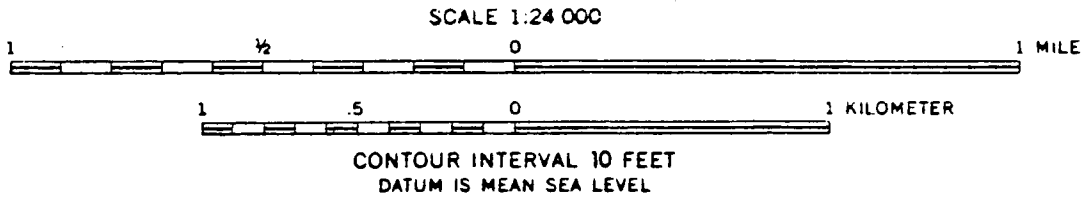
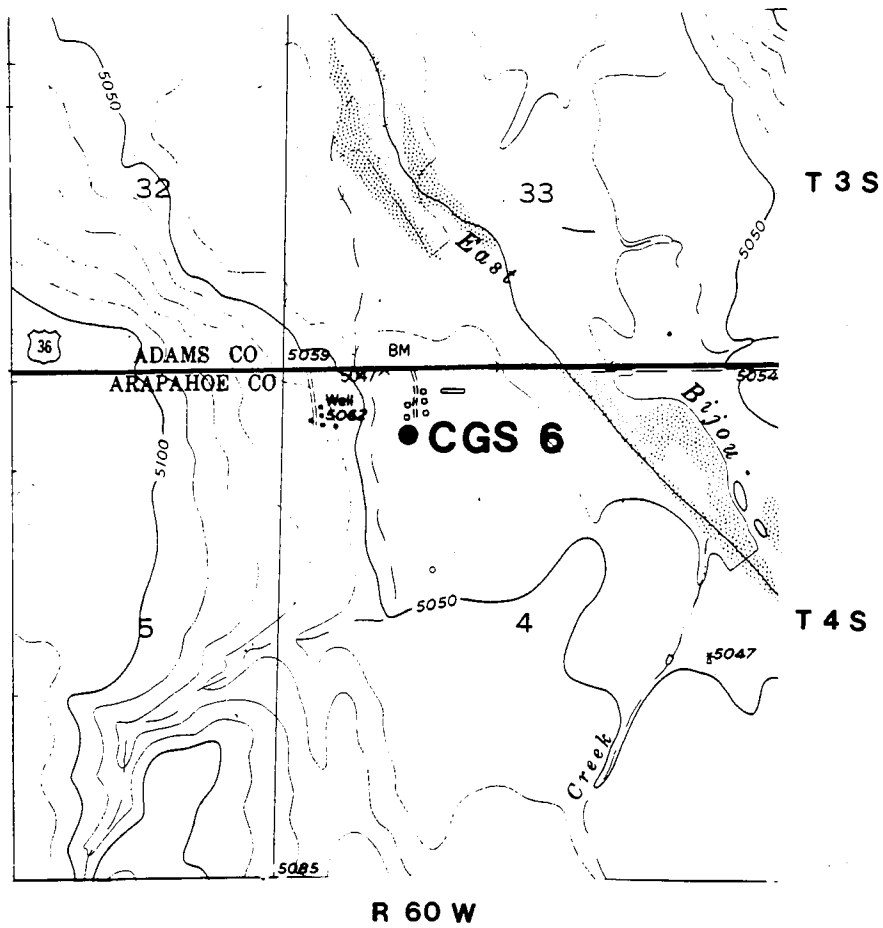


Figure 6.--Location of drill holes in the Peoria quadrangle.

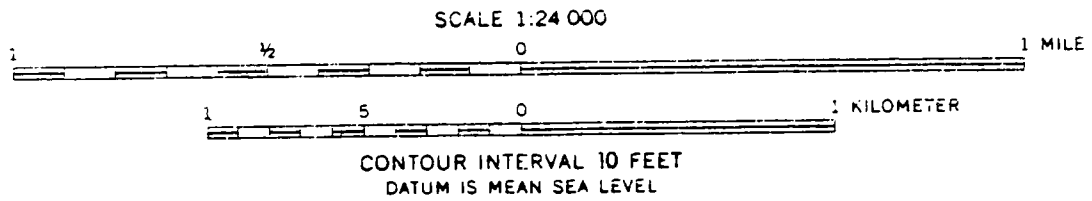
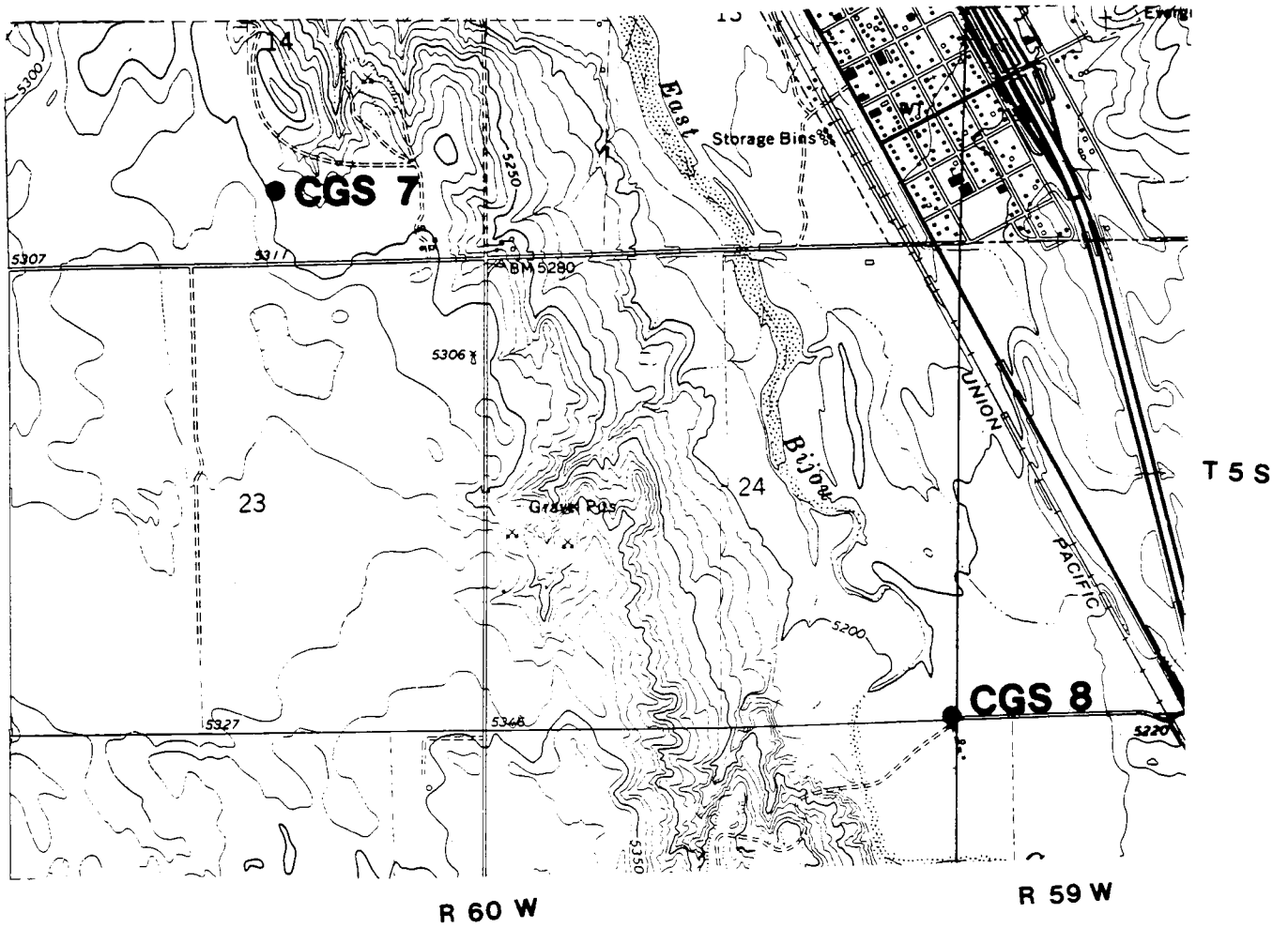


Figure 7.--Locations of drill holes in the Deer Trail quadrangle.

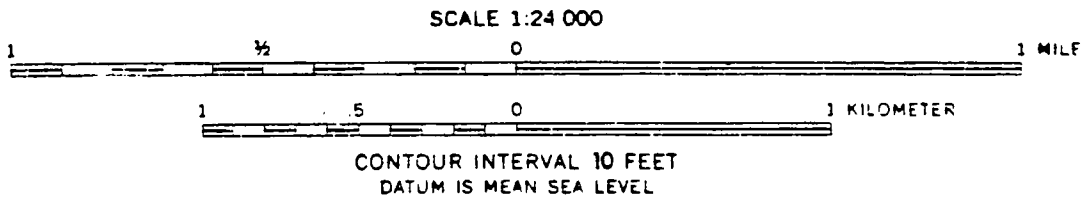
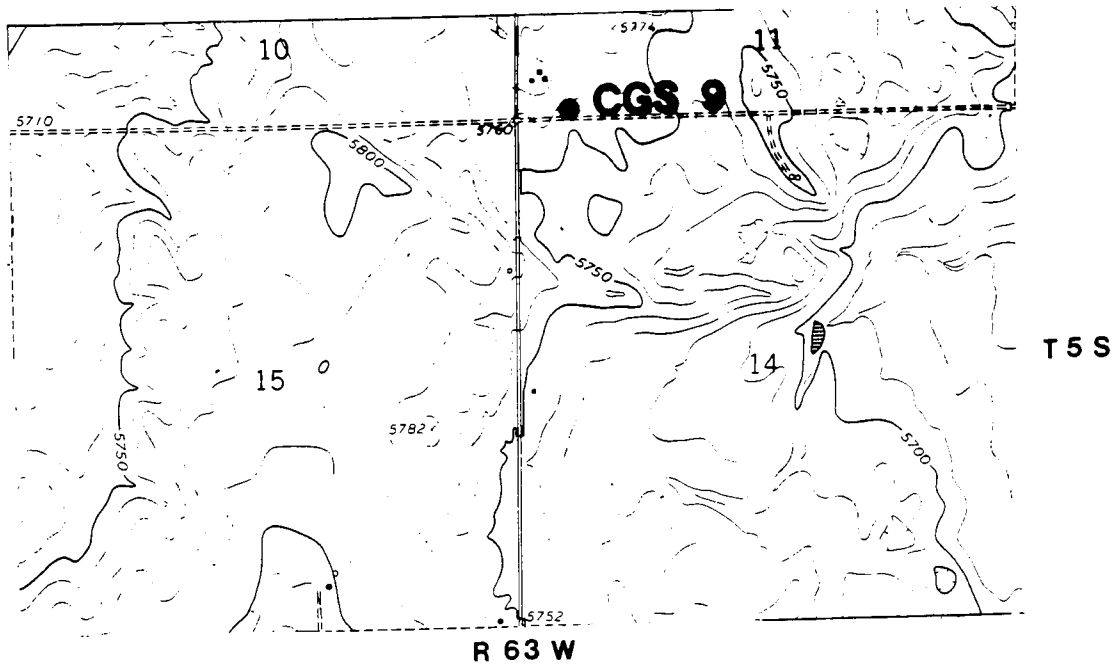


Figure 8.--Location of drill holes in the Strasburg SW quadrangle.



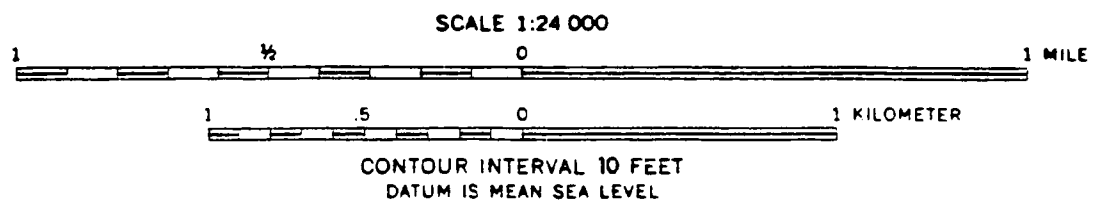
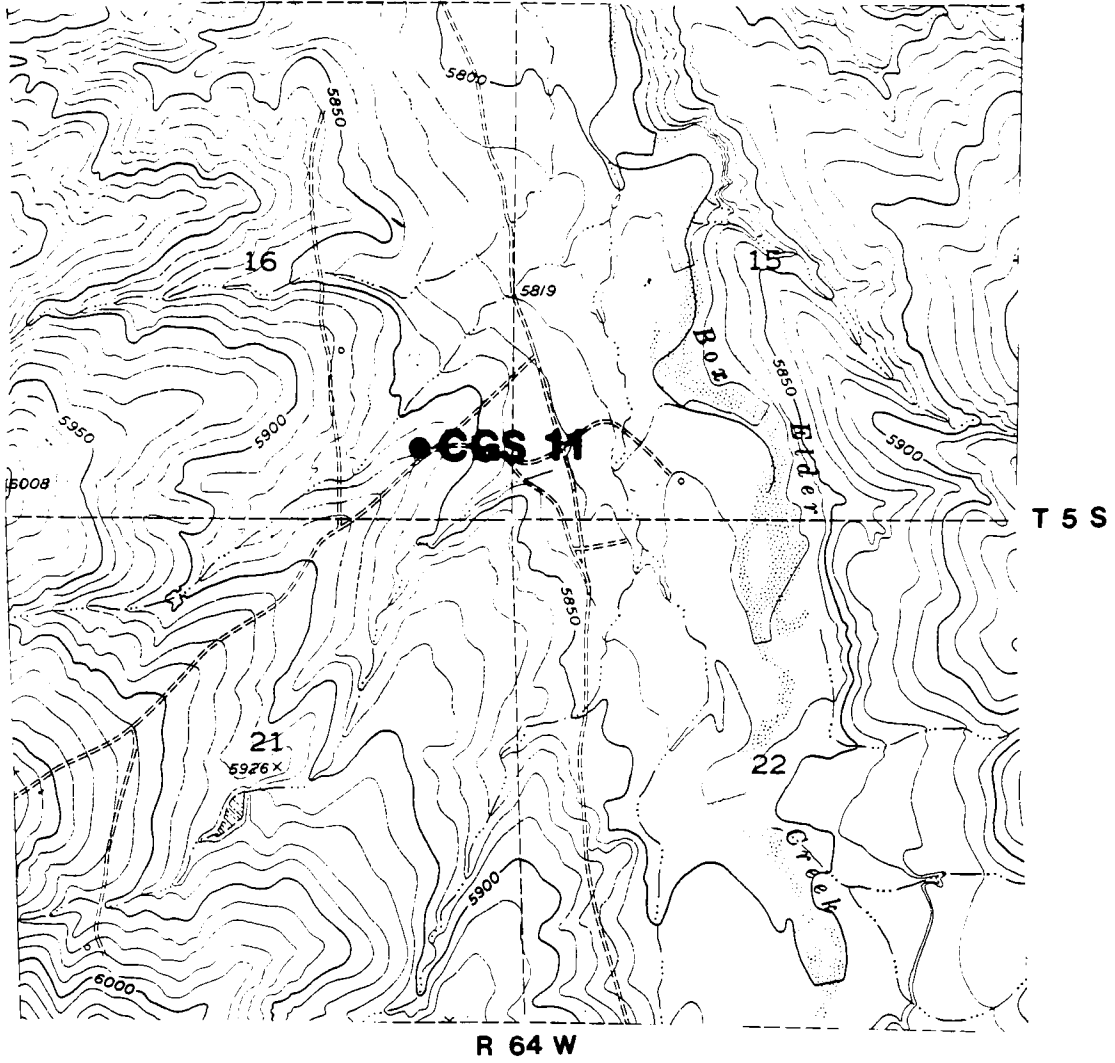


Figure 10.--Location of drill holes in the Watkins SE quadrangle.

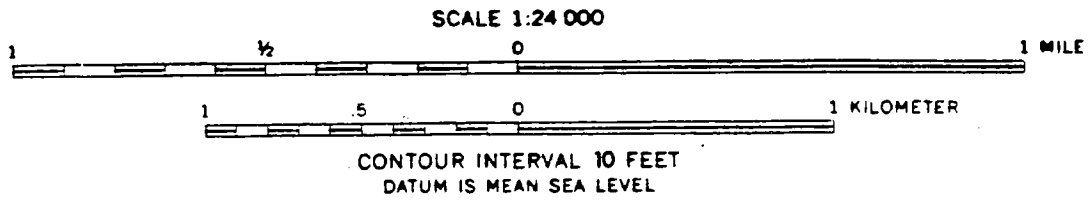
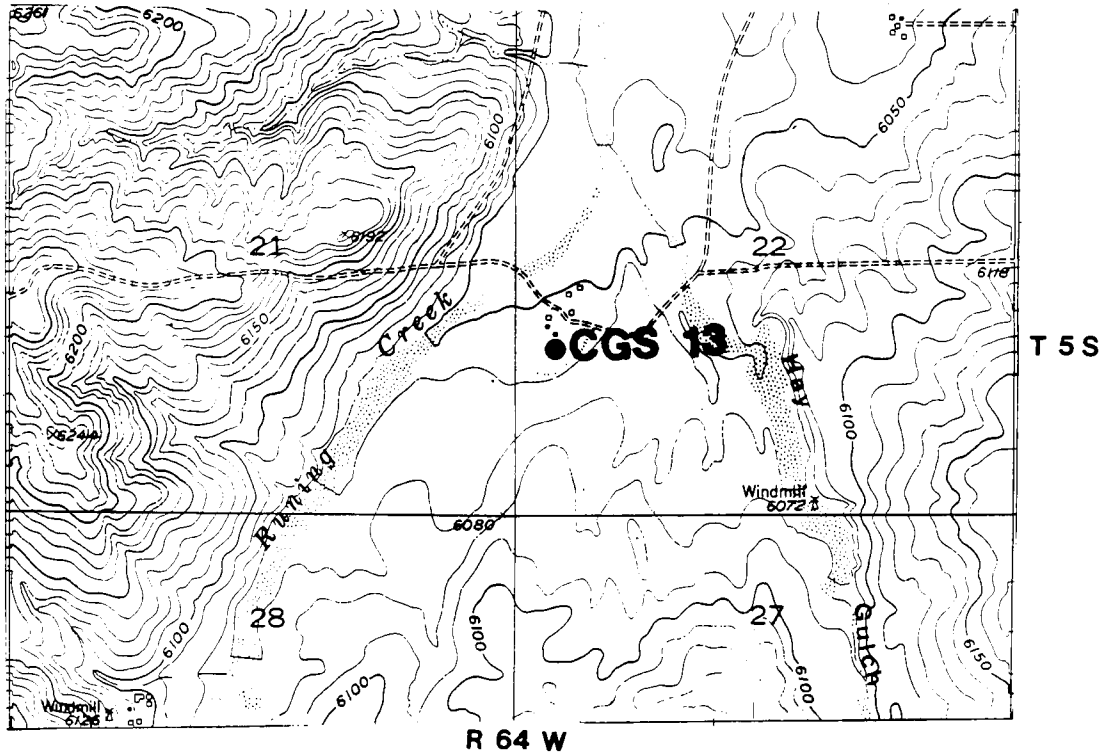


Figure 11.--Location of drill holes in the Watkins SE quadrangle.

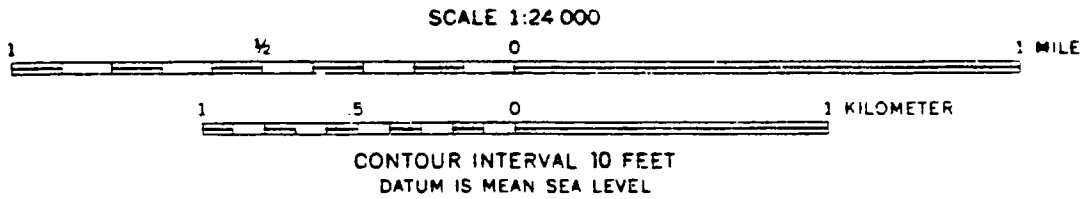
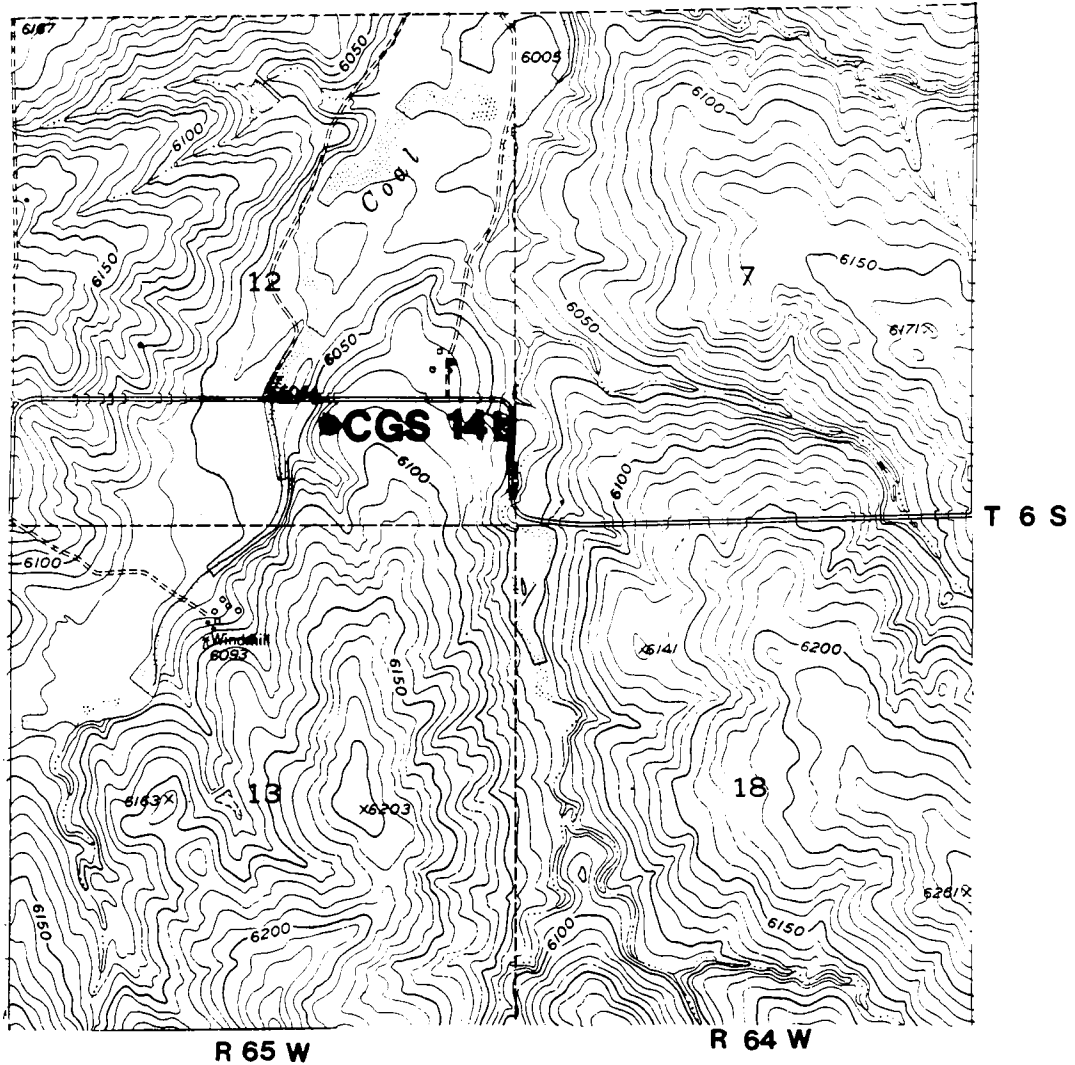


Figure 12.--Location of drill holes in the Watkins SE quadrangle.

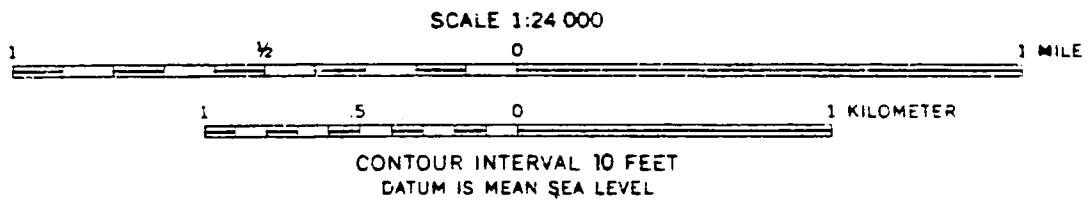
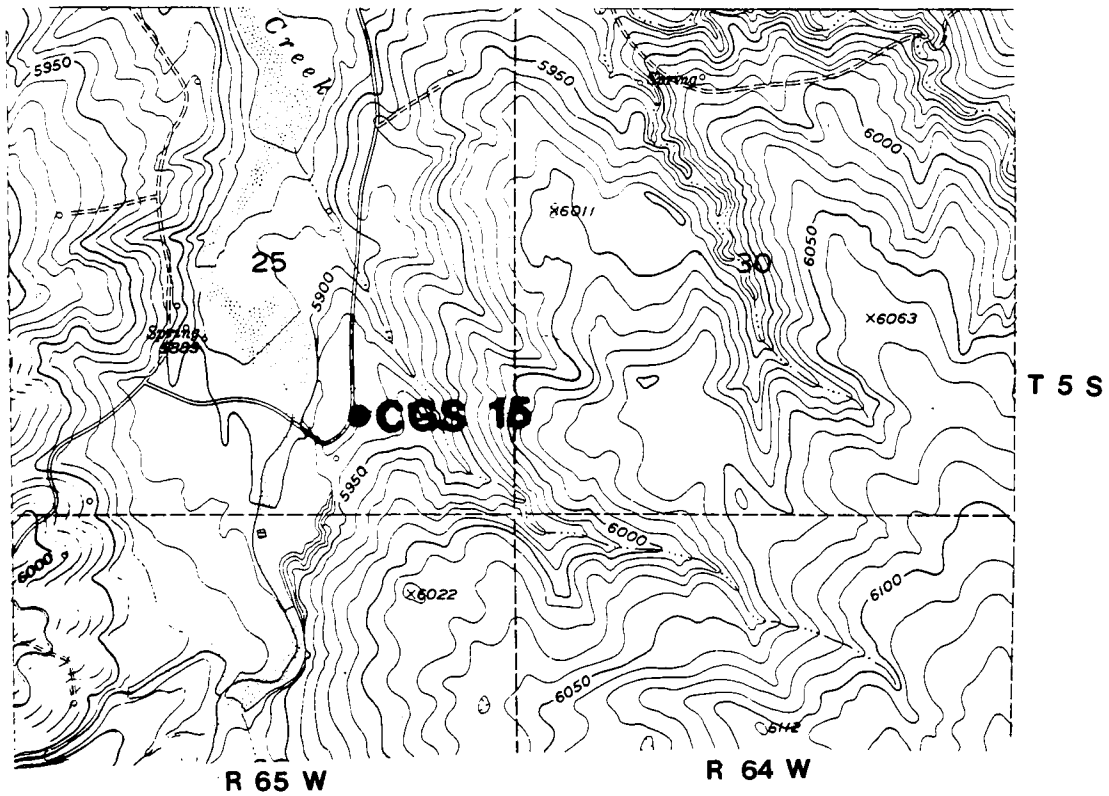


Figure 13.--Location of drill holes in the Watkins SE quadrangle.



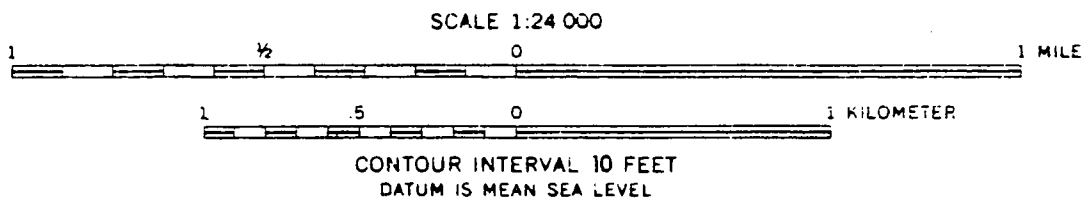
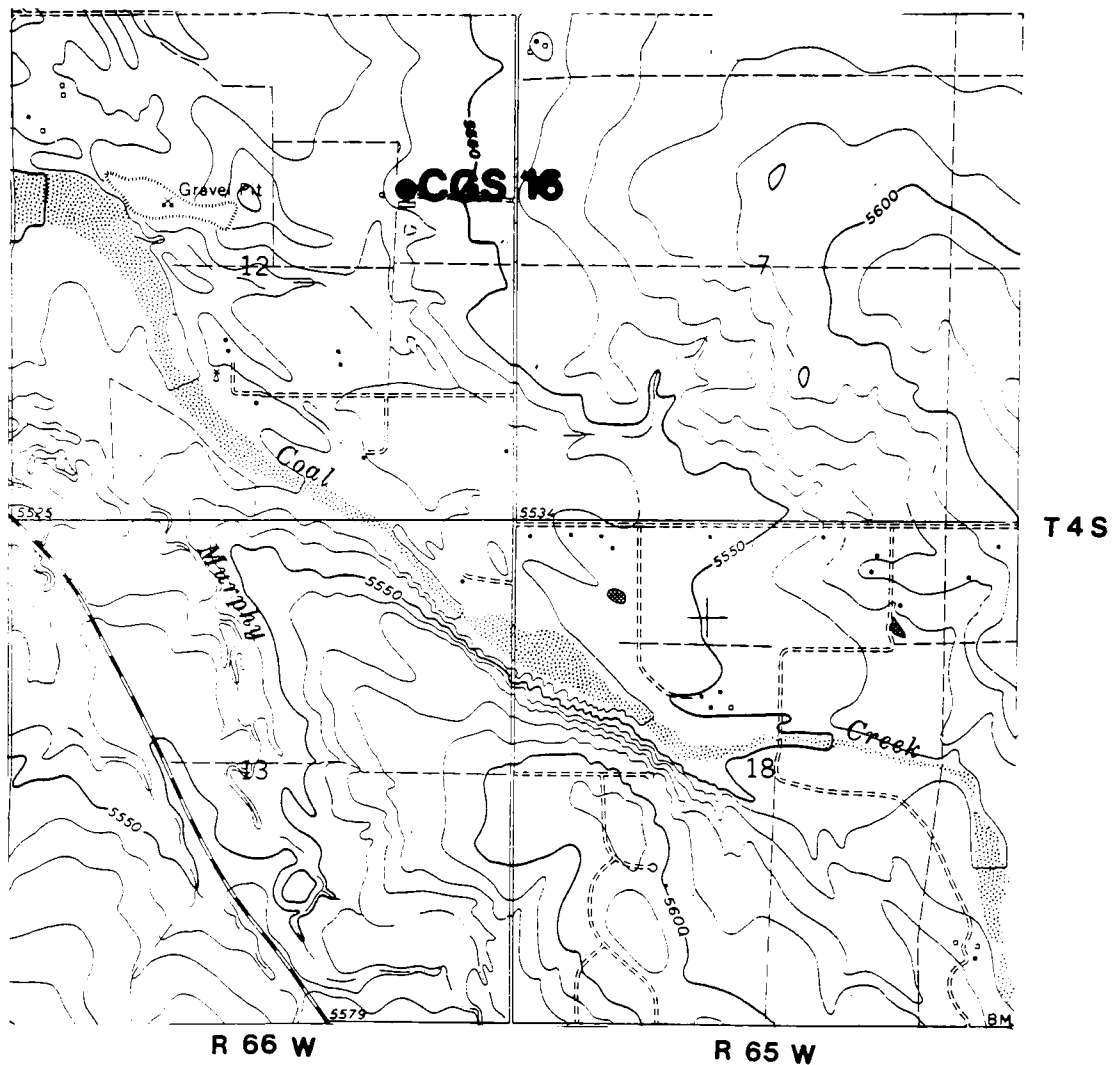


Figure 14.-- Location of drill holes in the Coal Creek quadrangle.

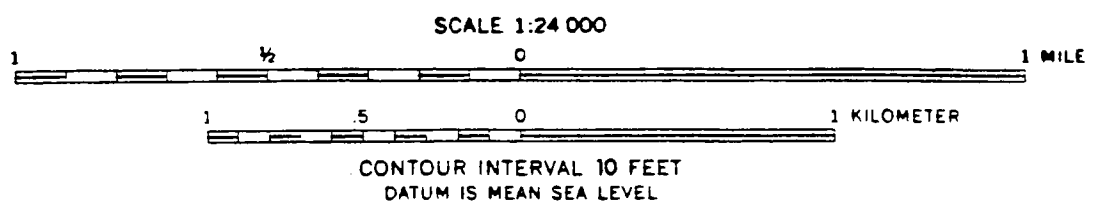
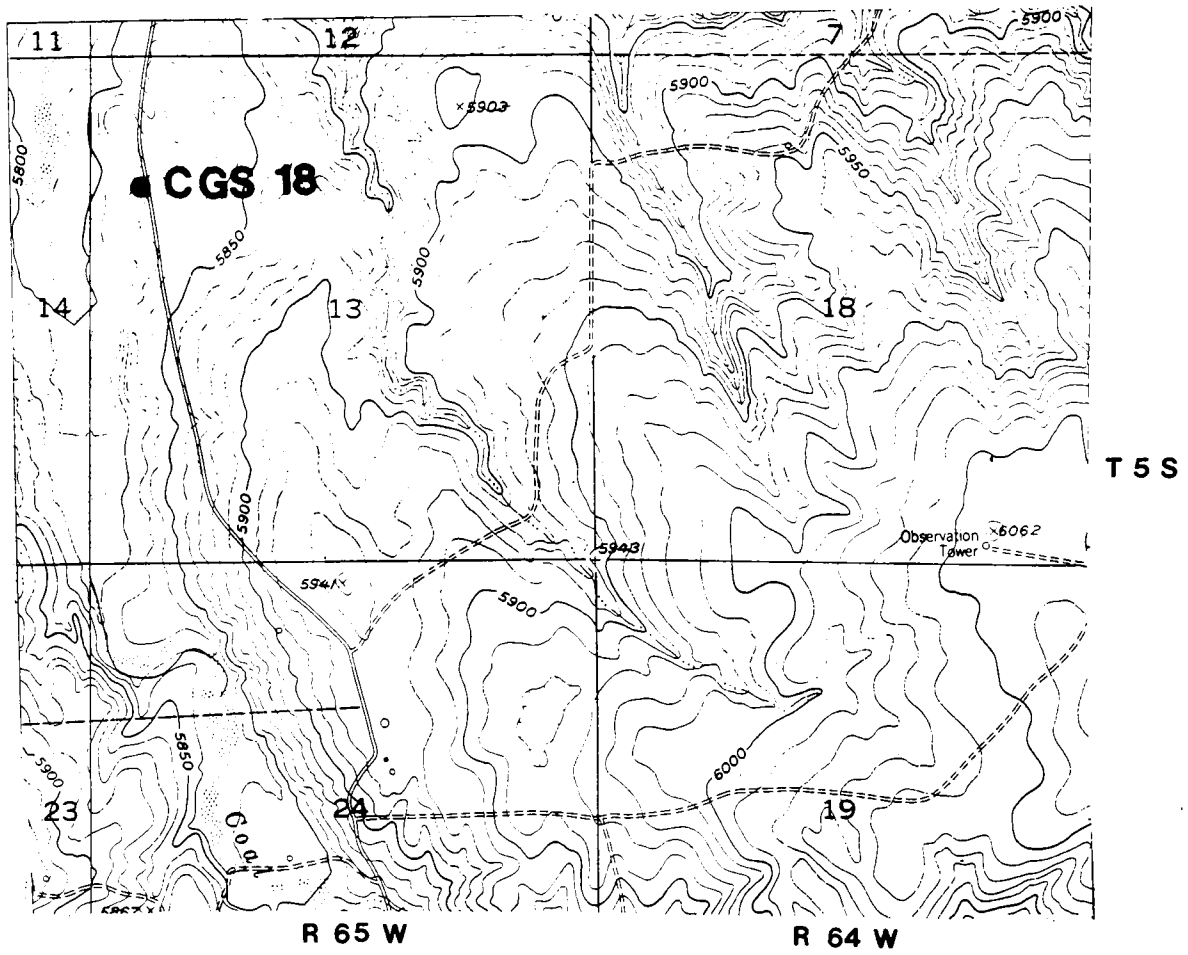


Figure 15.--Location of drill holes in the Watkins SE quadrangle.

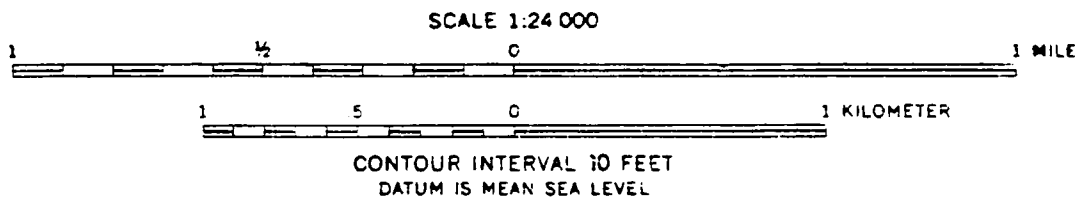
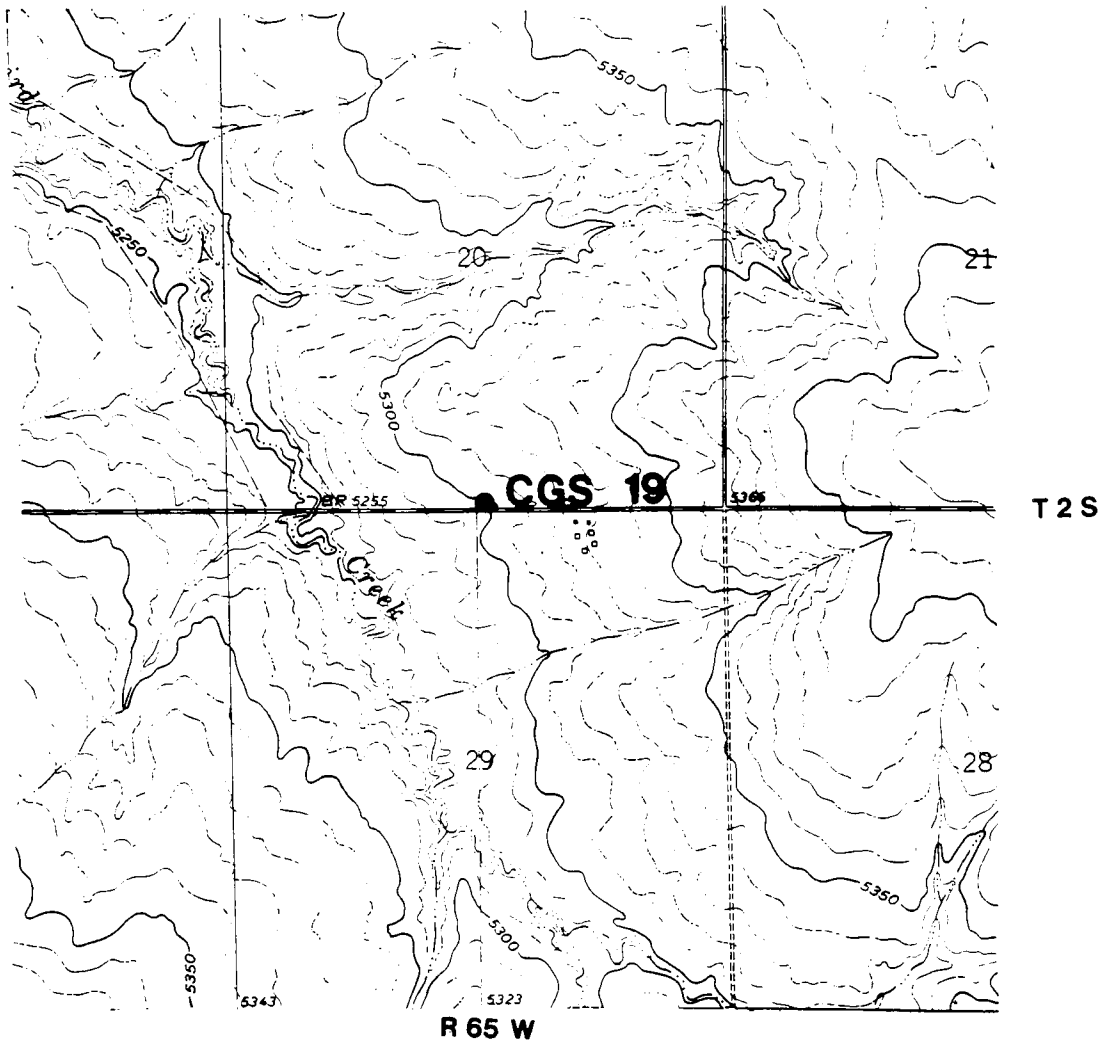


Figure 16.--Location of drill holes in the Box Elder School quadrangle.

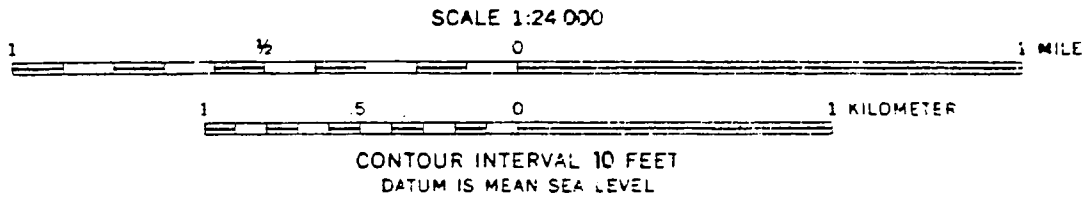
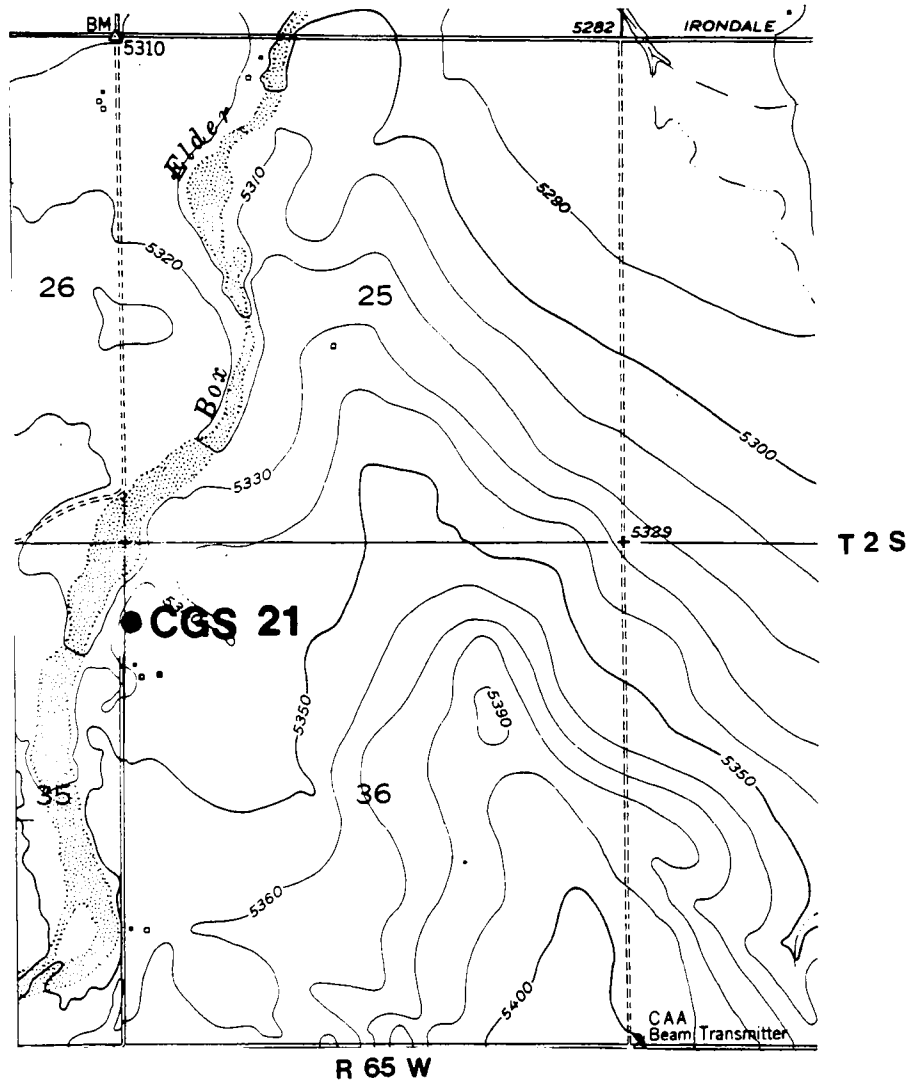


Figure 17.--Location of drill holes in the Manila quadrangle.

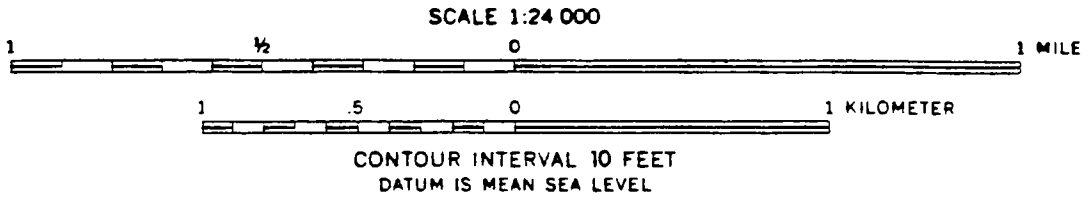
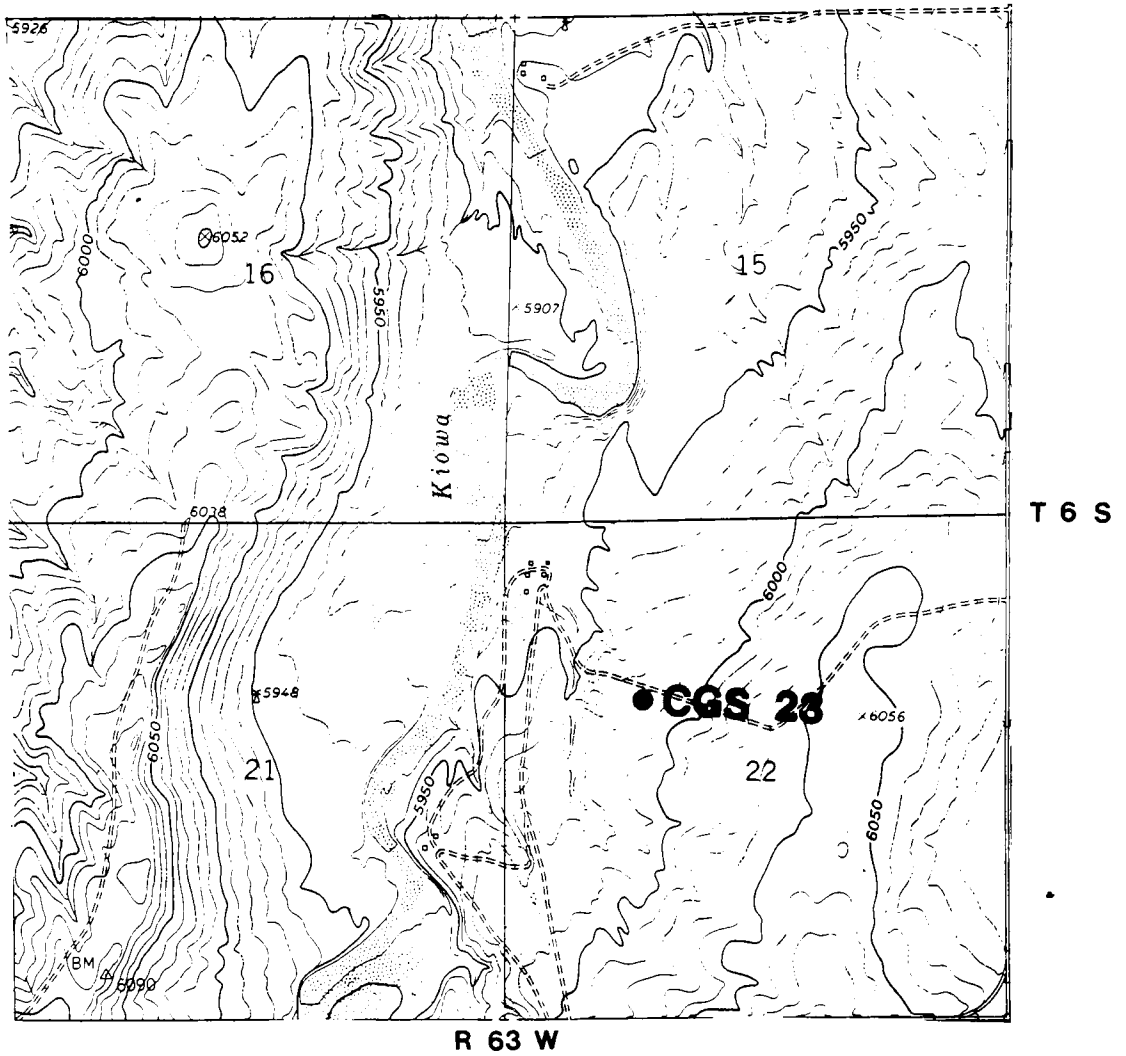


Figure 18.--Location of drill holes in the Strasburg SW quadrangle.

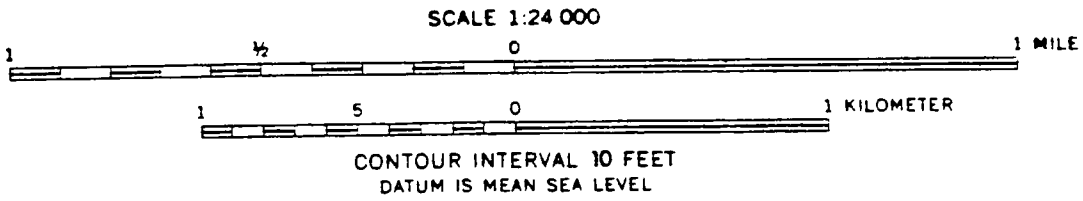
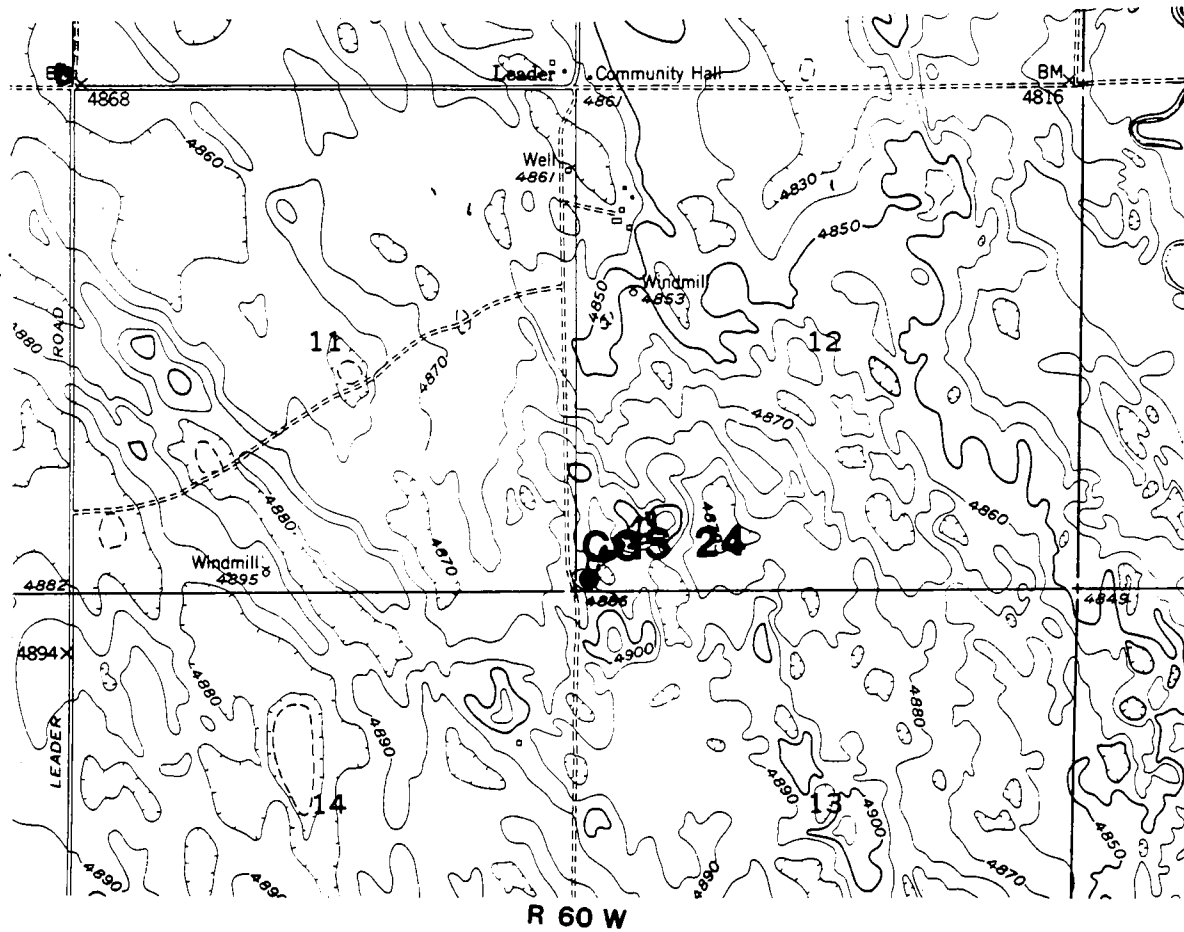


Figure 19.--Location of drill holes in the Leader quadrangle.

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

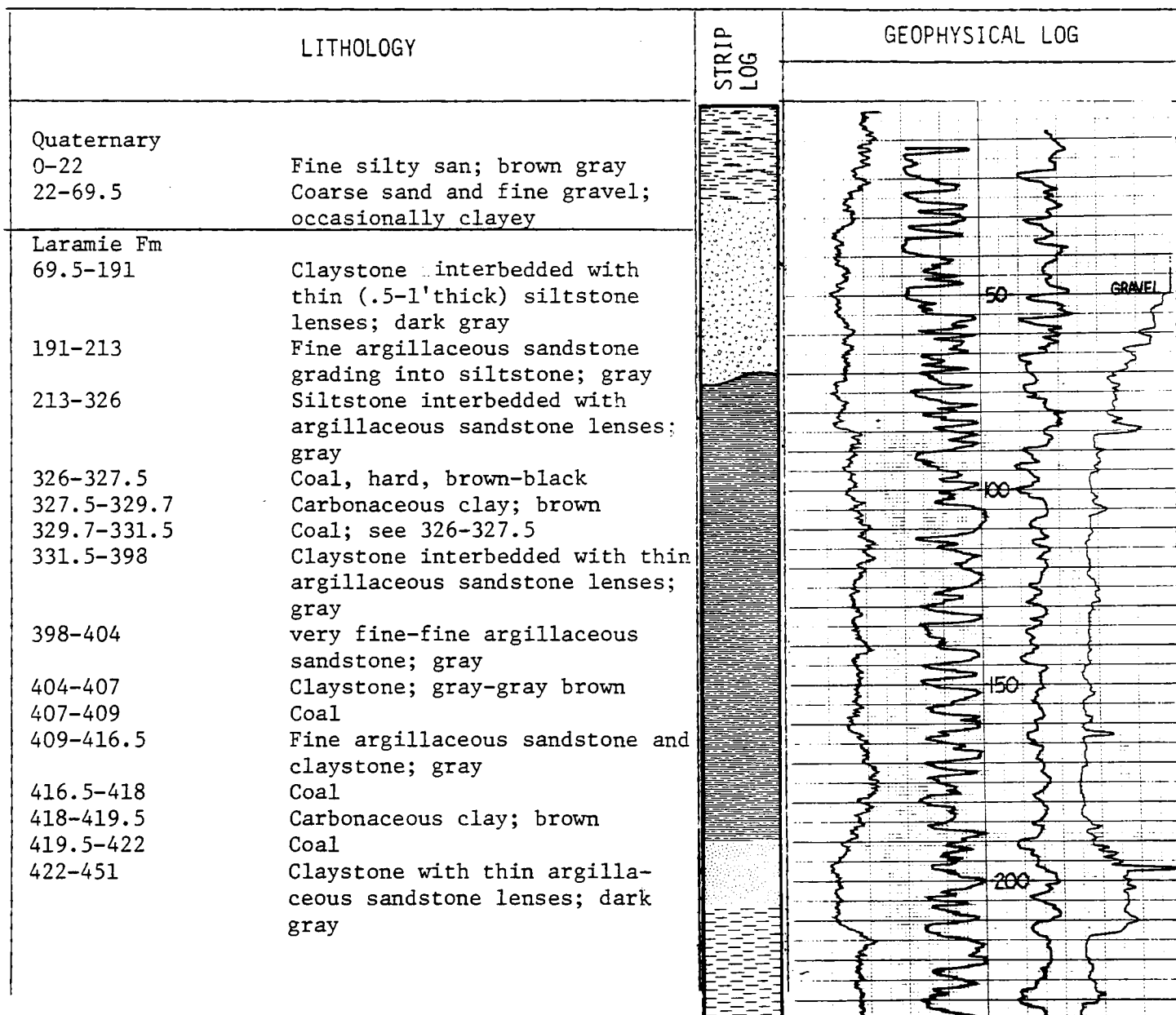
Location: T. 1 S., R. 62 W., secs. SWSE Cored: Yes No X

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

Geophysical logs:

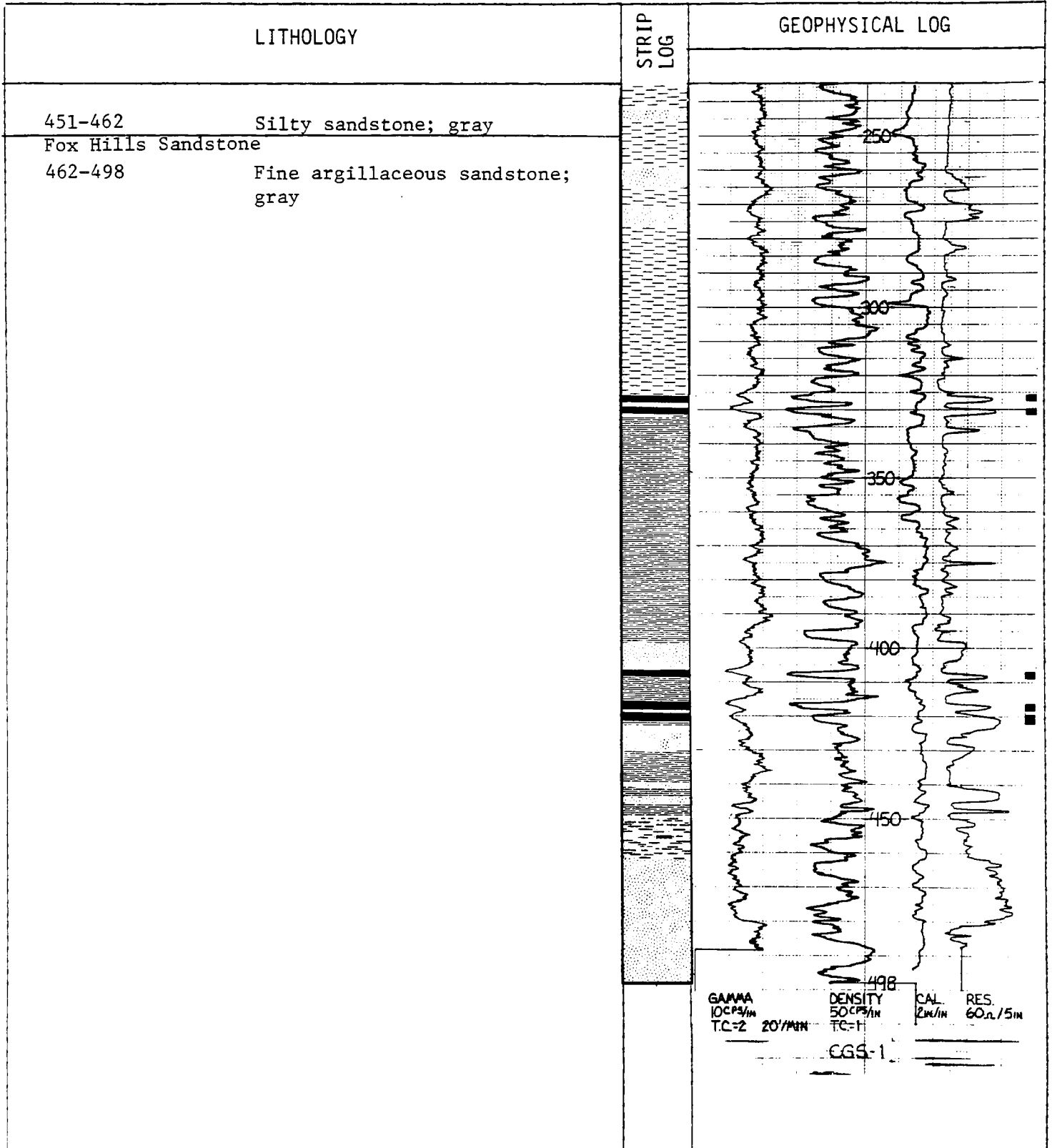
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 60 ohms/5in	Logging speed 20	fpm

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

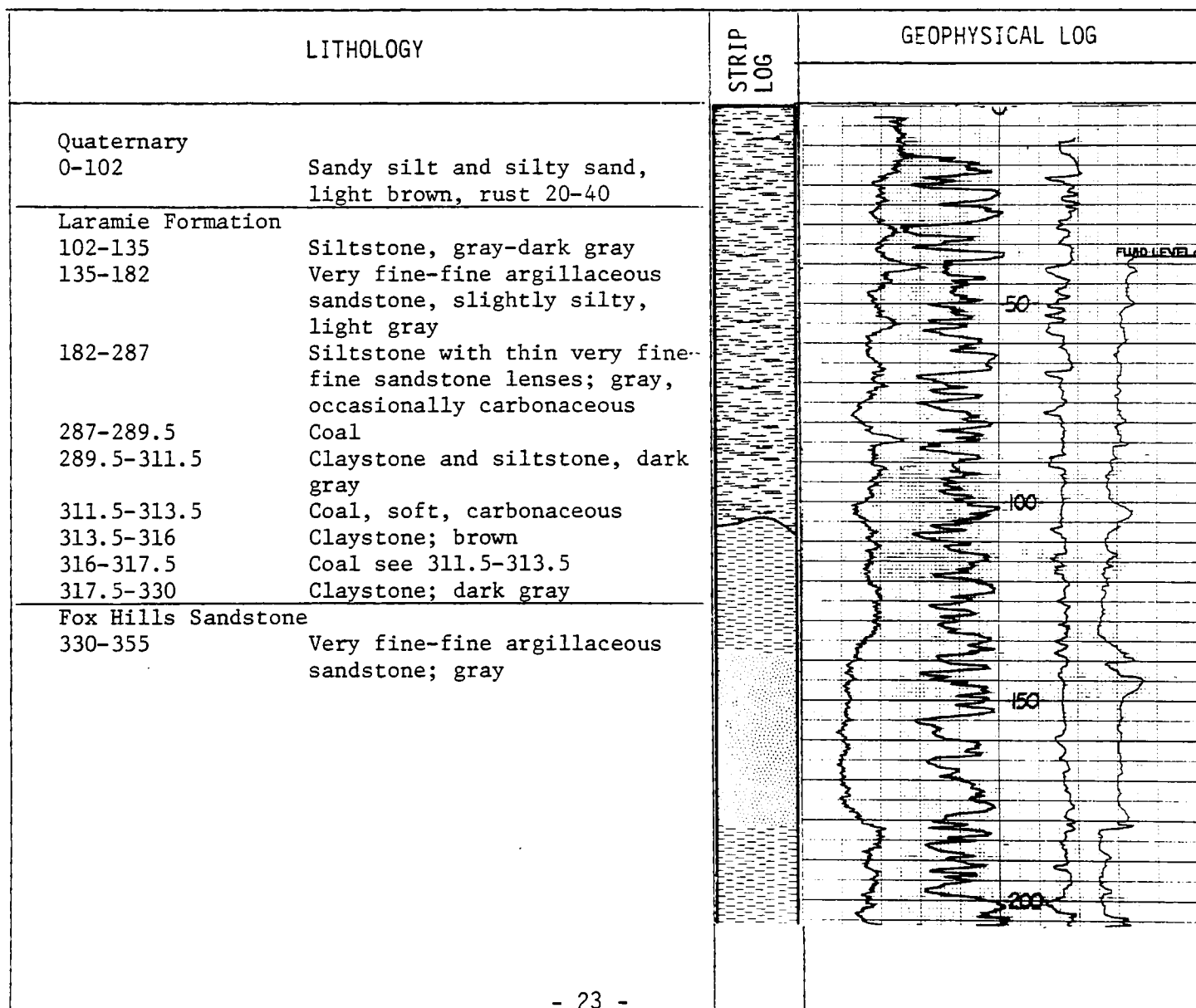
Location: T. 1 S., R. 61 W., secs. SESE 10 Cored: Yes No X

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

Geophysical logs:

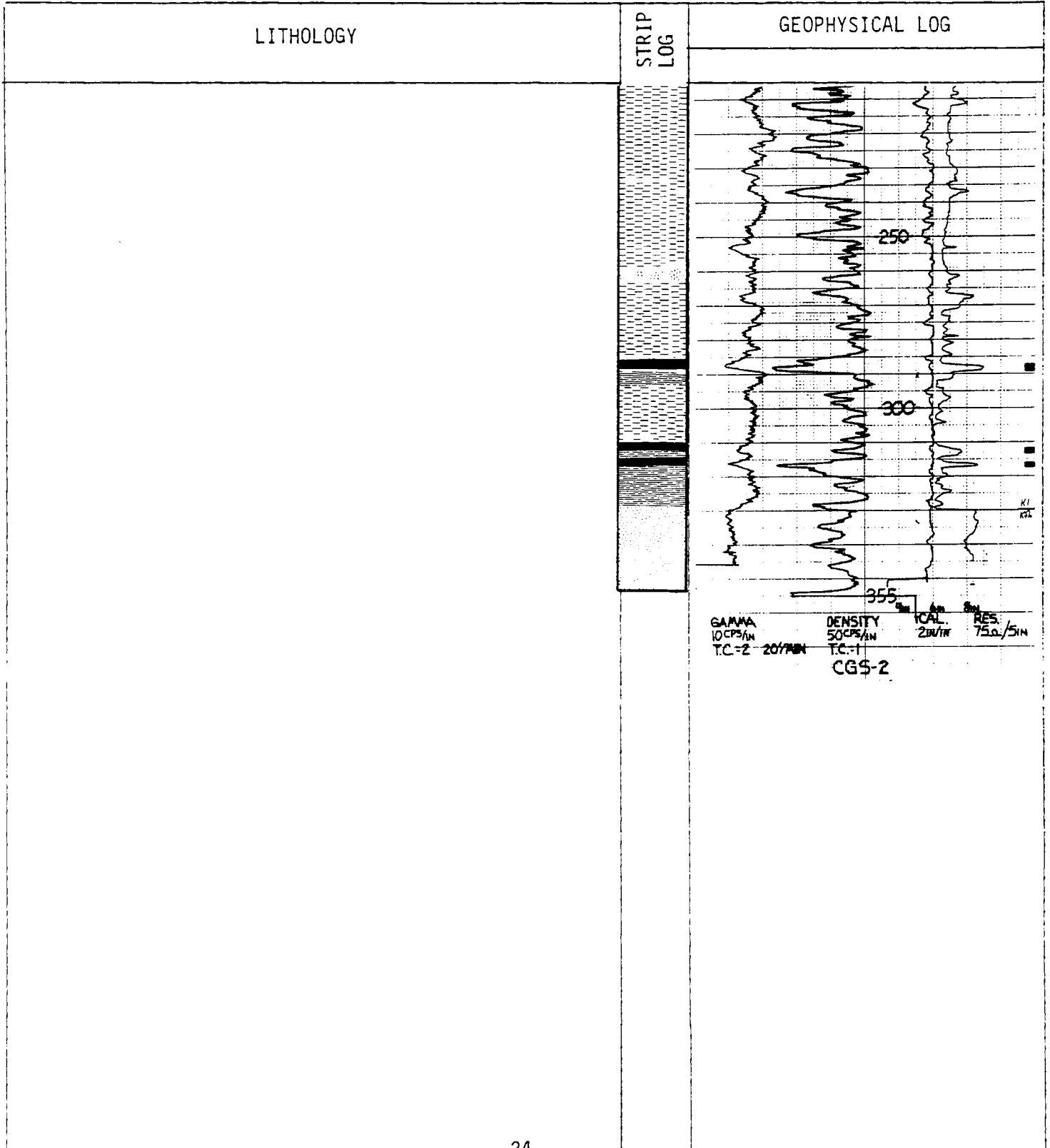
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 75 ohms/5in	Logging speed 20	fpm

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

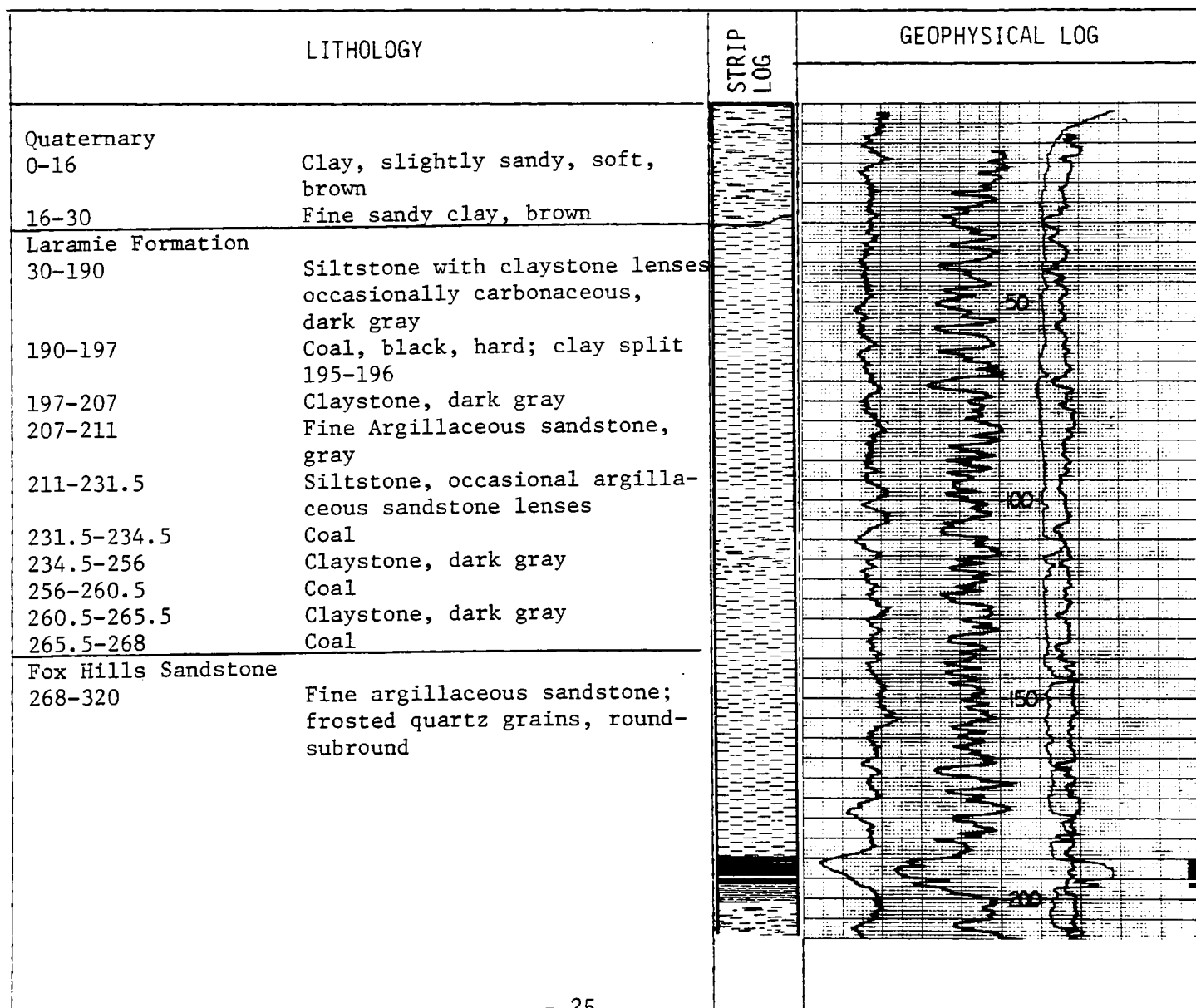
Location: T. 2 S., R. 61 W., secs. NWNW 14 Cored: Yes No X

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

Geophysical logs:

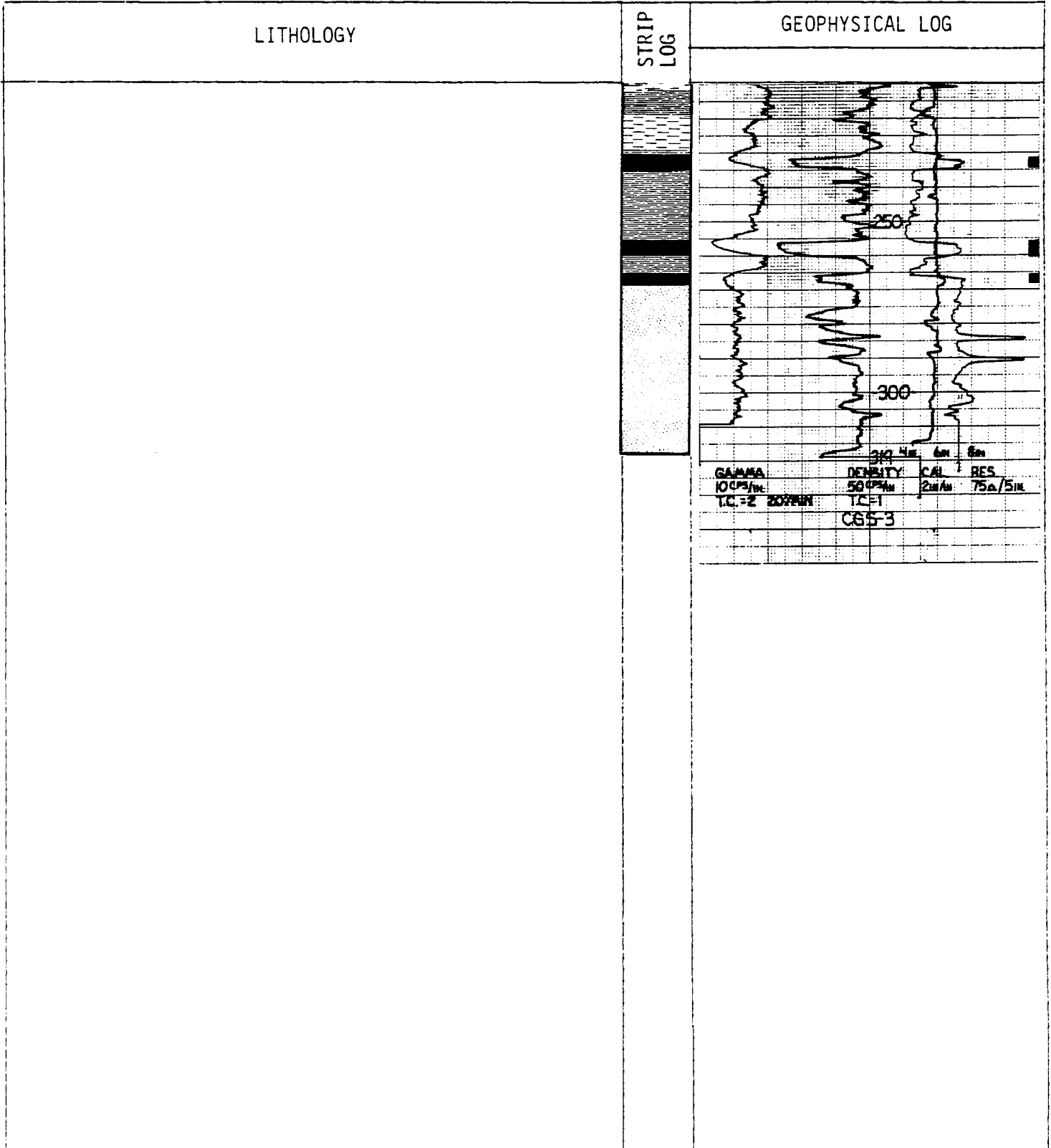
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 74 ohms/in	Logging speed 20	fpm

Remarks: Leader NW Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-3 - Continued



COLORADO GEOLOGICAL SURVEY

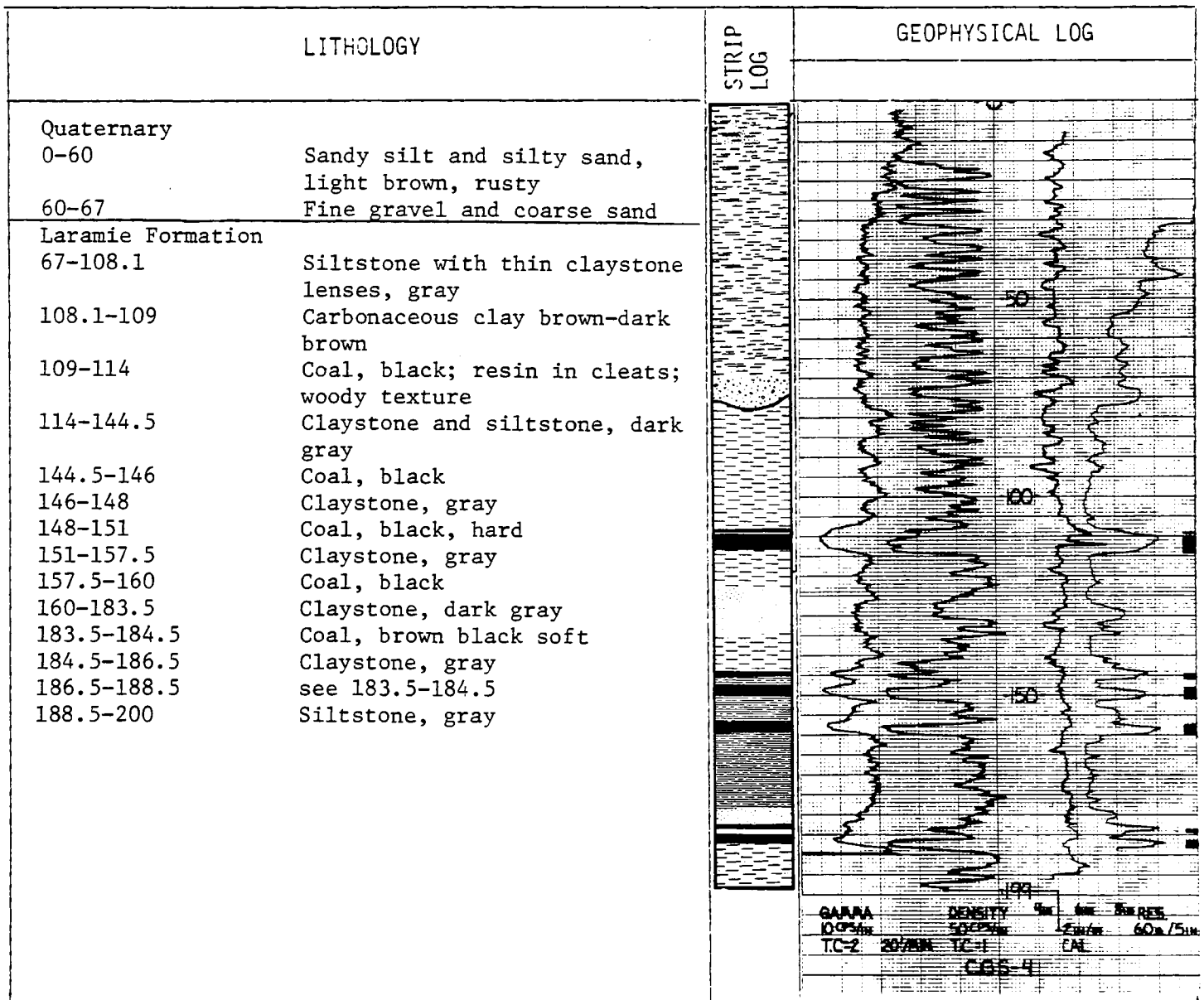
DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

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<sub>c</sub> 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

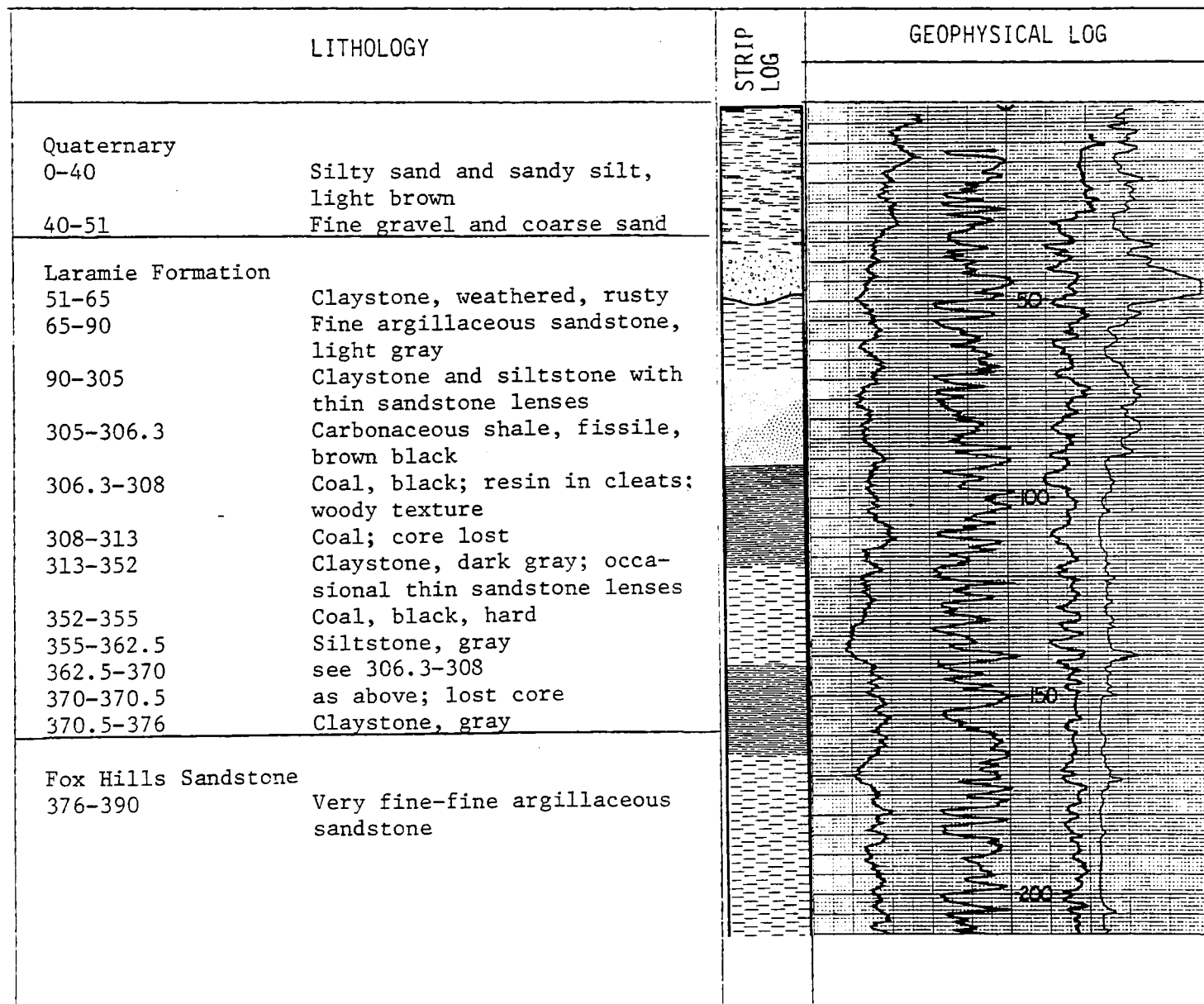
Location: T. 3 S., R.61 W., secs. NENE 4 Cored: X Yes No

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

Geophysical logs:

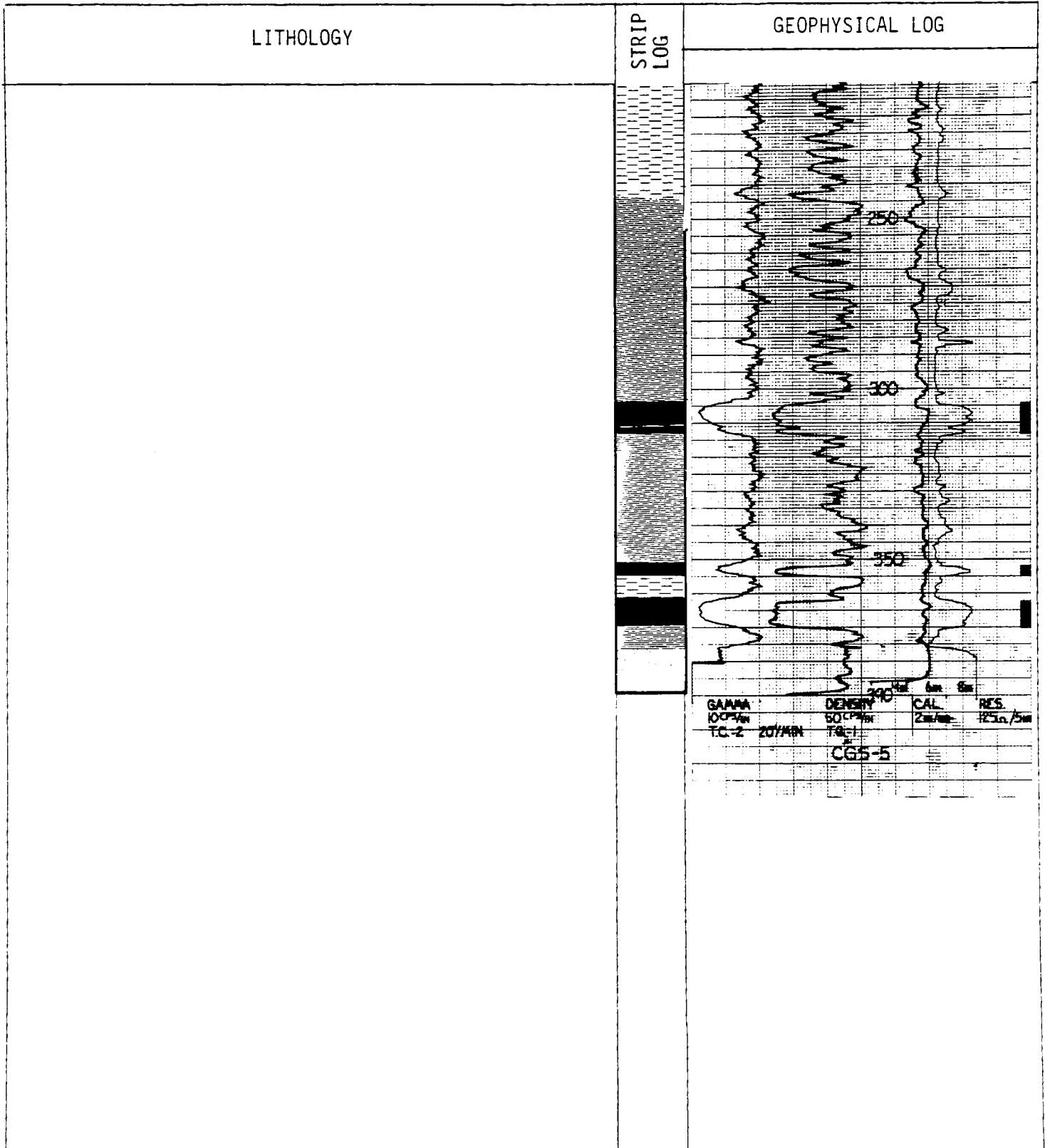
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 125 ohms/in	Logging speed 20	fpm

Remarks: CGS-5<sub>c</sub> 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

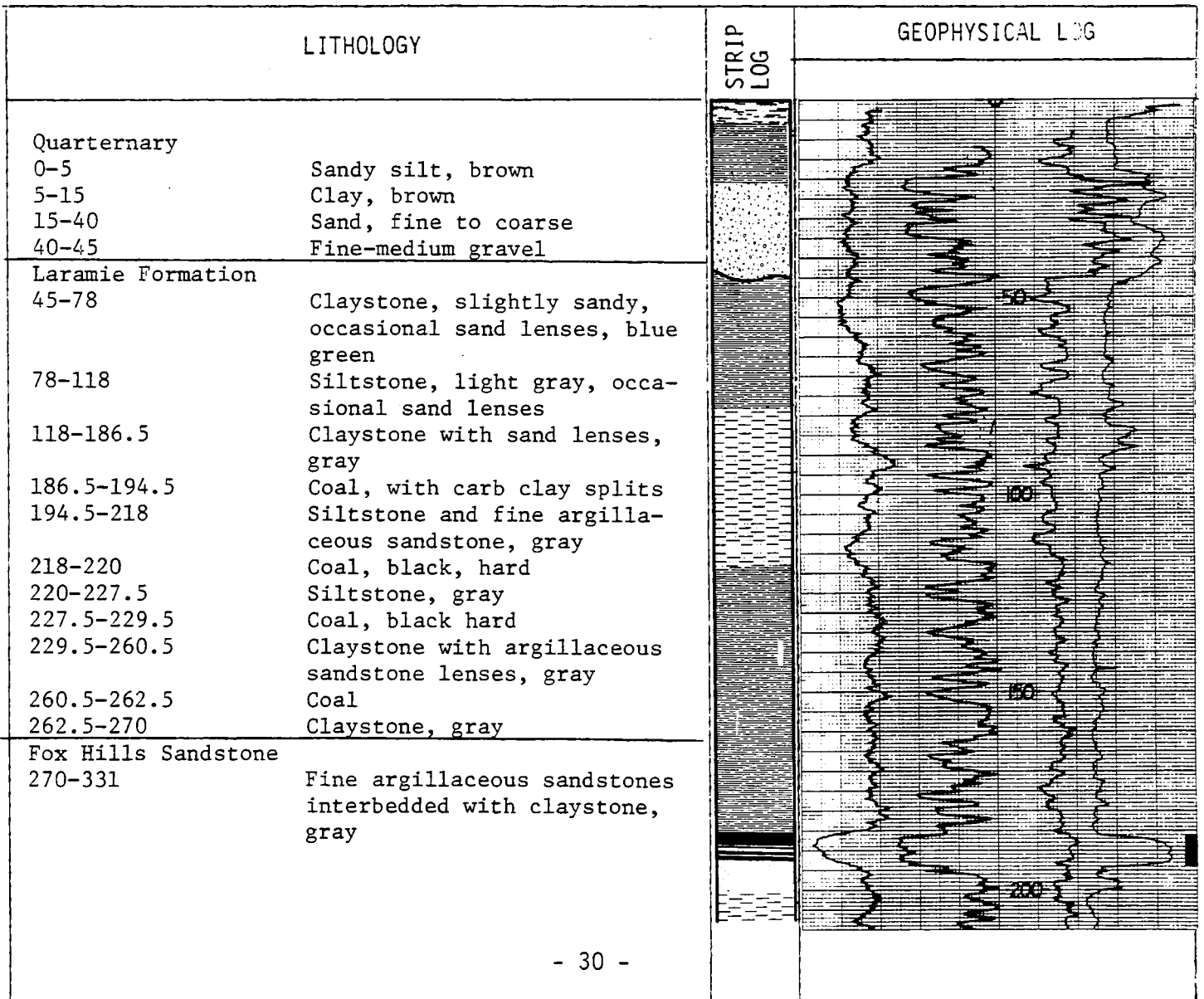
Location: T. 4 S., R. 60 W., secs. NENW 4 Cored: Yes No x

Drilled depth 331 Logged depth 331 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 60 ohms/5in	Logging speed 20	fpm

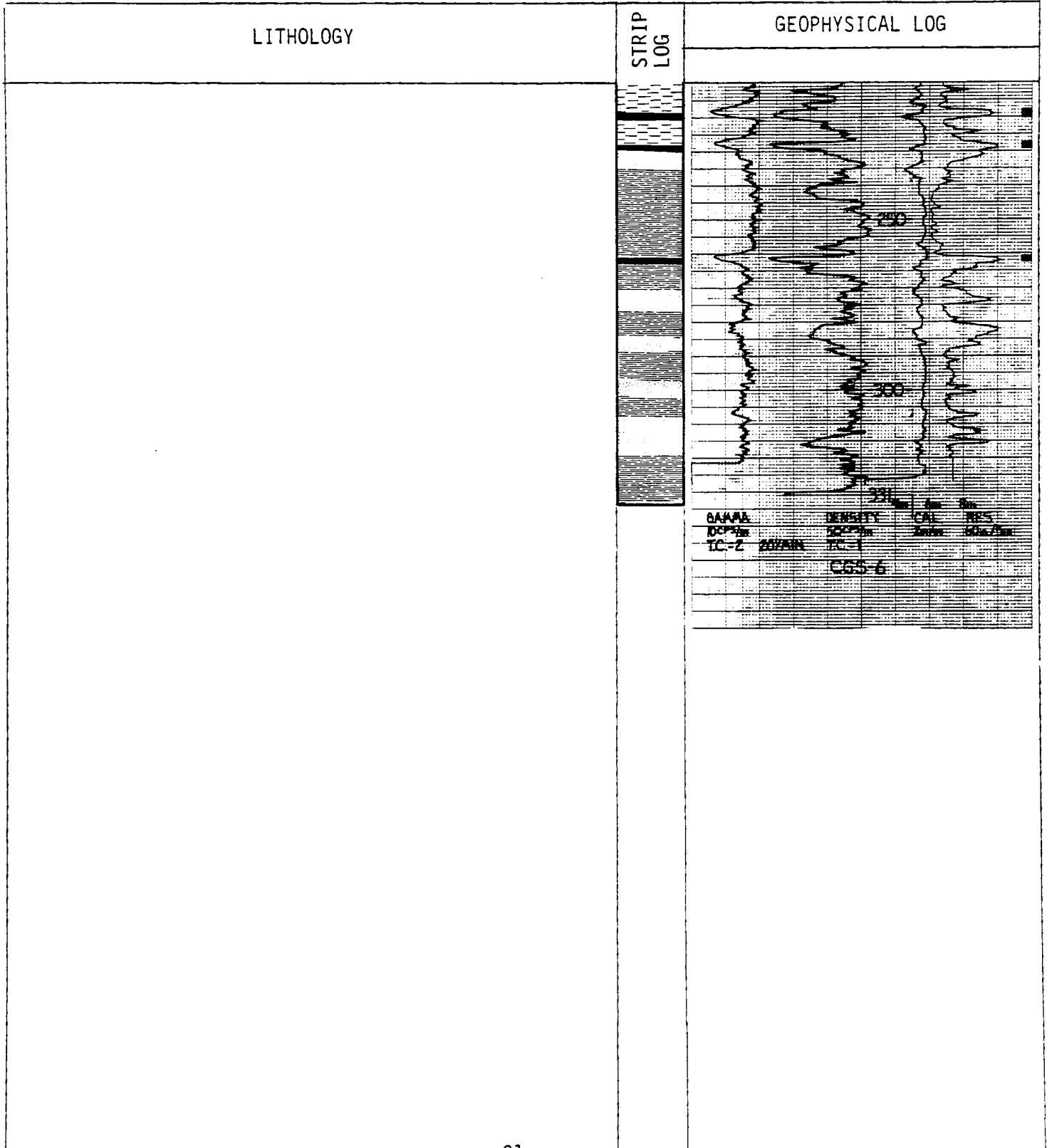
Remarks: Peoria Quadrangle.





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

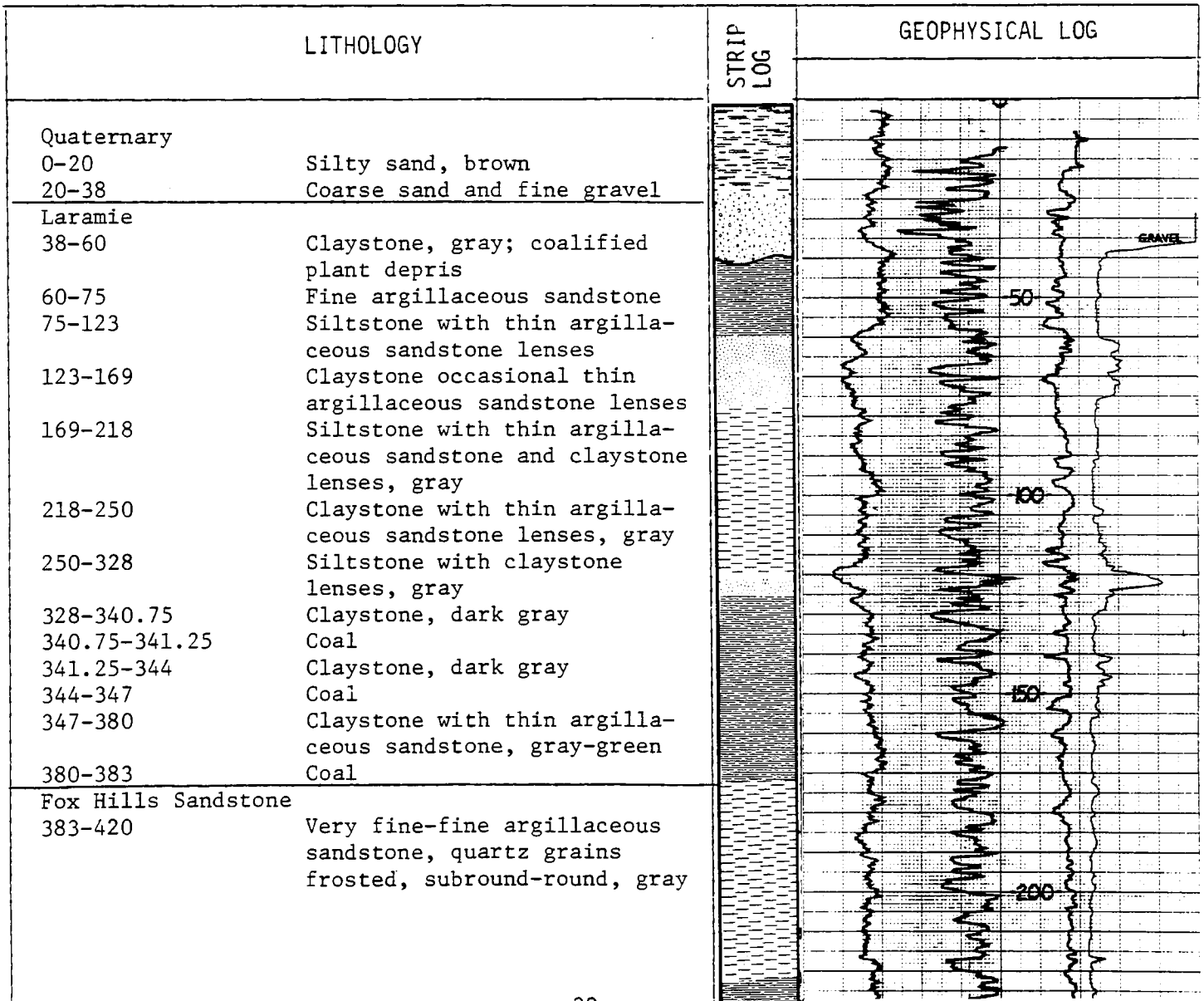
Location: T. 5 S., R. 60 W., secs. SWSE 14 Cored: Yes No x

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

Geophysical logs:

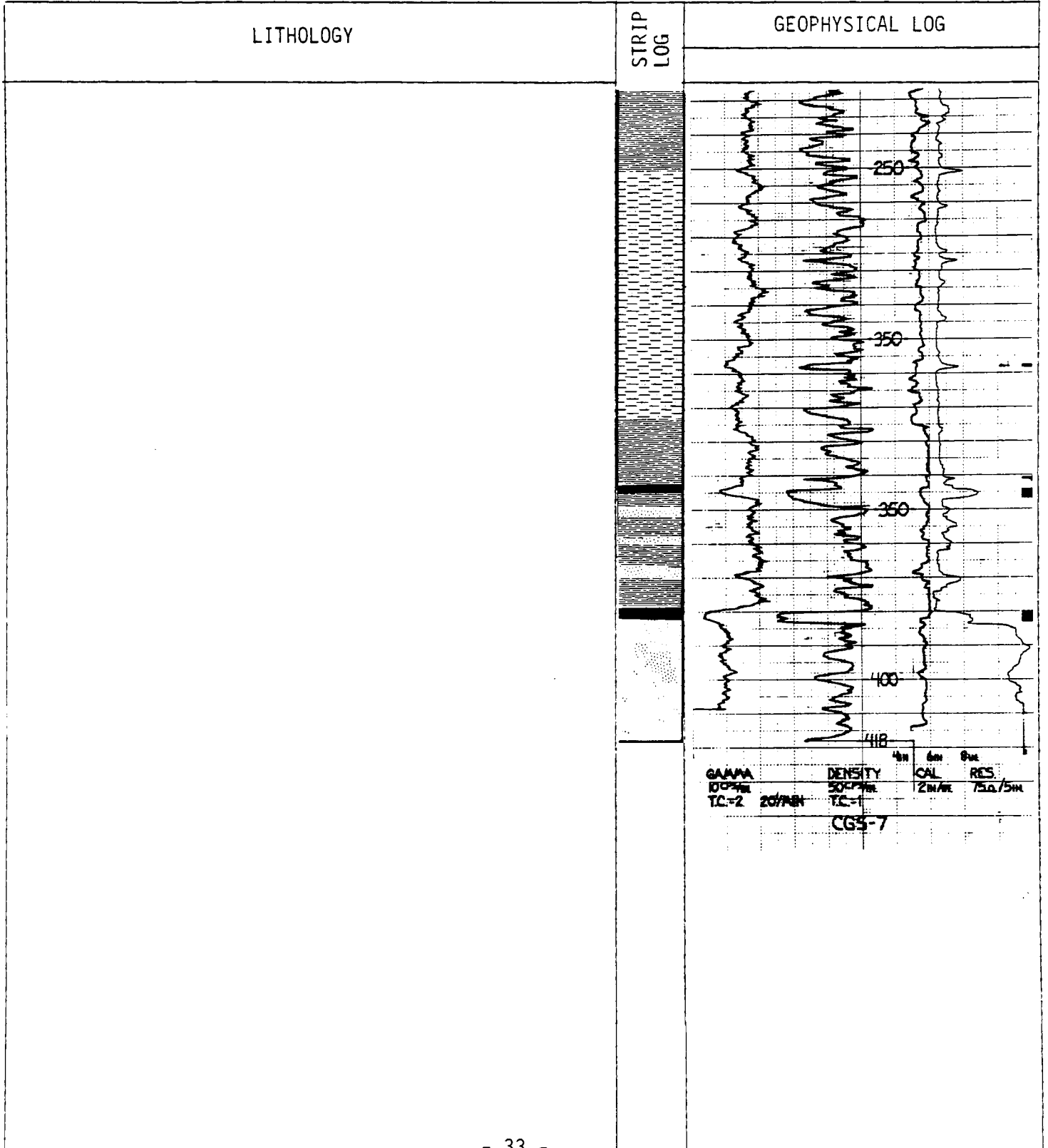
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	ftm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	ftm
Caliper (C):		Scale 2 in/in	Logging speed 20	ftm
Resistance (Res):		Scale 75 ohms/5in	Logging speed 20	ftm

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

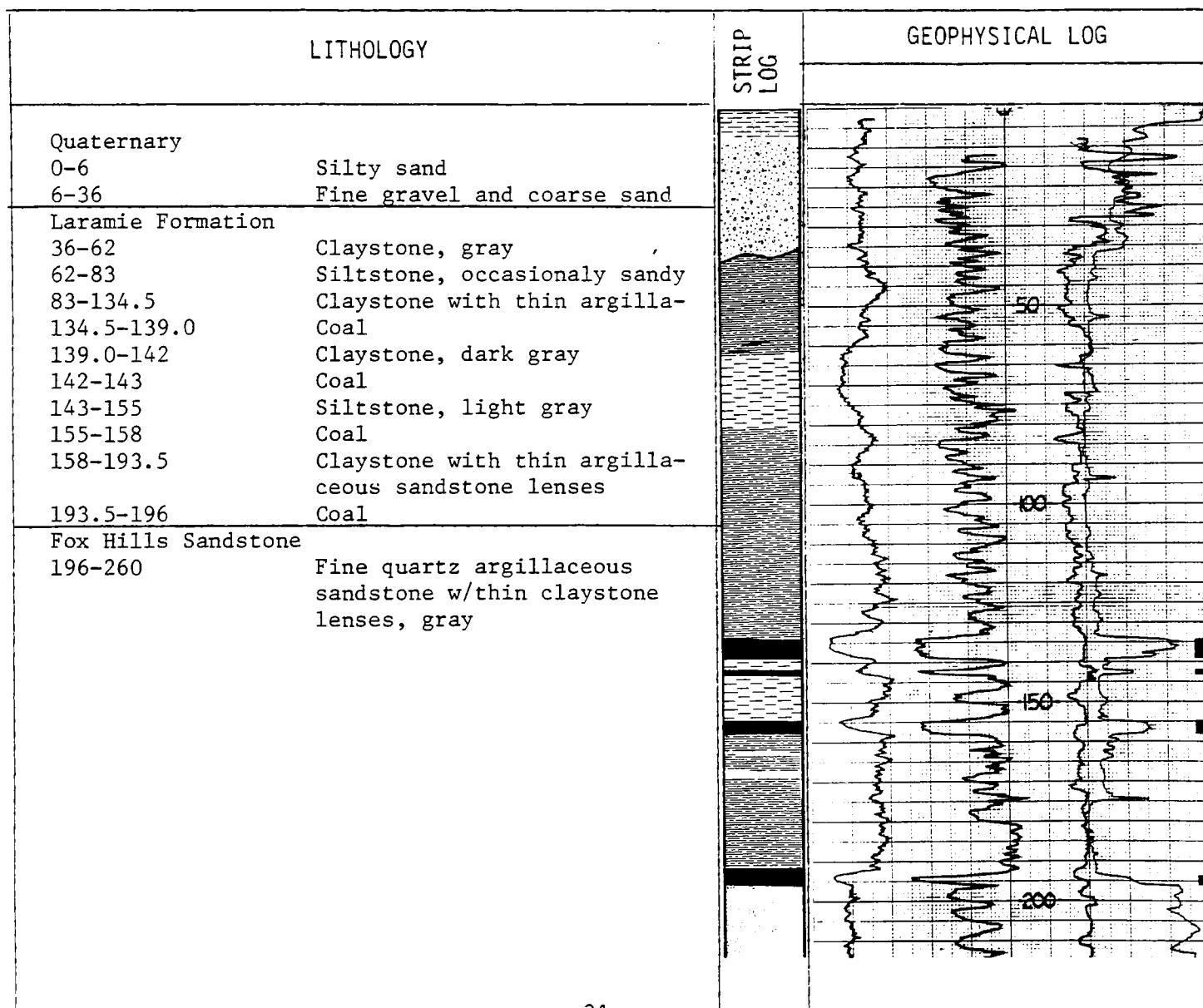
Location: T. 5 S., R. 60 W., secs. SESE Cored: Yes No x

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

Geophysical logs:

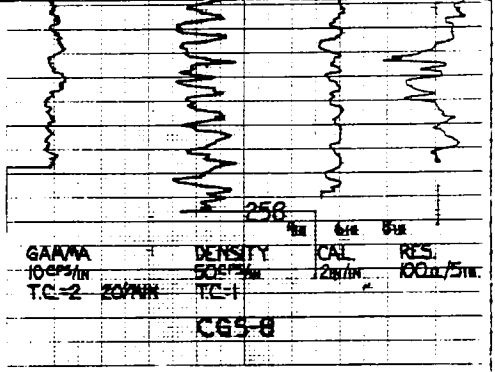
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Deer Trail Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-8 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG												
		 <p>250</p> <table border="1"> <thead> <tr> <th>GAAMA</th> <th>DENSITY</th> <th>CAL</th> <th>RES.</th> </tr> </thead> <tbody> <tr> <td>100%/IN</td> <td>50%/IN</td> <td>20%/IN</td> <td>100%/5IN</td> </tr> <tr> <td>T.C.-2 ZONING</td> <td>T.C.-1</td> <td></td> <td></td> </tr> </tbody> </table> <p>CGS-8</p>	GAAMA	DENSITY	CAL	RES.	100%/IN	50%/IN	20%/IN	100%/5IN	T.C.-2 ZONING	T.C.-1		
GAAMA	DENSITY	CAL	RES.											
100%/IN	50%/IN	20%/IN	100%/5IN											
T.C.-2 ZONING	T.C.-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

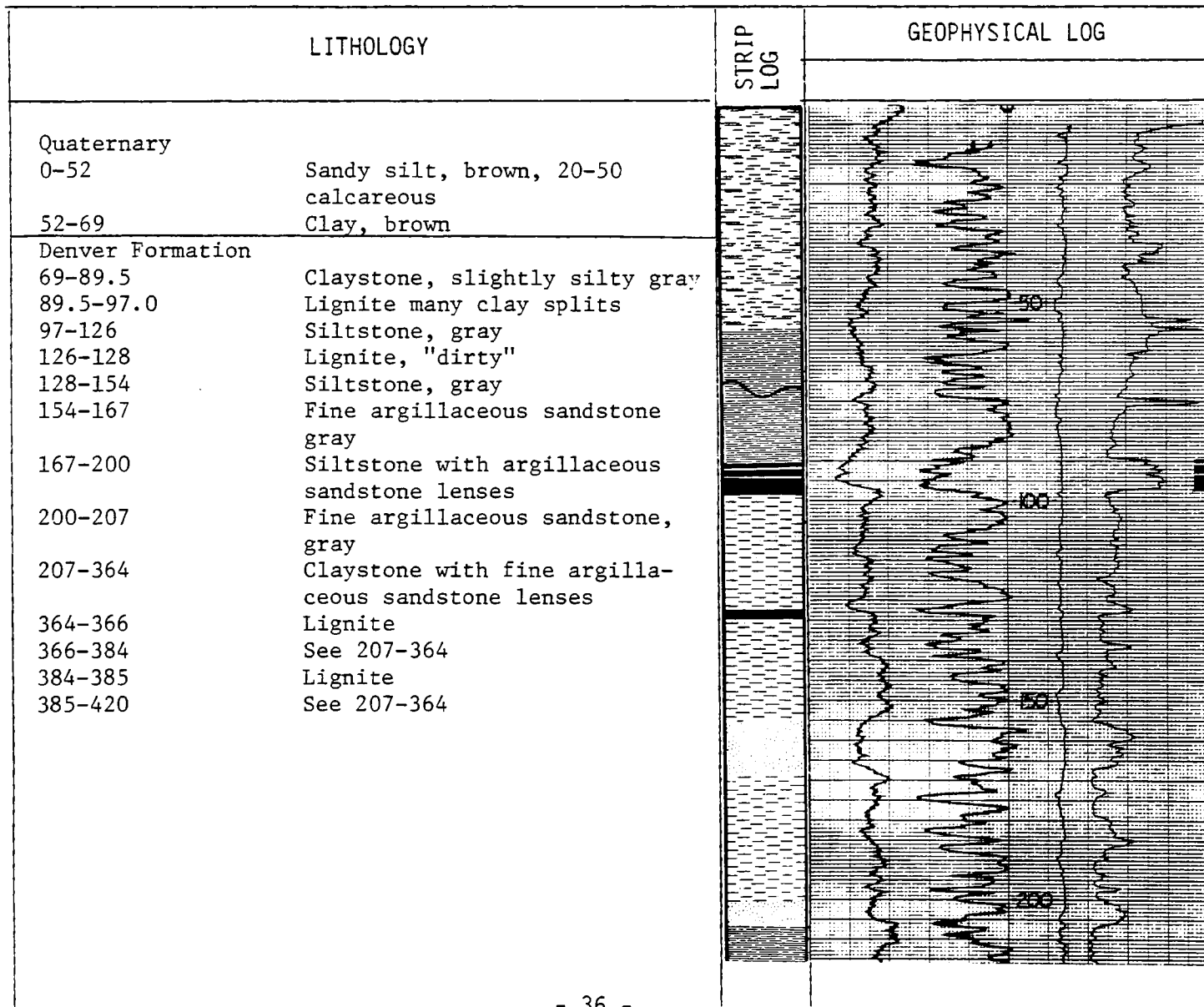
Location: T. 5 S., R. 63 W., secs. SWSW 11 Cored: Yes No X

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

Geophysical logs:

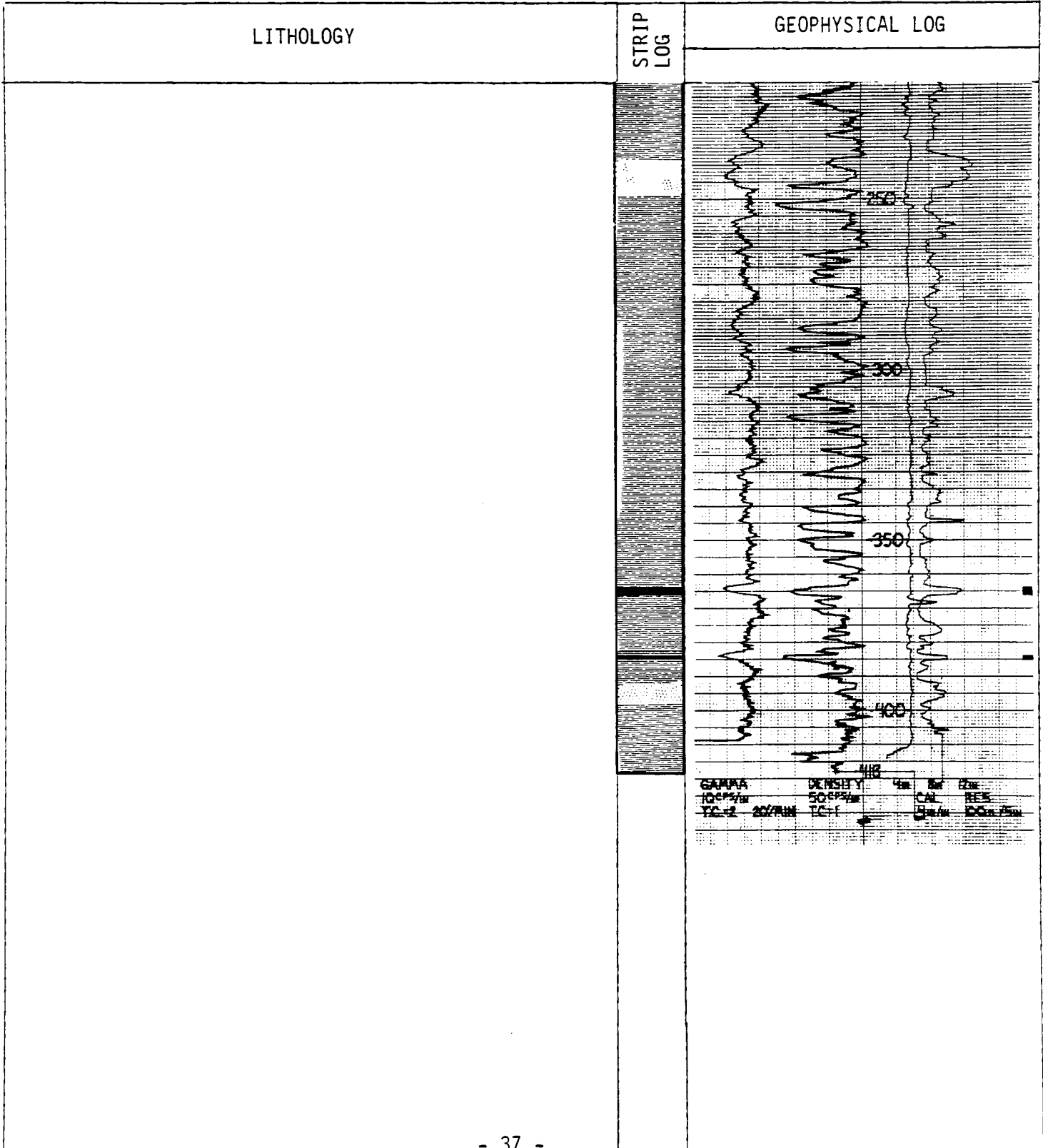
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

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<sub>c</sub> 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.

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG	
Quaternary				
15.0-15.6	slty cly, brn tan			
15.6-15.8	clyy sd, fn-cse; qtz, mag, mica, & feld grains			
Dawson Arkose				
15.8-19.0	clyst, brn tan, rusty, wx			
19.0-25	sdst, arg, x-bedd; color as above w/gry streaks			
25-30	same as 19-25			
30-31.1	same as 19-25			
31.1-31.6	tan cly, soft, slightly slty			
31.6-40.0	tan arg sdst, fn-med			
40.0-42.5	arg sdst fn-cse & fn grl feld, mica, mag			
Denver Formation				
42.5-45.3	sdly sltst rusty w/gyp veinlets			
45.3-47.1	sltst, gry, small colified frag			
47.1-47.2	blk brn carb sh, fissile			
47.2-50.0	sltst lt gry slightly sd w/musc & small coalified plant debris			
50-52	same as 47.2-50.0			
52-54.3	lost			
54.3-56.4	same as 47.2-50.0			
56.4-56.8	as above contains small <1/4" limonite concretions			
56.8-60.0	gry-dk gry clyst, slightly slty			
60-64	see 56.8-60.0 gry grn			
64.0-70.0	gry grn clyst, slightly slty			
70.0-73.1	fn-med arg sdst, gry feld, mica, & qtz some pyrite w/thin (<.05') carb layers and coalified plant debris			



COLORADO GEOLOGICAL SURVEY

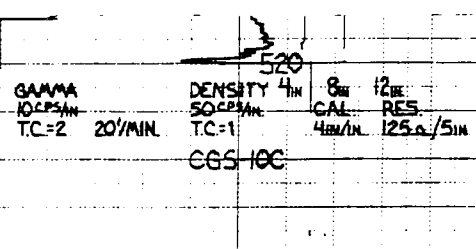
Hole No. CGS-10<sub>c</sub> - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
73.1-80.0 80.0-82.9 82.9-83.9 83.9-84.5	[Patterned strip log]	[Geophysical log traces]
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	[Patterned strip log]	[Geophysical log traces]
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	[Patterned strip log]	[Geophysical log traces]
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	[Patterned strip log]	[Geophysical log traces]
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	[Patterned strip log]	[Geophysical log traces]
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	[Patterned strip log]	[Geophysical log traces]
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.	[Patterned strip log]	[Geophysical log traces]
166.0-166.4 see 157.0-166.0 166.4-166.5 carb cly, dk brn contains coalified plant debris	[Patterned strip log]	[Geophysical log traces]
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	[Patterned strip log]	[Geophysical log traces]
173.2-174.9 clyst w/slty lenses, grn	[Patterned strip log]	[Geophysical log traces]

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10c- Continued

LITHOLOGY		STRIP LOG	GEOPHYSICAL LOG			
174.9-175.0	fn arg sdst, grn					
175.0-182.0	see 173.2-174.9					
182.0-183.7	clyst, grn					
183.7-184.0	pulled off					
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<sub>C</sub>- 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<sub>c</sub>- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
0-1.3	clyst, gry	
1.3-2.5	sltst, gry w/ vfn sd & coalified plant debris; exact depth unknown	
348-353.2	sltst gry	
353.2-354.6	carb sltst, brn w/ gry sltst	
354.6-358.0	arg sdst, fn-md, qtz, gry grn	
358.0-359.0	see 354.6-358.0	
359.0-361.0	clyst, gry grn	
361.0-361.2	carb cly, dk brn	
361.2-363.9	clyst, gry grn	
363.9-367.5	gry sltst, sdy	
367.5-368.0	clyst, gry grn	
368.0-368.3	see 367.5-368.0	
368.3-369.2	as above, calcareous	
369.2-375.9	slst, gry grn w/ clst lenses	
375.9-378.0	clyst gry grn	
378.0-382.0	sltst, gry, frac	
382-384	rotary	
384.0-385.6	slty cly, brn, cpd	
385.6-385.9	arg sdst, fn-cse, qtz, fining down	
385.9-391.0	sltst, gry grn, w(thin( $\leq$ 1')) clyst lenses, contains cpd	
391.0-393.8	see 385.9-391.0	
393.8-395.1	arg sdst, fn, qtz, gry grn	
395.1-395.5	clyst, gry grn	
395.5-395.7	arg sdst, qtz, cse, gry grn	
395.7-396.1	slst, lt brn	
396.1-398.0	clyst, gry grn	
398.0-398.9	see 396.1-398.0	
398.9-399.5	arg sdst, fn-cse, qtz gry grn, fining down	
399.5-400.3	clyst, gry grn	
400.3-401.1	sltst w/cpd	
401.1-401.7	see 398.9-399.5	
401.7-405.0	see 398.9-399.5 calc. cem fn-cse, tr grl, cly balls qtz, fm	
408.0-415.0	see 401.7-405.0	
415.0-416.9	see 401.7-405.0 disem, pyrite xtals	
416.9-417.1	clyst, slty, gry, small ( $\leq$ .05') pyrite xtals	
417.1-417.6	blk brn carb sh, fissile	
417.6-421.6	see 416.9-417.1 @ 419.4 limonitic	

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10<sub>c</sub> - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
421.6-422.6		
422.6-425.0		
425.0-434.3		
434.3-434.6		
434.6-434.9		
434.9-435.0		
435.0-435.8		
435.8-436.1		
436.1-436.9		
436.9-437.9		
437.9-438.8		
438.8-438.9		
438.9-438.9		
438.9-439.4		
439.4-439.6		
439.6-439.9		
439.9-440.0		
440.0-440.6		
440.6-441.9		
441.9-442.1		
442.1-445.0		
445.0-447.0		
447.0-447.2		
447.2-447.7		
447.7-448.0		
448.0-448.2		
448.2-449.9		
449.9-450.1		
450.1-450.8		
450.8-450.9		
450.9-452.4		
452.4-453.7		
453.7-454.1		
454.1-454.2		
454.2-455.0		
455.0-455.5		
455.5-456.1		
456.1-465.3		

COLORADO GEOLOGICAL SURVEY

Hole No. CGS-10c - Continued

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

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

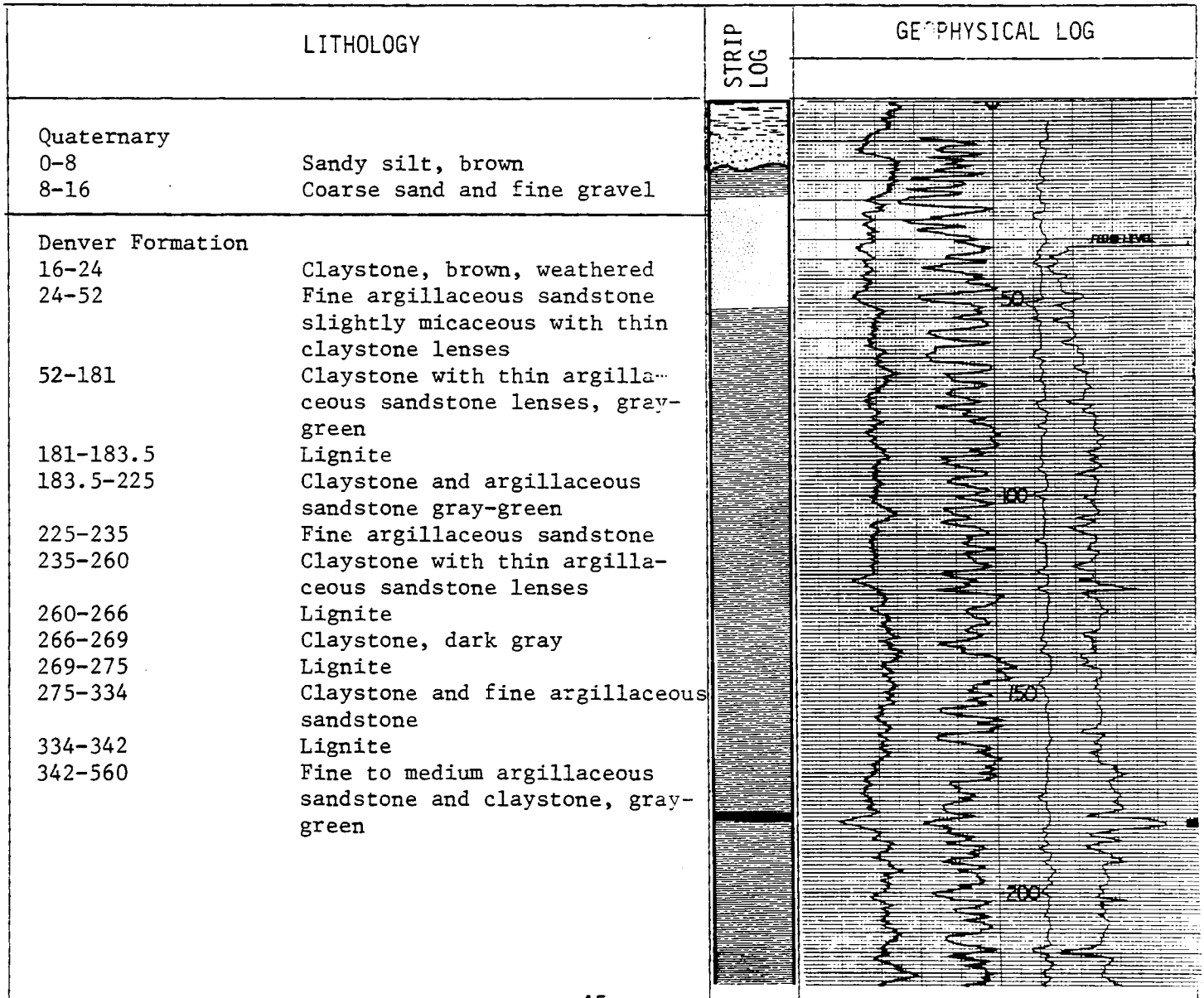
Location: T. 5 S., R. 64 W., secs. SESE 16 Cored: Yes No X

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

Geophysical logs:

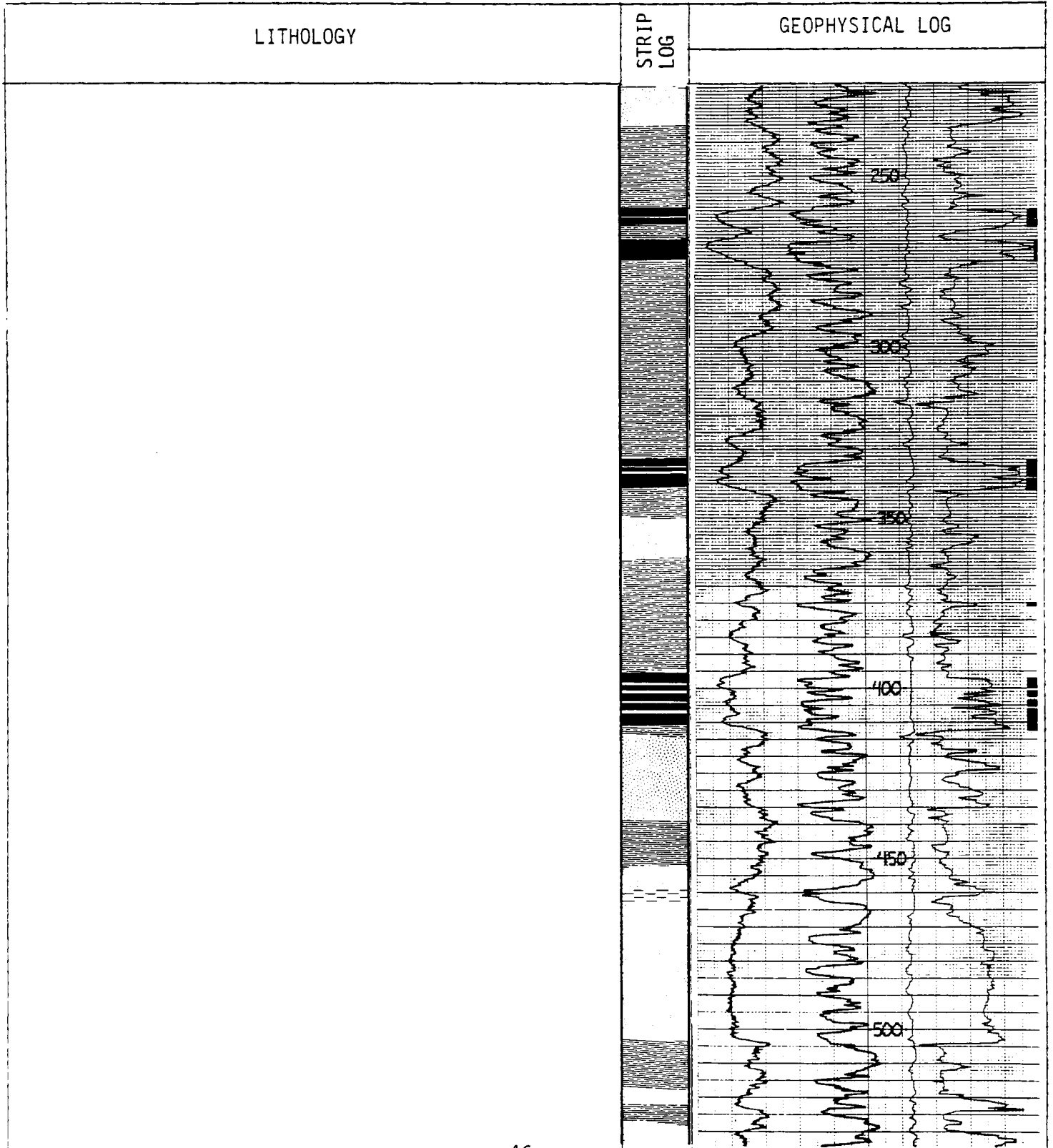
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle



COLORADO GEOLOGICAL SURVEY

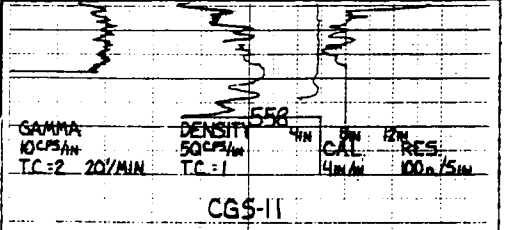
Hole No. CGS-11- Continued





COLORADO GEOLOGICAL SURVEY

Hole No. CGS-11 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG
		 <p>                     GAMMA 10 CPS/IN TC=2 20V/MIN                      DENSITY 50 CPS/IN TC=1                      CAL 4 IN/IN                      RES 100 OHM/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

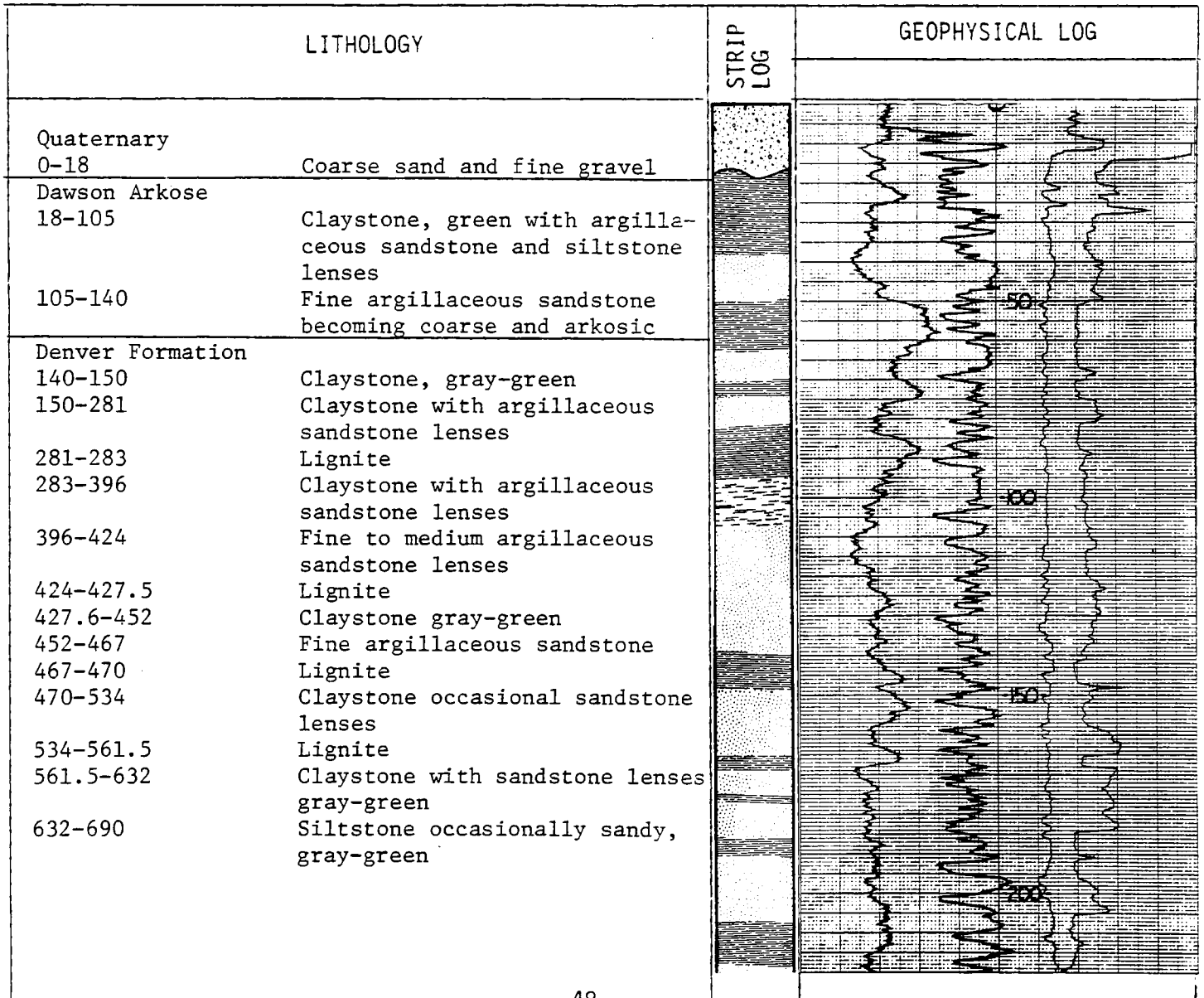
Location: T. 6 S., R. 64 W., secs. NWSW 15 Cored: Yes No X

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

Geophysical logs:

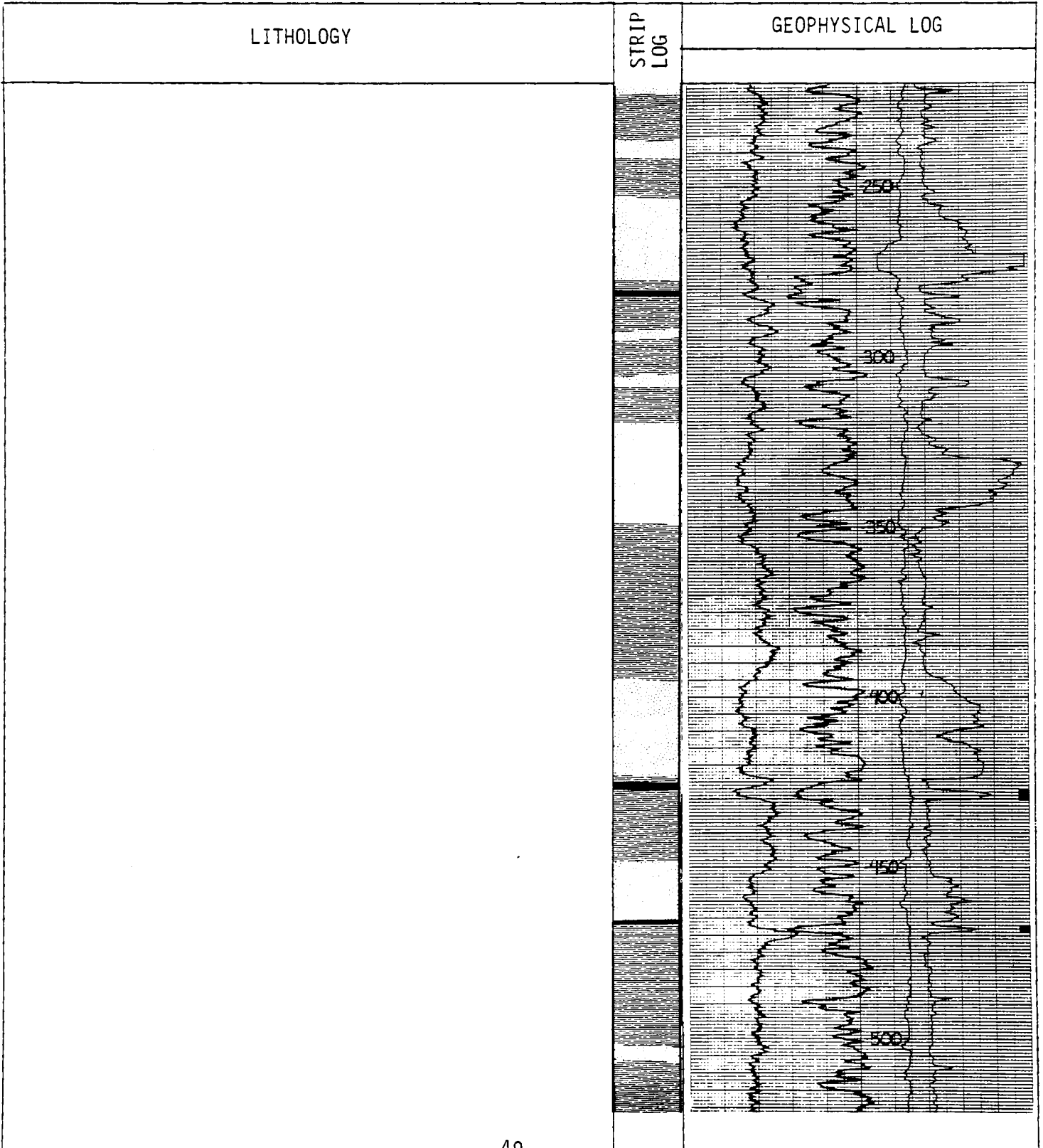
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-13- Continued



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-13 - Continued

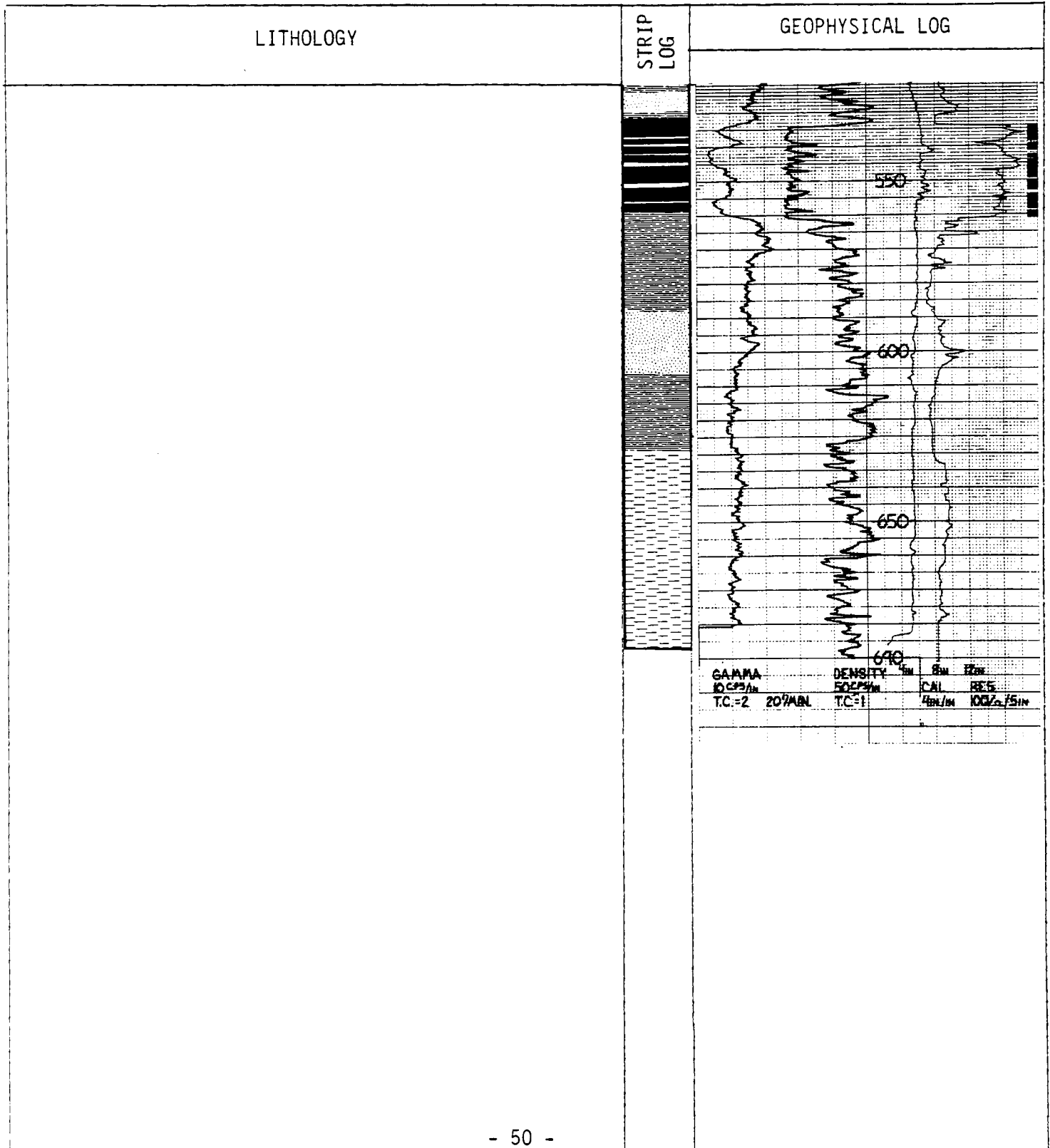


TABLE 5

LIQUID PERMEABILITY DATA  
CGS-10<sub>c</sub>

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

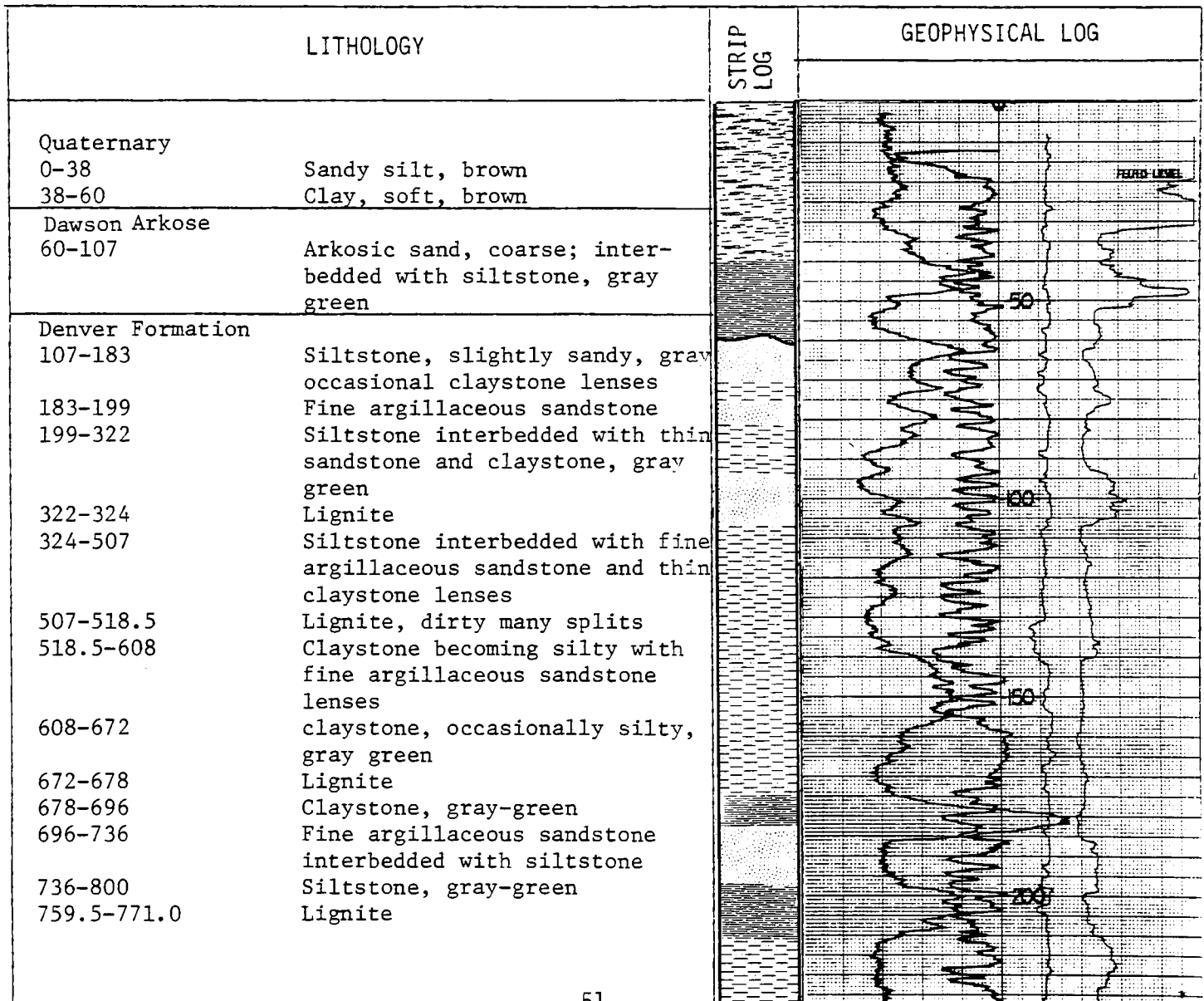
Location: T. 6 S., R. 65 W., secs. SWSE 12 Cored: Yes No X

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

Geophysical logs:

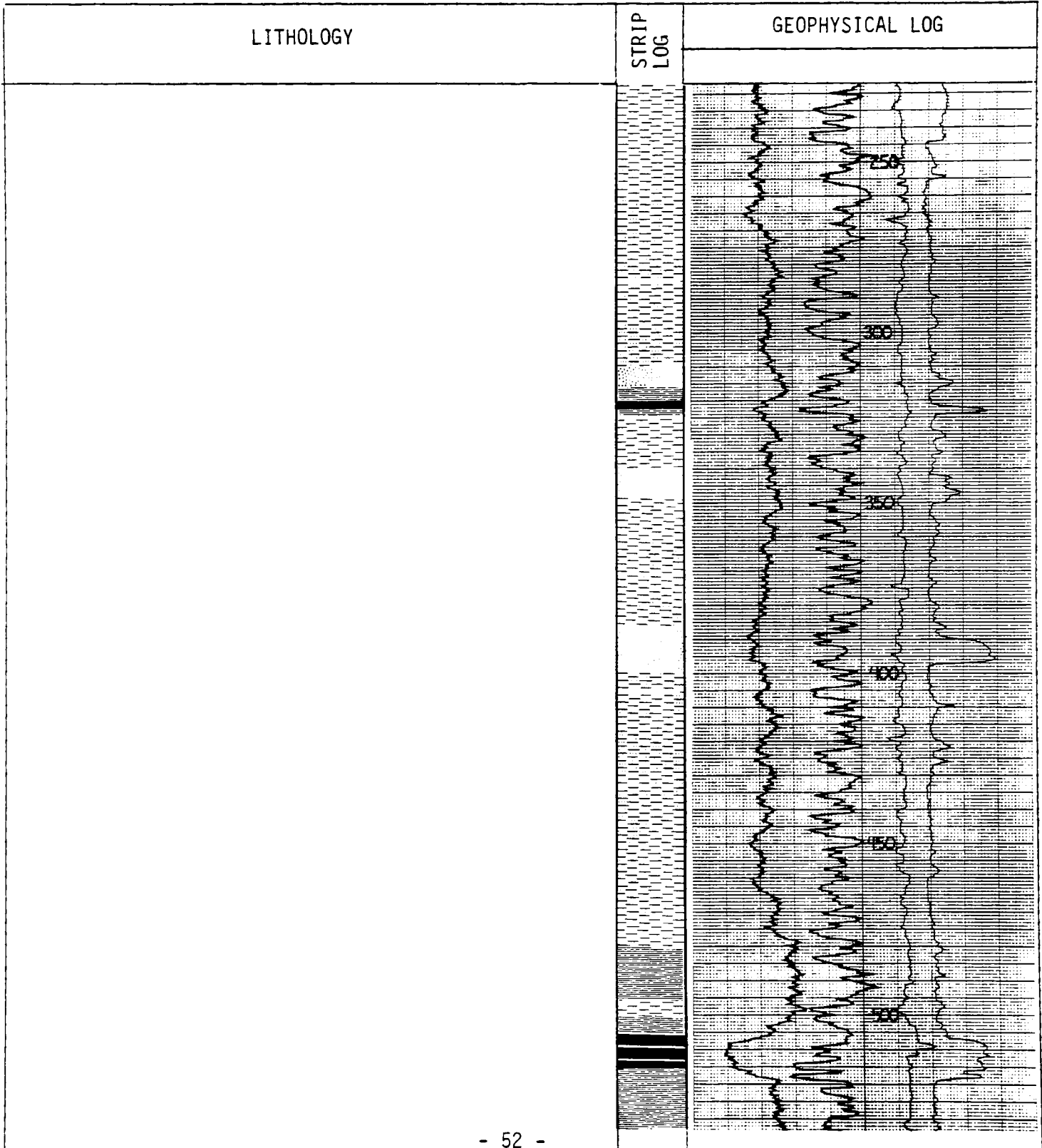
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

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



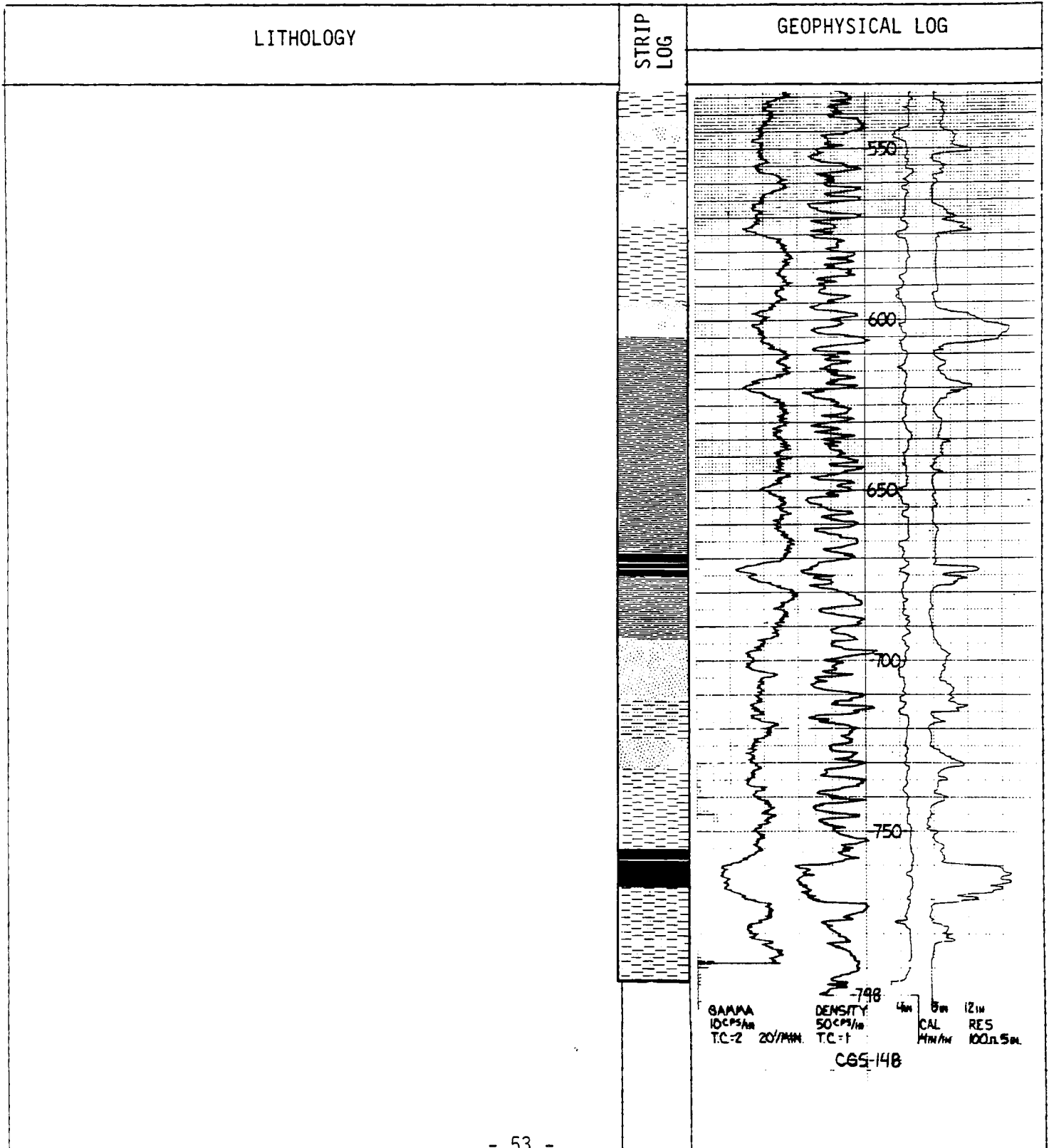
COLORADO GEOLOGICAL SURVEY

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

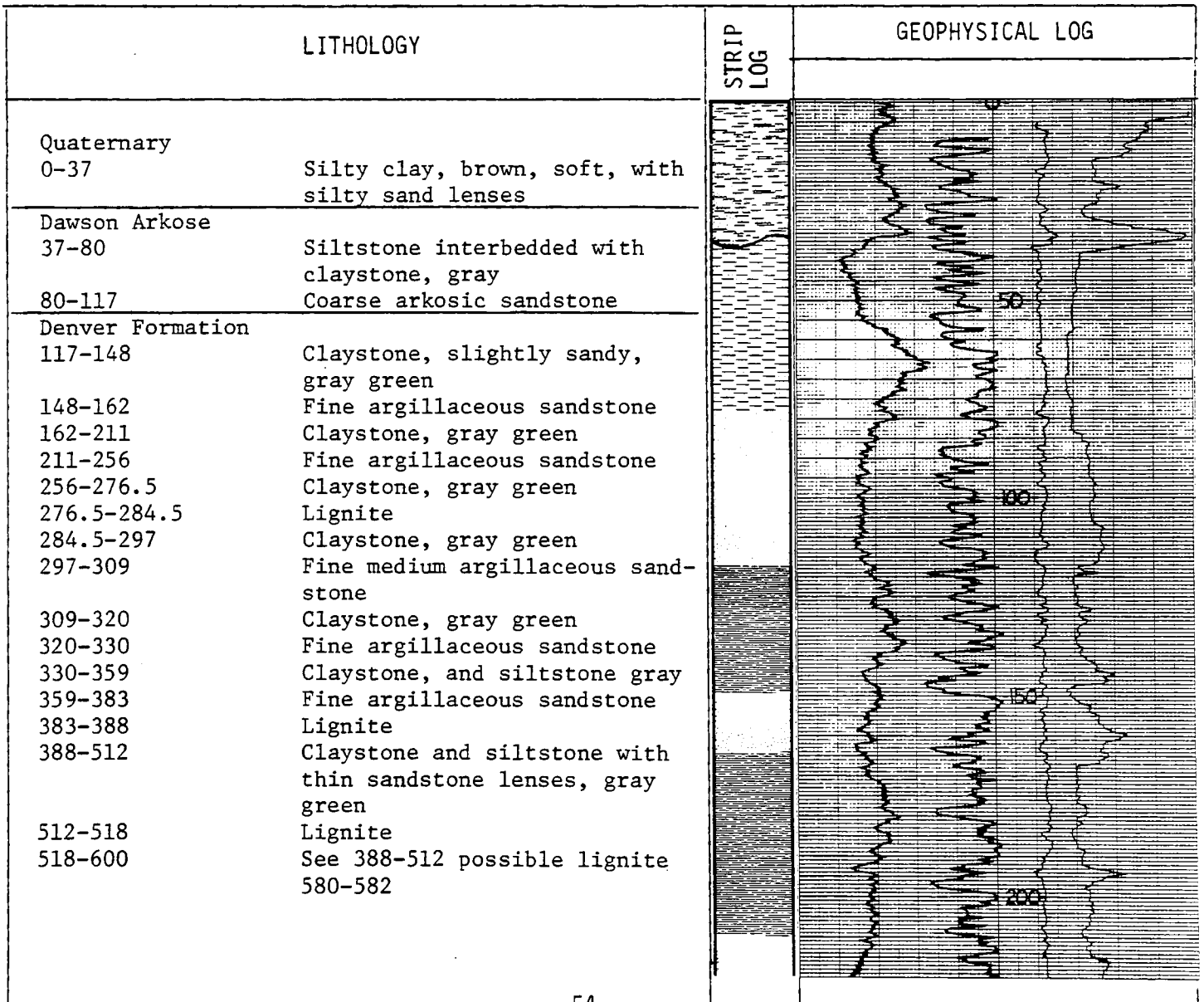
Location: T. 5 S., R. 64 W., secs. SWSE 25 Cored: Yes NoX

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

Geophysical logs:

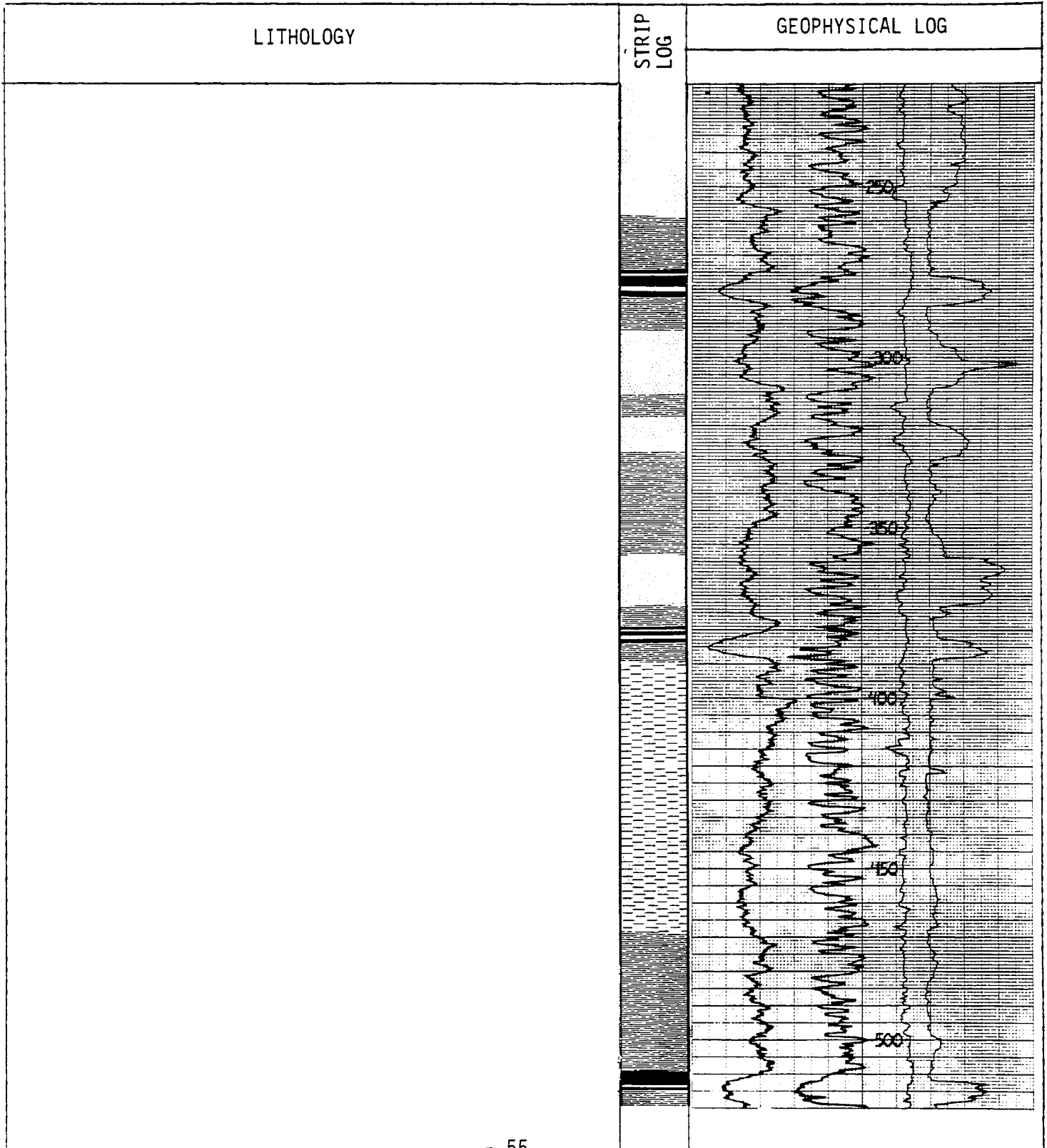
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-15 - Continued



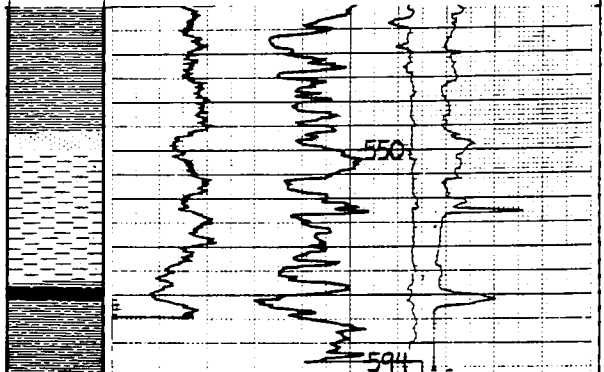
COLORADO GEOLOGICAL SURVEY

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	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

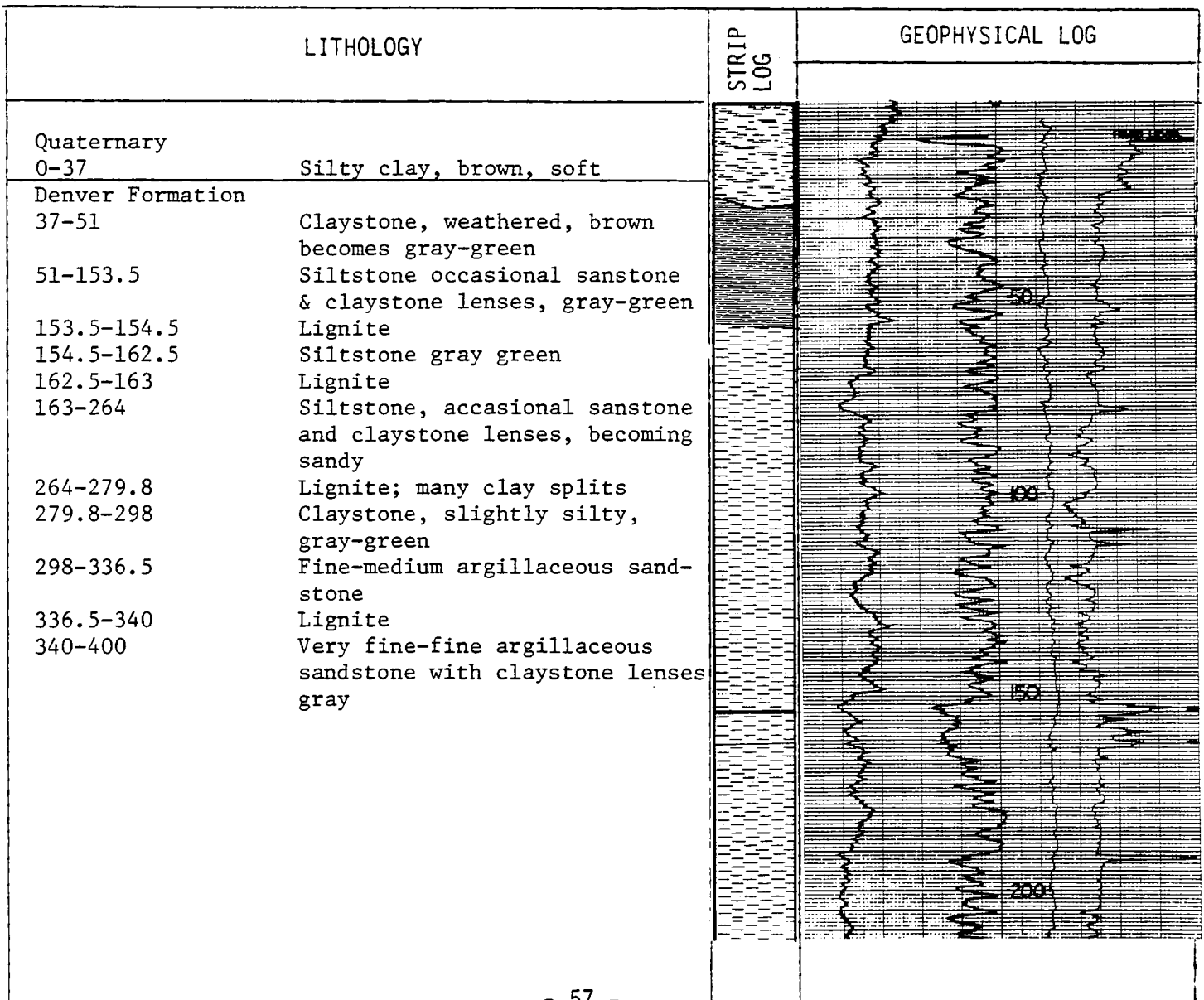
Location: T. 4 S., R.66 W., secs. SENE 12 Cored: Yes No X

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

Geophysical logs:

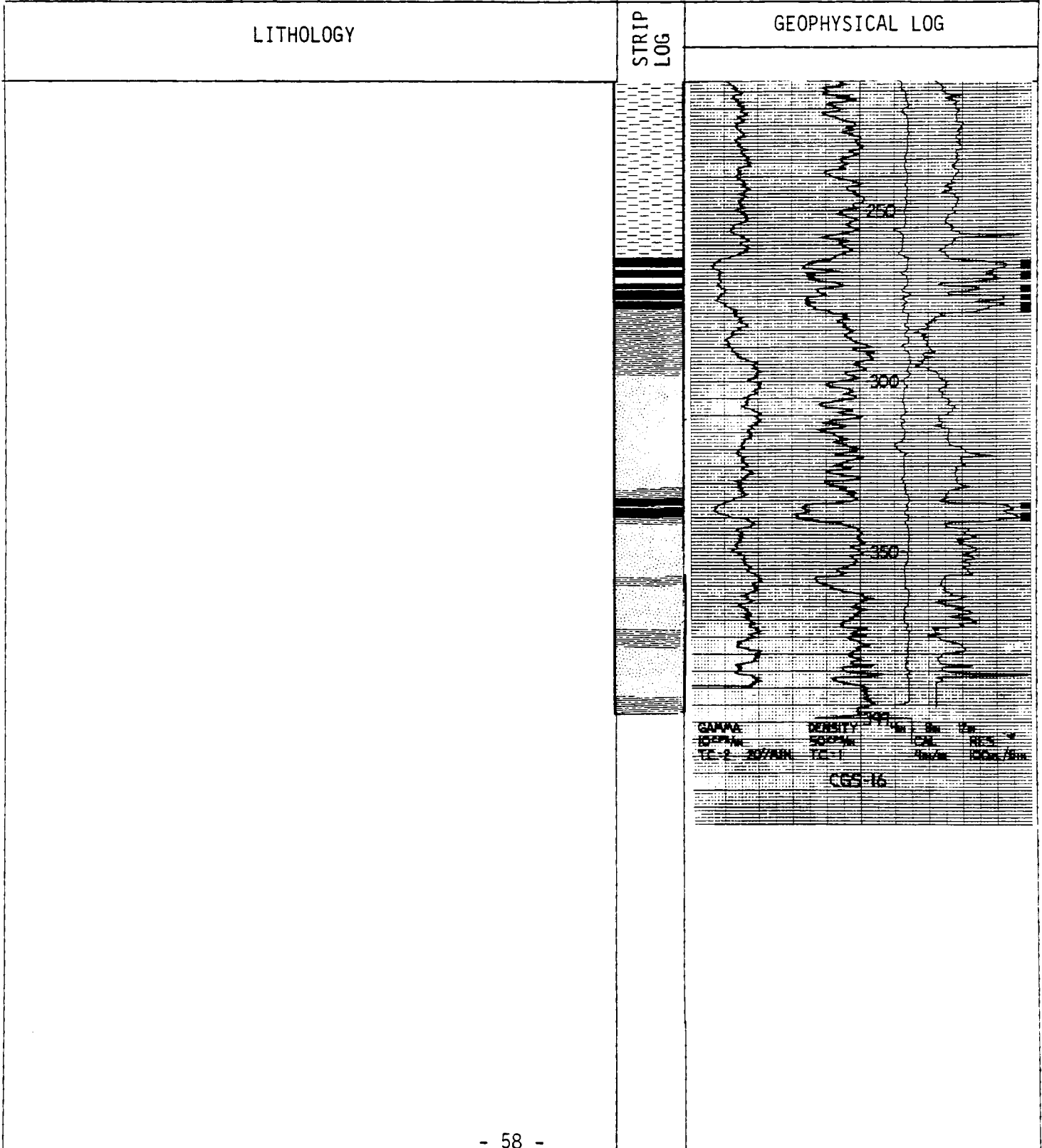
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

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

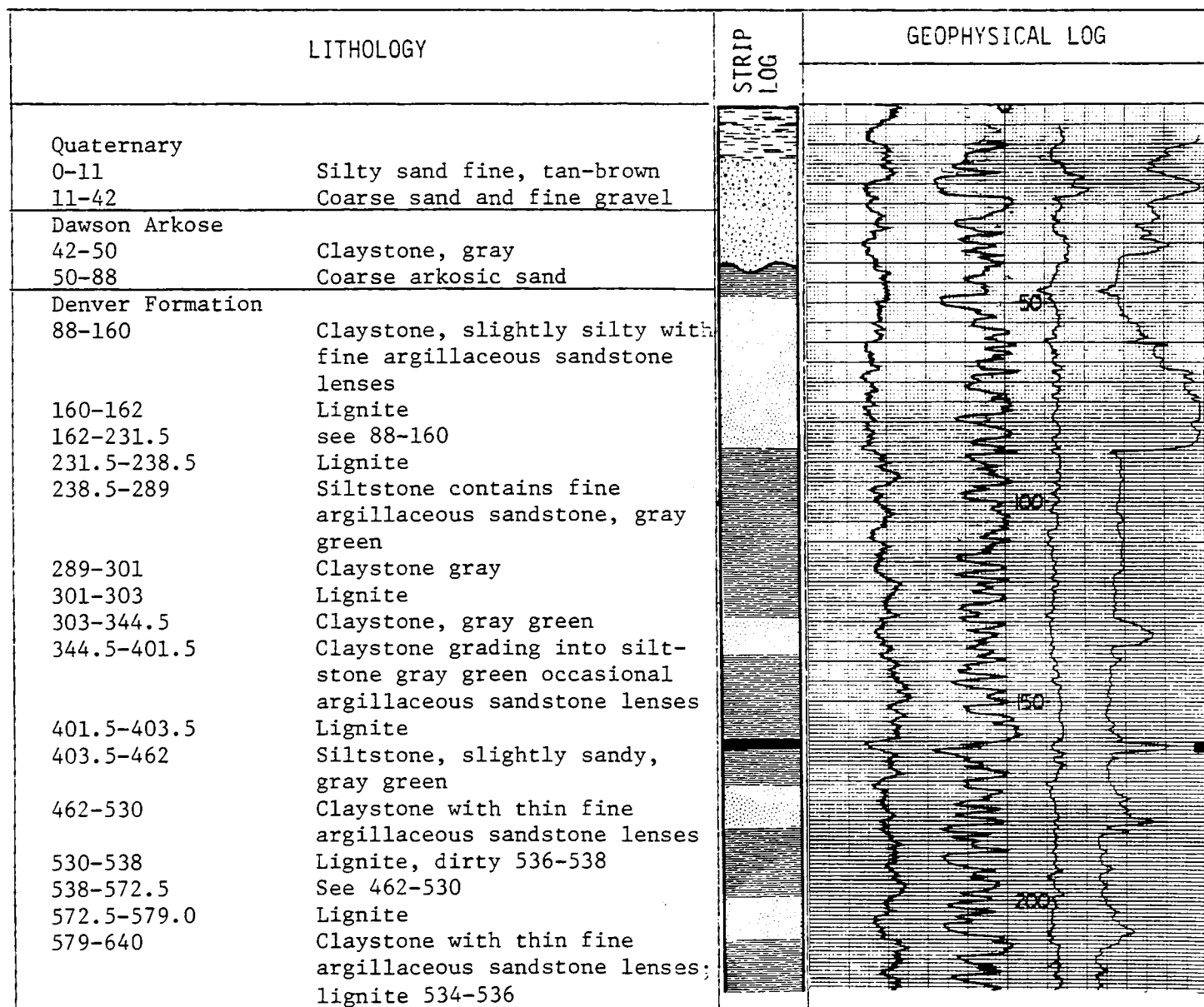
Location: T. 5 S., R. 65 W., secs. SWNW 13 Cored: Yes No X

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

Geophysical logs:

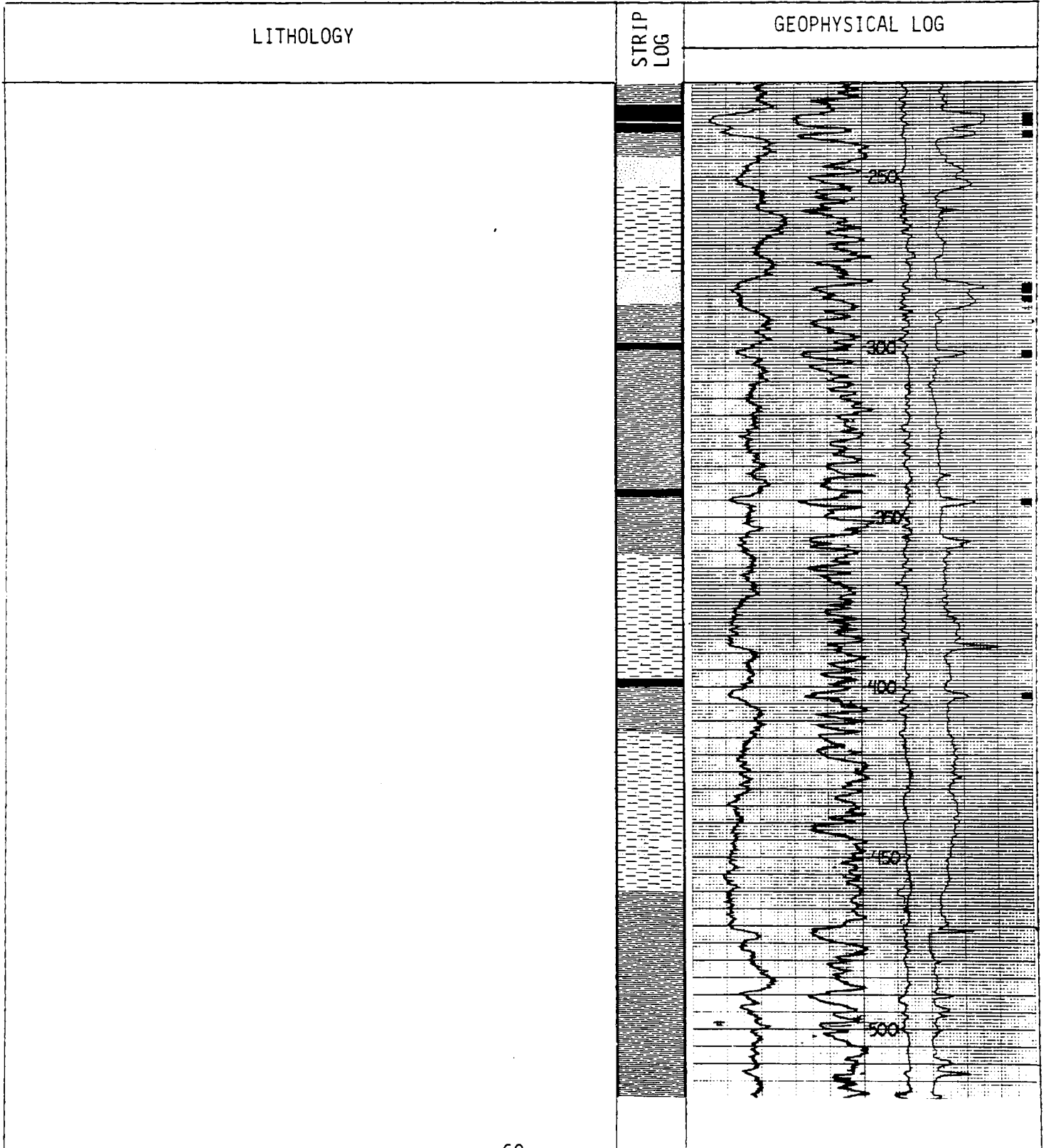
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. L	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Watkins SE Quadrangle.



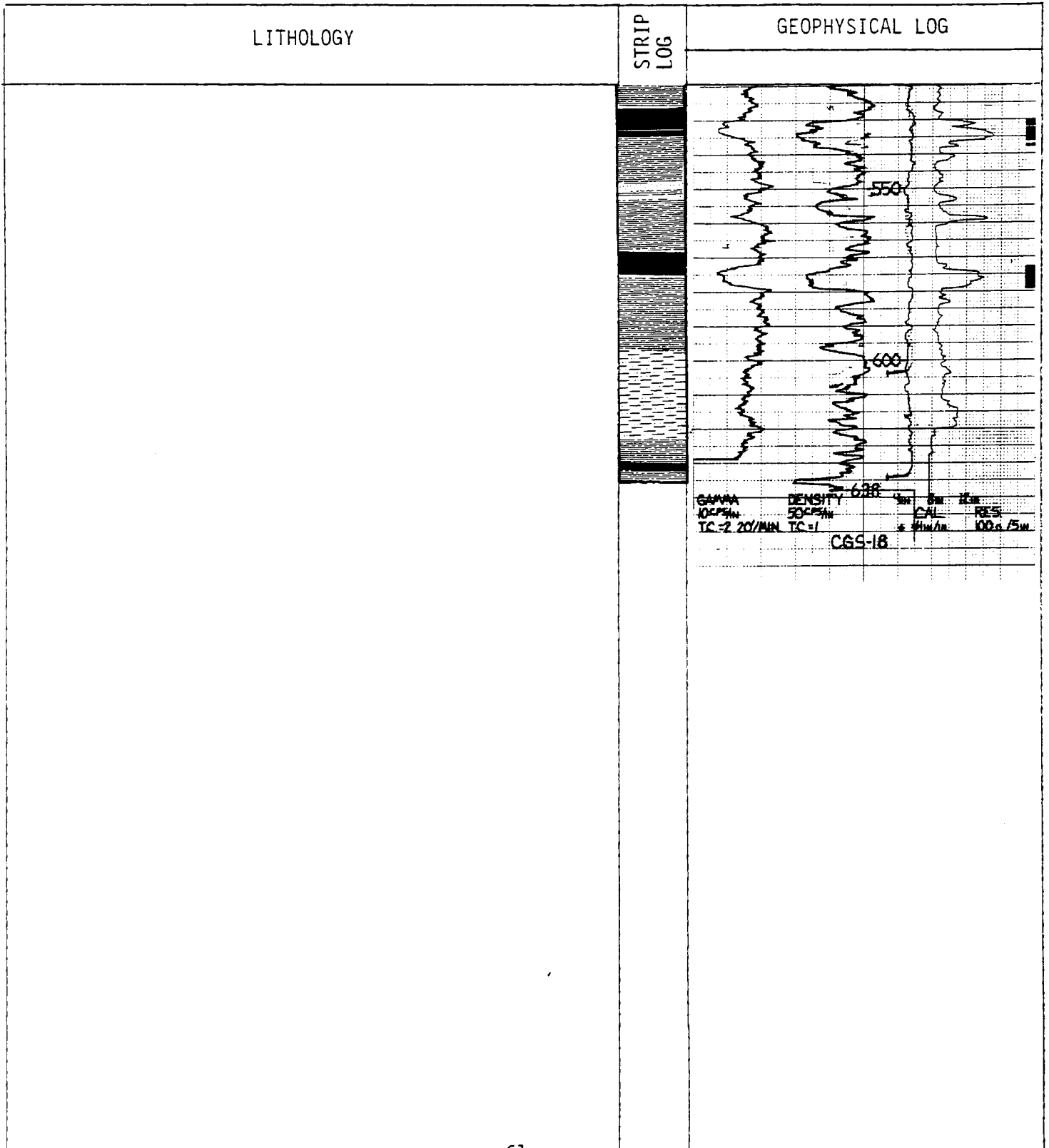
COLORADO GEOLOGICAL SURVEY

Hole No. CGS-18- Continued



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-18- Continued





COLORADO GEOLOGICAL SURVEY

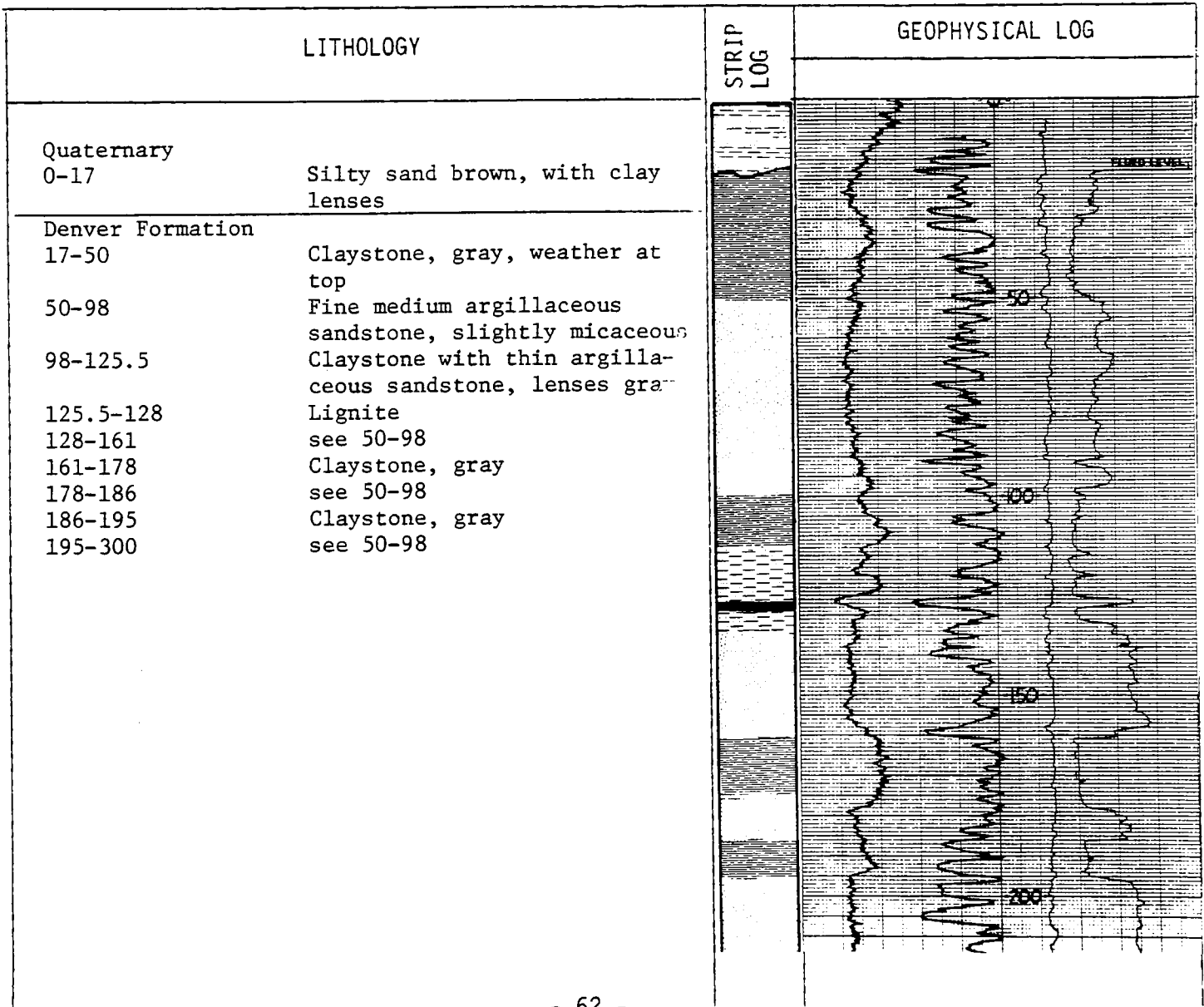
DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

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:

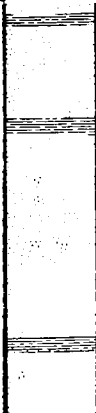
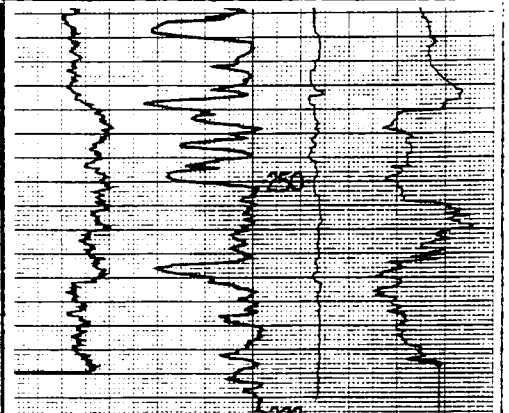
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 4 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 100 ohms/5in	Logging speed 20	fpm

Remarks: Box Elder School Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-19 - Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG															
		 <p data-bbox="1061 886 1540 963"> <table border="0"> <tr> <td>GAMMA</td> <td>DENSITY</td> <td>GR</td> <td>GR</td> <td>GR</td> </tr> <tr> <td>CPM/IN</td> <td>SG/CM<sup>3</sup></td> <td>CPM</td> <td>SG</td> <td>CPM</td> </tr> <tr> <td>TC-2</td> <td>ZOHMIN</td> <td>TC-1</td> <td>TC-1</td> <td>TC-1</td> </tr> </table> </p> <p data-bbox="1252 957 1348 990">CGS-19</p>	GAMMA	DENSITY	GR	GR	GR	CPM/IN	SG/CM <sup>3</sup>	CPM	SG	CPM	TC-2	ZOHMIN	TC-1	TC-1	TC-1
GAMMA	DENSITY	GR	GR	GR													
CPM/IN	SG/CM <sup>3</sup>	CPM	SG	CPM													
TC-2	ZOHMIN	TC-1	TC-1	TC-1													

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

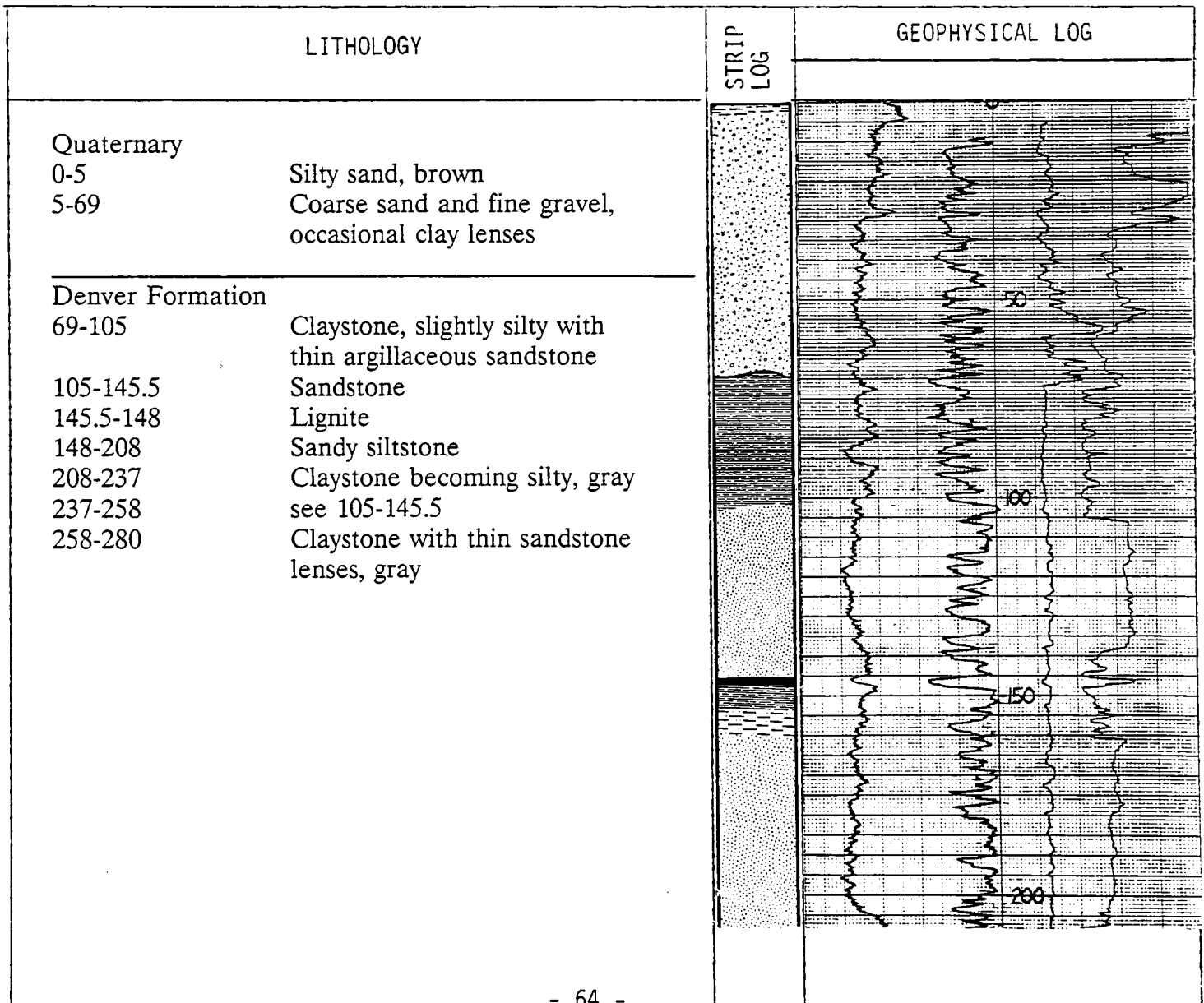
Location: T. 2 S., R. 65 W., secs. NWNW 36 Cored: Yes No X

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

Geophysical logs:

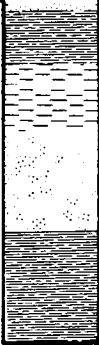
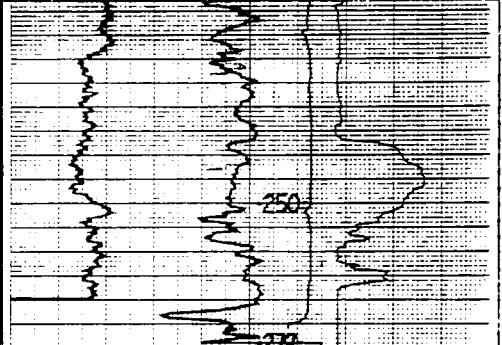
Gamma (G):	T.C. 2	Scale	10 cps/in	Logging speed	20	fpm
Density (DEN)	T.C. 1	Scale	50 cps/in	Logging speed	20	fpm
Caliper (C):		Scale	4 in/in	Logging speed	20	fpm
Resistance (Res):		Scale	100 ohms/5in	Logging speed	20	fpm

Remarks: Manila Quadrangle.



COLORADO GEOLOGICAL SURVEY

Hole No. CGS-21- Continued

LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG			
					
		GAMMA KC-2 20MIN	DENSITY TC-1	CAL KC-2/5M	RES KC-2/5M
		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

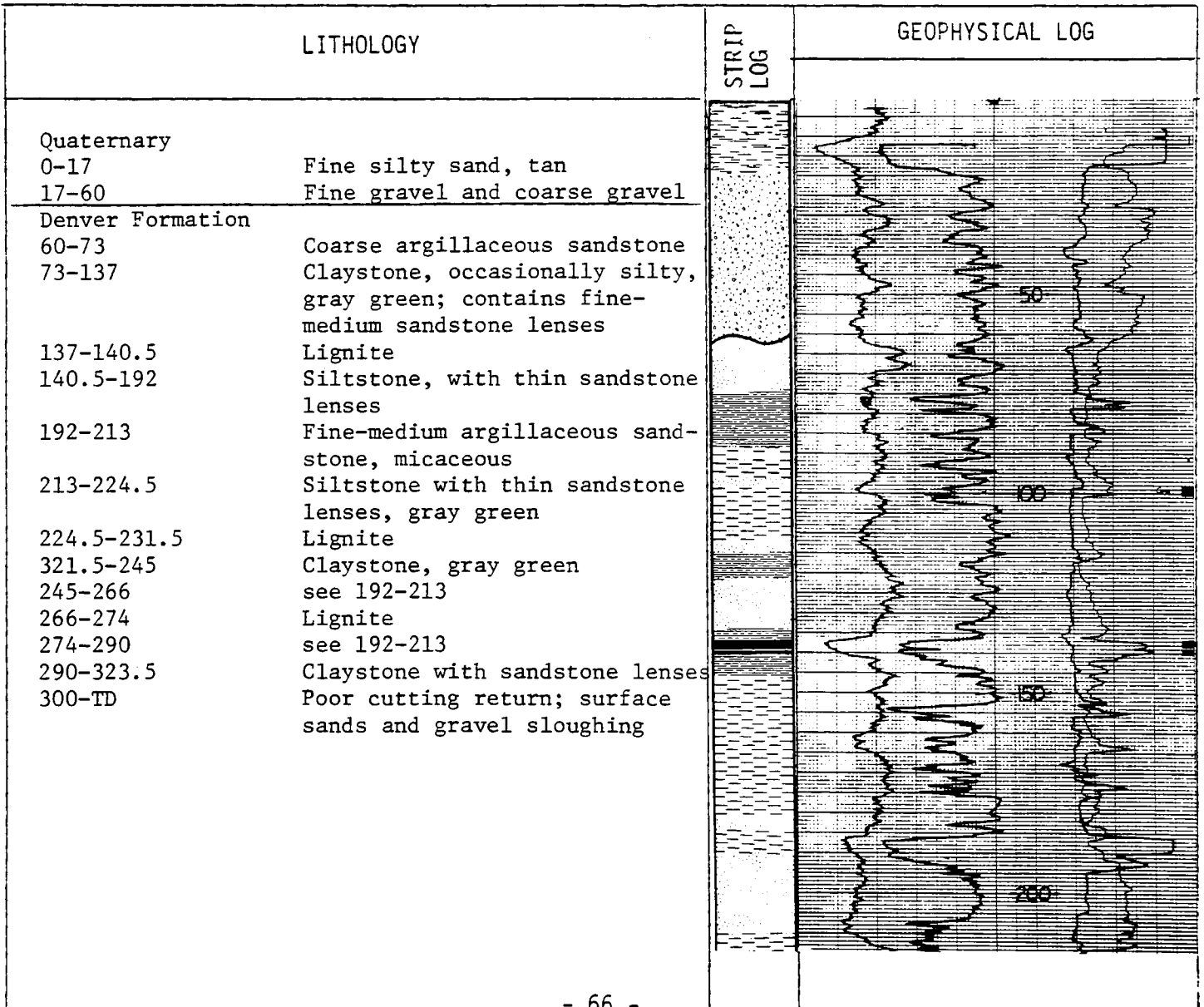
Location: T. 6 S., R. 63 W., secs. SENW 22 Cored: Yes No X

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

Geophysical logs:

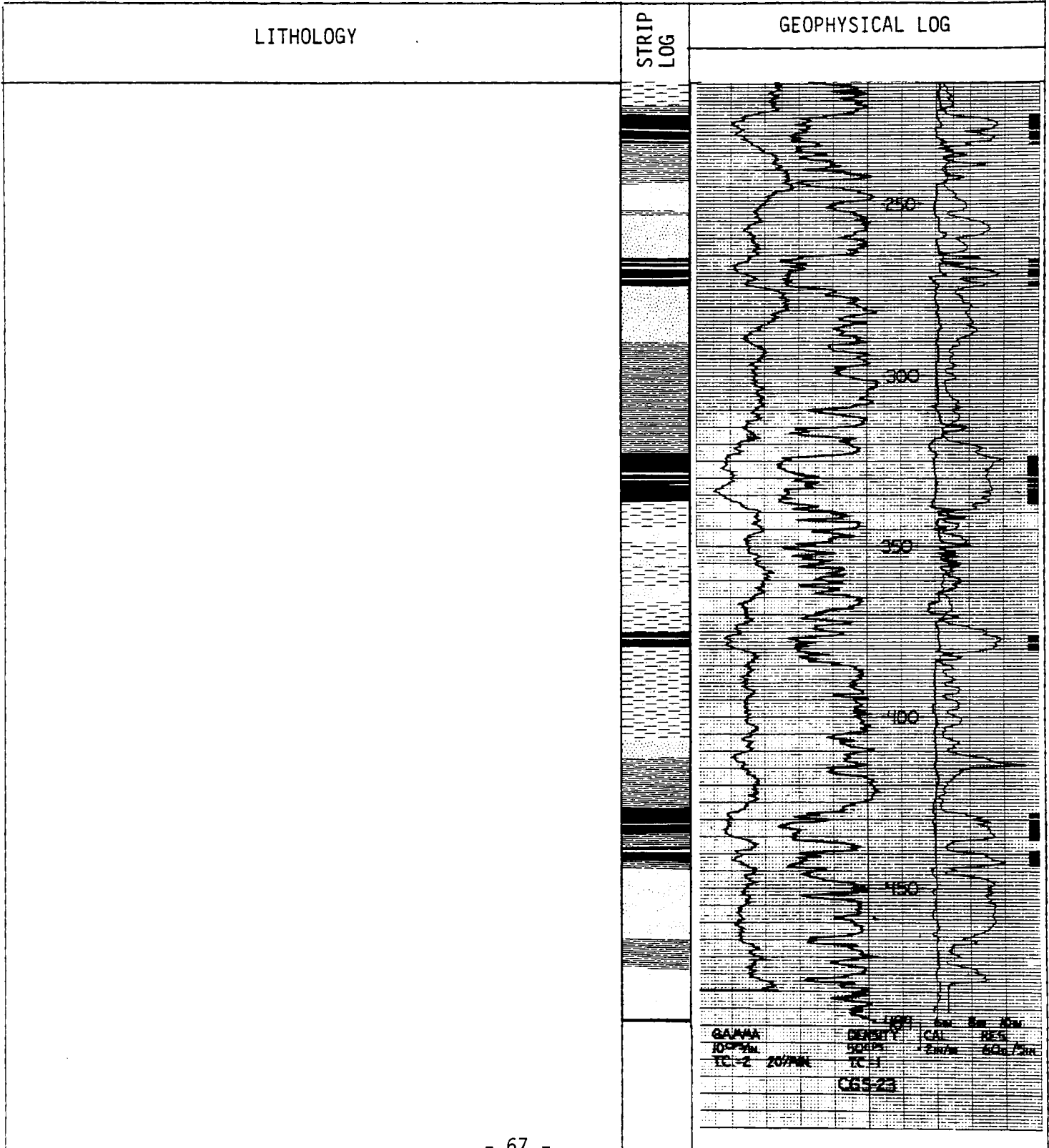
Gamma (G):	T.C. 2	Scale 10 cps/in	Logging speed 20	fpm
Density (DEN)	T.C. 1	Scale 50 cps/in	Logging speed 20	fpm
Caliper (C):		Scale 2 in/in	Logging speed 20	fpm
Resistance (Res):		Scale 60 ohms/5in	Logging speed 20	fpm

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

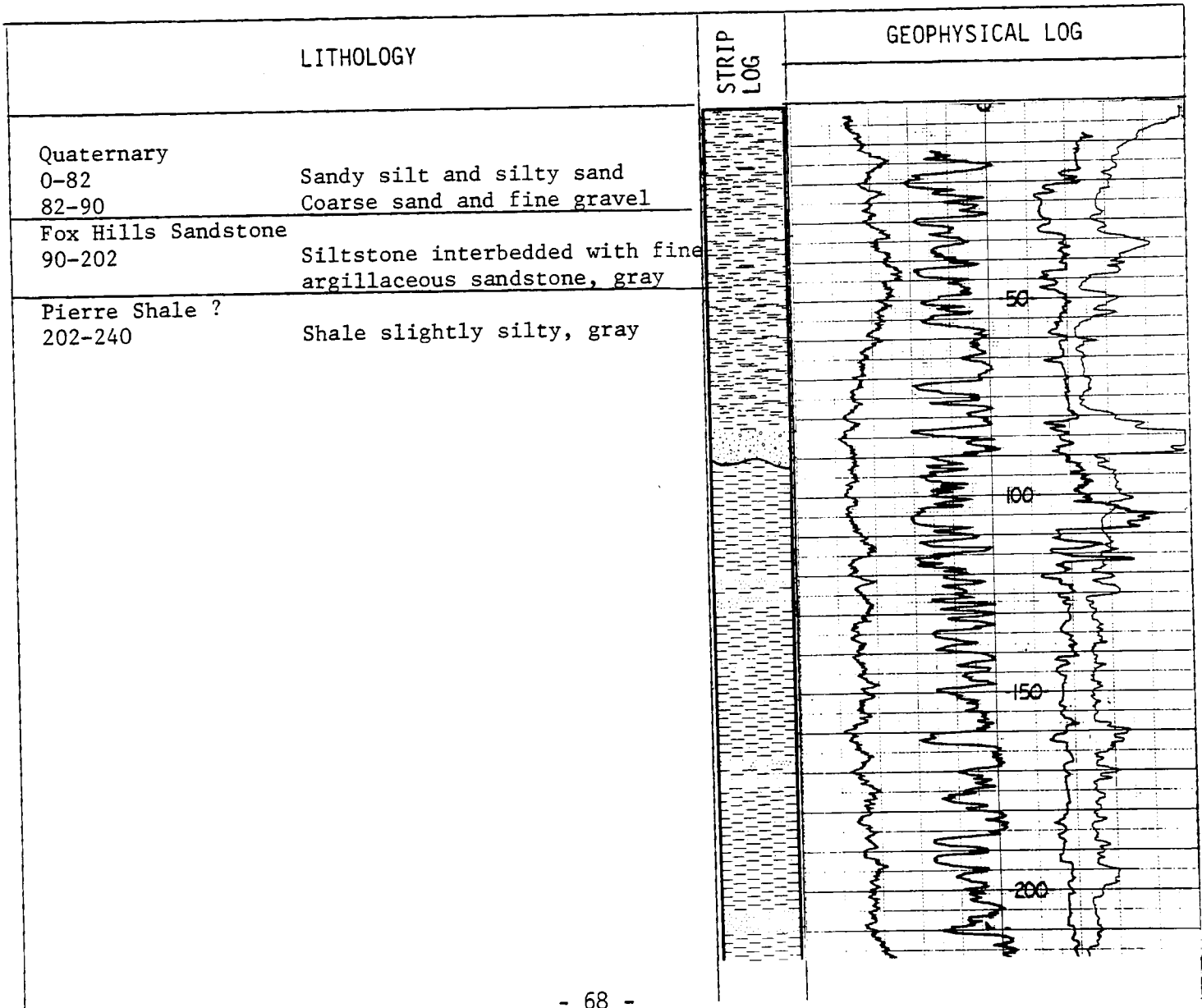
DRILL-HOLE LOG, DENVER EAST 1/2° X 1° QUADRANGLE

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


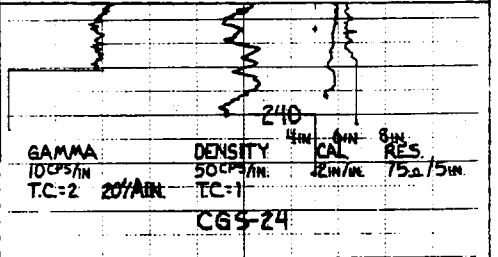
LITHOLOGY	STRIP LOG	GEOPHYSICAL LOG						
		 <p style="text-align: center;">240</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">GAMMA 10 CPS/IN</td> <td style="width: 33%;">DENSITY 50 CPS/IN</td> <td style="width: 33%;">CAL RES 22 IN/IN</td> </tr> <tr> <td>T.C.-2</td> <td>20/AIN</td> <td>TC-1</td> </tr> </table> <p style="text-align: center; font-weight: bold;">CGS-24</p>	GAMMA 10 CPS/IN	DENSITY 50 CPS/IN	CAL RES 22 IN/IN	T.C.-2	20/AIN	TC-1
GAMMA 10 CPS/IN	DENSITY 50 CPS/IN	CAL RES 22 IN/IN						
T.C.-2	20/AIN	TC-1						



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

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  
 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 26.5			
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			
SULFATE	.00	.01	.01
PYRITIC	.04	.06	.08
ORGANIC	.24	.35	.46
FREE SWELLING INDEX		0.0	
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  
 COLLECTOR: RONALD H. AFFOLTER

DATE RECEIVED: 1-29-78

DATE OF REPORT: 2-13-80

	AIR DRY LOSS	25.6	COAL AS RECD.	COAL MOIST FREE	COAL MOIST, ASH FREE
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 <sup>+F</sup>			
SOFTENING TEMP		2800 <sup>+F</sup>			
FLUID TEMP		2800 <sup>+F</sup>			
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<sub>c</sub>

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.

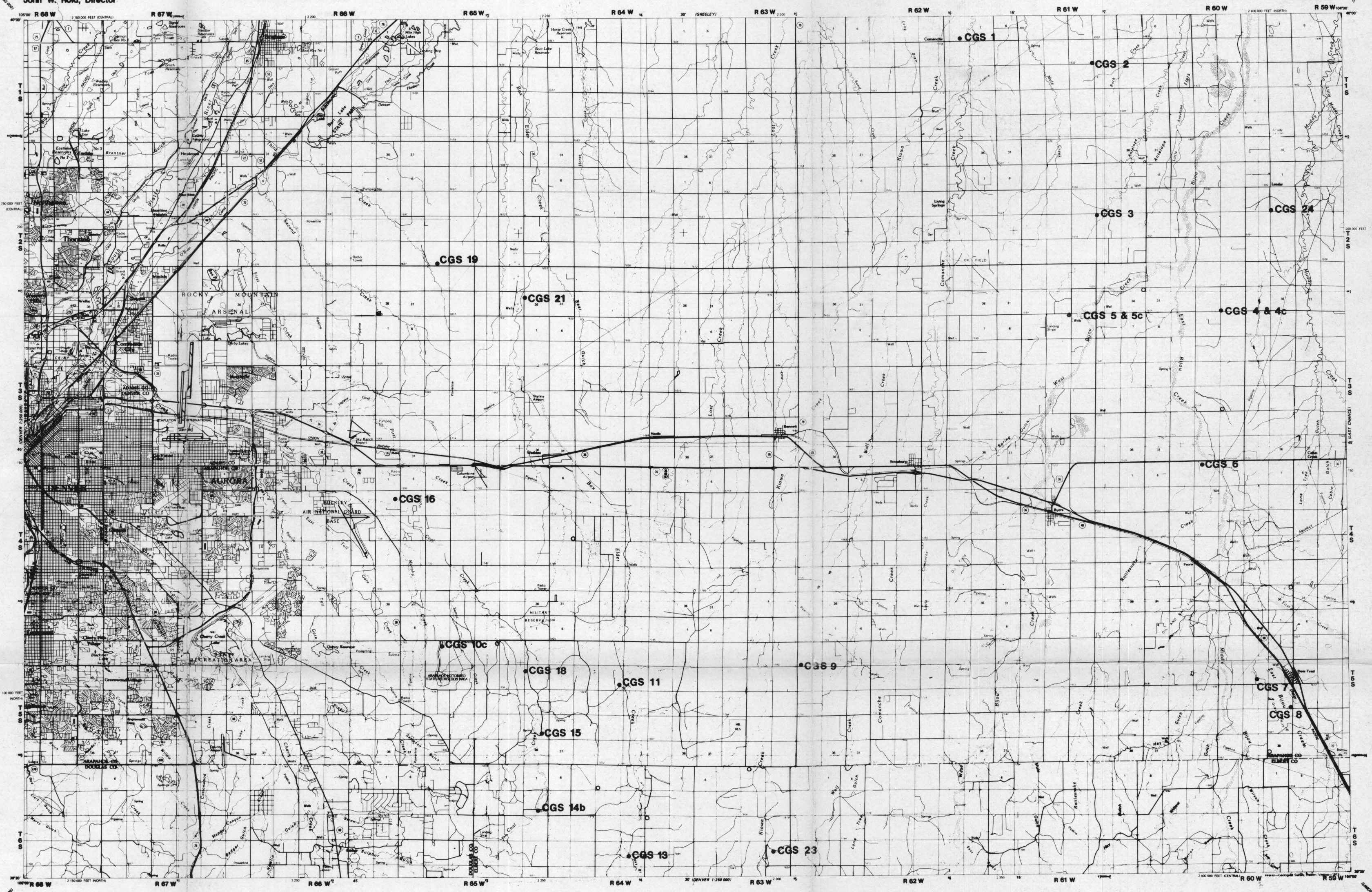


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Department of Natural Resources  
Colorado Geological Survey  
John W. Roid, Director

## INDEX MAP OF DRILL HOLE LOCATIONS, DENVER EAST QUADRANGLE

Colorado Geological Survey  
Open File Report 80-1  
Plate 1 of 1

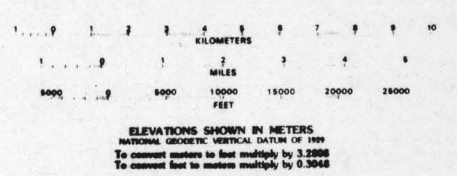
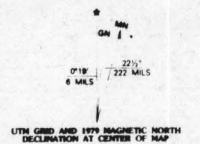


Produced by the Geological Survey  
in cooperation with the Soil Conservation Service

Compiled from USGS 1:250,000-scale topographic maps  
dated 1949-1950. See index for dates of individual maps.  
Partially revised from aerial photographs taken 1975-76  
and other source data. Revised information not field checked  
May 1979.

Projection and 10 000-meter grid, zone 13.  
Universal Transverse Mercator.  
80 000-foot grid data based on Colorado coordinate  
system, north and central zones, 1987 North American datum.

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



LEGEND		ROAD CLASSIFICATION	
Perennial stream, lake		Primary highway, hard surface	
Intermittent stream, lake		Secondary highway, hard surface	
Village or locality		Light-duty road, hard or improved surface	
Landmark structure		Street or other road	
Public park or recreation area		Trail	
Forest or game land area		Interstate route	
Other public use or military or Indian reservation		U.S. route	
		State route	

DENVER EAST, COLORADO  
DENVER NE.4 (N. 13.2) 1:250,000 SCALE MAP  
1979

This map complies with national map accuracy standards.