

CORE LOG

U. S. GEOLOGICAL SURVEY

2175

DRILL HOLE Arco-Federal 2B LOCATION Sec. 10, T. 3 S., R. 96 W., Rio Blanco Co., Colorado ELEVATION 7250 GL PAGE 1 OF
 DATE BEGUN 10/10/68 DATE COMPLETED 10/31/68 DRILLER Garmack LOGGED BY W. B. Cashion and R. B. O'Sullivan TOTAL DEPTH
 CASING REMARKS: Colors described with core wet

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION	
1084.0	1084.5	0.5	Oil shale, brown to gray, varved, graded fair	
84.5	84.6	0.1	Tuff, tan, calc, irr top and base	
84.6	93.3	8.7	Oil shale, brown to dk gray, varved, grade mod	
93.3	93.35	0.05	Tuff, tan extremely irr	
93.35	94.3	0.95	Interbedded marlstone and tuff, abundant contorted bed	
94.3	96.3	2.0	Oil shale, dk brown to dk gray, grade mod, abundant thin numerous beds of tuff, contorted bedding, many dikes)
96.3	10.1	13.8	Oil shale, tan to dk gray, grade fair to mod, contorted bedding, numerous tuff beds (est. 40%), lower 5' contains less contorted beds than above, 1/8" siltstone at base, dk brown, spotted white, very even top and bottom.	core msg 1113.4-1114.0
1110.1	1117.1	7.0	Oil shale, tan to dk brown, grade fair to mod, slightly less than above, contains numerous tuff laminae, some irr bedding, tuff bed - top at 1112.1 (1/8" thick) - tuff dk brown spotted white, even top and slightly irr base	

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 CASING _____ REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1251.5	1253.6	2.1	Oil shale, dk brown & dk gray, varved, rare contorted bed, grade rich
53.6	54.0	0.4	Core msg
54.0	54.8	0.8	Oil shale, brown to dk gray, varved, grade mod
54.8	61.0	6.2	Core msg
61.0	63.3	2.3	Oil shale, brown to dk gray, varved, grade mod
63.3	66.3	3.0	Oil shale, tan to dk brown, varved, contains several thin irr tufts less than 1/4" thick, grade fair
66.3	69.0	2.7	Oil shale, dk brown to dk gray, varved, grade rich
69.0	78.1	9.1	Oil shale, brown to dk brown, varved, few V thin tuff beds less than 1/4" thick, grade mod
78.1	81.0	2.9	Oil shale, dk brown to dk gray, varved, few thin irr tufts less than 1/4" thick, grade rich
1281.0	1283.2	2.2	Oil shale, gray to brown, varved, grade mod

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1283.2	1284.0	0.8	Core msg
84.0	85.7	1.7	Oil shale, brown to dk gray, varved, grade mod
85.7	86.0	0.3	Core msg
86.0	89.5	3.5	Oil shale, brown to dk gray, varved, grade mod to rich. Contains 0.1' irr tuff at 1288.3 - 1288.4
89.5	95.6	6.1	Oil shale, dk brown to dk gray, varved, grade rich. Two 1/2" irr tuff beds at 1293.6 and 1293.8
95.6	1303.7	8.1	Oil shale, brown to dk gray, varved, grade mod, tufts about 1/2" thick w/irr tops and bases with tops at 1295.8, 1296.7, 1297.0, 1298.1, 1300.9. Tufts 0.1' thick, irr bedding, with tops at 1295.9, 1298.3, 1299.4
03.7	06.0	2.3	Oil shale, dk brown to dk gray, irr bed, predominate, some varves, grade mod
06.0	12.0	6.0	Core msg?
1312.0	1314.7	2.7	Oil shale, dk brown to dk gray, varved, grade mod. Few thin irr tuff beds less than 1/2" thick

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 CASING _____ REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1314.7	1316.3	1.6	Oil shale, tan to dk brown, varved, grade lean. Lower 1' is partially leached, contains vugs filled with solid hydrocarbon
16.3	19.2	2.9	Oil shale, dk brown to dk gray, irr bedding, contains lenses of tuff, V irr bedding, grade rich
19.2	22.6	3.4	Oil shale, dk brown to dk gray, varved, grade mod
22.6	22.9	0.3	Tuff and oil shale interbedded, oil shale dk gray, grade mod. Interval from top down is as follows: 1/2" tuff, 1/2" oil shale, 1/2" tuff, 1/4" oil shale, 2" tuff, V irr bed
22.9	24.4	1.5	Oil shale, brown to dk gray, varved, grade mod. Tuffs, irr bedding, tops at 1323.2' (1/4" thick), and 1323.6' (1" thick)
24.4	26.9	2.5	Oil shale, dk brown to dk gray, varved, grade rich
26.9	27.2	0.3	Tuff and interbedded oil shale, V irr bedding. Oil shale is dk brown to dk gray, grade mod. Tuffs are brown. Interval from top down is as follows: 1/4" tuff, 1/4" oil shale, 1/4" tuff, 1/2" oil shale, 2-1/2" tuff
1337.2	1331.1	3.9	Oil shale, dk brown to dk gray, varved, grade mod, irr tuffs 1/2" thick tops at 29.3' and 30.3'

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1382.0	1384.3	2.3	Oil shale, brown to dk gray, varved, grade fair
84.3	88.4	4.1	Oil shale, dk brown to dk gray, varved; grade mod, core badly broken between 1386 and 1388
88.4	91.0	2.6	Interbedded oil shale and irr, tuff, contains <u>.2'</u> vuggy zone 1' below top; "Wavy Bed"?
91.0	1401.7	10.7	Oil shale, dk brown to dk gray, varved; grade mod, contains lenses of tuff less than 1/4" thick, the tufts are numerous, brown,
1401.7	11.0	9.3	Core msg
11.0	18.0	7.0	Oil shale, dk brown to dk gray, varved, irr, grade mod to rich, contains tuffaceous? Lenses up to 1/2" thick, core from 1414-1418 badly broken
18.0	38.6	20.6	Oil shale, gray to dk brown, varved, some irr beds, grade fair, tuff- top at 1421 (1"thick) w/ irr top and base, ktal cavity bed from 1428.3 to 1428.5 (nahcolite?)
38.6	50.0	11.4	Oil shale, brown to dk gray, varved, grade fair,
1450.0	1452.6	2.6	Oil shale, dk brown to dk gray, varved, grade rich, few thin irr, tuff beds less than 1/4" thick

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 CASING _____ REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION	
1452.6	1469.3	16.7	Oil shale, dk brown to dk gray, varved, grade fair, tuff, grayish brown, top at 1465.4 (1/4" thick)	core msg 1460-1461.2
69.3	72.0	2.7	Oil shale, dk gray to dk brown, varved, some irr laminae, grade rich	
72.0	77.7	5.7	Oil shale, brown to dk gray, varved, mainly regular but some irr varves, upper part grade mod, lower 1' grade fair	
77.7	80.0	2.3	Oil shale, gray to almost black, varved, some irr varves, grade rich	
80.0	98.0	18.0	Oil shale, tan to dk brown, varved, grade lean, core from 1480.8 to 1489.0 badly broken, many pieces of core are stained a dead white, probably from nahcolite	core msg 1489.0-1496.0
98.0	1500.6	2.6	Oil shale, med gray to almost black, some varving but most layers lenticular, contains numerous thin (less than 1/8" thick) tufts in lower 1', grade rich	
1500.6	04.0	3.4	Oil shale, brown to dk gray, varved, grade fair, tuff - top at 1502.3 (1-1/2" thick), contains laminae of organic material, tuff contorted	
1504.0	1505.5	1.5	Oil shale, tan to dk brown, numerous tuff laminae less than 1/8" thick	

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1505.5	1509.5	4.0	Oil shale, dk brown to almost black, irr varving, grade rich, contains numerous 1t gray tuff laminae, tuff as follows - tops at 1506.8' (1-1/2" thick); 1507.3' (1" thick); and 1/2" tuff at base of interval <u>Fine Marker?</u>
09.5	12.0	2.5	Oil shale, brown to dk gray, varved, grade mod
12.0	14.2	2.2	Oil shale, dk brown to almost black, varved, grade rich, contains numerous tuff laminae, tuff top at 1513.1 (1/2" thick) irr, interval contains some pyrite nodules
14.2	18.0	3.8	Oil shale, gray to dk brown, varved and contorted, grade fair to mod, contains thin zones about 2" thick of tuff intrusions, irr tuff. - top at 1517.5 (1" thick)
18.0	27.0	9.0	Oil shale, brown to dk gray, varved, grade fair, .3' vuggy zone at top
27.0	27.5	0.5	Tuff, blue gray, fine grained in upper part, tan coarser grained and contorted in lower part, top is even, base slightly irr (<u>Mahogany Marker?</u>)
27.5	32.5	5.0	Oil shale, brown to dk gray, varved, grade fair, 1" irr tuff at base
32.5	35.0	2.5	Oil shale, dk brown to almost black, varved, grade rich to very rich
1535.0	1538.3	3.3	Oil shale, dk bray to dk brown, varved, some beds irr, grade mod

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 CASING _____ REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION	
1538.3	1554.3	16.0	Oil shale, dk brown to dk gray, varved, some beds irr, grade rich, conspicuous pyritic zone from 1538.4 - 1538.7, interval contains numerous thin, tan tuff beds, a concentration of tuff beds between 1545 and 1546.4, a zone of intruded tuffs between 1551.8 and 1552.1 <i>Minor bed 5A</i>	core msg 1550.6-1551
1554.3	1559.0	4.7	Oil shale, brown to dk gray, varved, w/some irr bedding, grade mod	
59.0	67.3	8.3	Oil shale, tan to dk gray, bedding mostly contorted, grade rich, numerous tuff intrusions	
67.3	72.3	5.0	Oil shale, tan to dk gray, varved, grade mod, some thin tuff lenses less than 1/4" thick	
72.3	76.0	3.7	Oil shale, gray to dk gray, contorted, varved, grade rich, contains numerous irr lenses of tuff less than 1/4" thick	
76.0	78.8	2.8	Oil shale, gray to dk brown, varved, grade fair	
78.8	82.5	3.7	Oil shale, dk gray to almost black, varved, grade rich, wavy and contorted bedding, tuffaceous?, xtal cavity at 1579.8 (0.1' thick), gilsonite lenses at 1581.3' (1/8" thick)	
82.5	98.0	15.5	Oil shale, gray to dk gray, varved, grade mod to rich, contains numerous tuff lenses and thin beds less than 1/4" thick, much of core badly broken, contains several thin vuggy and punky zones	
1598.0	1604.0	6.0	Oil shale, tan, varved, grade lean, core badly broken	core msg 1600-1601

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1604.0	1610.0	6.0	Oil shale, dk brown to dk gray, core badly broken, grade mod
10.0	20.0	10.0	Core msg
20.0	20.8	0.8	Oil shale, lt to dk gray, varved, grade mod, punky, vuggy zone (0.3') at base, core badly broken
20.8	31.4	10.6	Oil shale, lt to dk gray, varved, grade fair, punky, vuggy zones, tops at 1626.2 (0.2' thick) and 1628.0 (0.1' thick) both zones contain pyrite, core badly broken
31.4	32.5	1.1	Oil shale, dk gray to almost black, grade rich
32.5	35.3	2.8	Oil shale, tan to dk gray, varved, grade fair
35.3	36.3	1.0	Oil shale, lt gray, punky, vuggy, porous, grade lean. Lower 1/2 is badly broken
36.3	37.0	0.7	Oil shale, tan to dk gray, varved, grade mod
37.0	44.0	7.0	Core msg
44.0	45.3	1.3	Oil shale, tan to lt gray, vuggy, punky, porous, grade lean, core badly broken
1645.3	1647.4	2.1	Oil shale, lt to dk gray, varved, grade mod

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1647.4	1649.5	2.1	Oil shale, lt gray, vuggy, punky, porous, grade lean, core badly broken
49.5	51.3	1.8	Oil shale, tan and lt gray, varved, grade lean, silty
51.3	54.0	2.7	Marlstone, tan, silty, vuggy, badly broken, evidently 2 feet of core missing although there is no record of it
54.0	55.2	1.2	Oil shale, lt to med gray, varved, grade mod, lower 0.5' contains many oblate-shaped, white xtl'n pods (1/8"-1/4" diameter)
55.2	55.6	0.4	Oil shale, tan to lt gray, vuggy, punky, porous, grade lean, several bladed xtal cavities, probably weathered-out nahcolite, silty, contains some white oblate xtl'n pods
55.6	67.0	11.4	Oil shale, tan to lt gray, silty, grade lean, numerous tuff intrusions as much as 1/4" thick, numerous oblate white xtl'n pods (there is 1.2 ft of core representing this interval. Cannot determine which part is missing)
1667.0	1682.0	15.0	Oil shale, tan and lt gray, some varving, grade fair to lean, 0.4' punky, vuggy zone at top and one at 1667.7' (0.1' thick) and one at 1668.0' (0.4' thick). conspicuous zone of white xtl'n pods at 1668.6' (2.6" thick). Core badly broken. Lower 1/2' contains zone of white xtl'n pods

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TOTAL DEPTH _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1728.0	1732.9	4.9	Oil shale, lt to dk gray, varved, grade lean to fair. Core badly broken
			1728.0'-1729.2'. Well developed pyrite cubes at 1729.0'
32.9	45.8	12.9	Oil shale, lt to dk gray, upper 3.0' grade lean. Lower part - grade fair. Several vuggy, punky porous zones. Numerous thin tuff intrusions and beds. Contains leached zones, solution cavities and brecciated zones resulting from leaching of nahcolite(?). Lower 8' bedding is more regular. Lowermost 20' badly broken
45.8	52.0	6.2	Core msg
52.0	52.5	0.5	Oil shale, lt to dk gray, varved, grade fair. Core badly broken
52.5	54.6	2.1	Oil shale, tan to lt gray, varved except upper 1.2' where bedding is very contorted, grade fair. Some tuff intrusions in lower 0.6'
54.6	55.0	0.4	Oil shale, dk brown to almost black, varved, grade rich
55.0	59.2	4.2	Oil shale, tan to dk gray, varved, grade fair
59.2	62.7	3.5	Oil shale, gray to almost black, varved, grade rich
1762.7	1764.0	1.3	Siltstone, tan, dolomitic, core badly broken

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 CASING _____ REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1801.0	1801.3	0.3	Oil shale, lt to dk gray, varved, grade mod. Contains several solution cavities as much as 3/8" in diameter
01.3	01.7	0.4	Siltstone, tuffaceous, very lt gray, varved with a few dk gray laminae
01.7	02.0	0.3	Oil shale, dk gray, grade mod. Core badly broken contains solution cavities
02.0	02.3	0.3	Siltstone, tuffaceous & lt gray
02.3	03.6	1.3	Oil shale, lt to dk gray, varved, grade mod
03.6	04.0	0.4	Siltstone, tuffaceous, & lt gray (there is 0.1' of this in core box but assume it extends to 1804.0')
04.0	10.9	6.9	Oil shale, lt to dk gray, varved, grade mod, tuff, top at 1804.2' (1/2" thick) sl irr top and base. From 1810' to 1811' core badly broken, lower 1/2 of interval of better grade than upper part. Upper half 2 or 3 thin (2"-3" thick) Units of lean grade
1810.9	1816.0	5.1	Core msg

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CASING _____ REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
1870.0	1875.4	5.4	Oil shale, brown to med gray, laminated, grade fair, contains at least 3 vuggy zones, each about 0.3' thick, contains tuff? 1874.1 to 1874.4', irr bedded
75.4	86.5	11.1	Oil shale, tan to gray-brown, laminated, lower part varved, grade fair, lower 2' contains some irr bedding, some thin (less than 1/2" thick) punky, vuggy zones. Leached zone top at 1878.8' (4" thick)
86.5	98.0	11.5	Marlstone, lt to med gray, varved and laminated, grade lean, contains small amount of organic matter, contains small vugs filled with calcite, and abundant particles and lenses of pyrite, punky and porous throughout interval, contains siltstone bed - top at 1895.0' (0.2' thick), much of interval speckled white
98.0	1900.0	2.0	Oil shale, tan to dk brown, varved, grade fair, contains vugs filled w/calcite, lower part is irr bedded
00.0	6.1	6.1	Oil shale, dk gray, laminated, grade mod, contains abundant thin (less than 1/16" thick) lenticular (1/4" long) white to lt gray oblate material (probably calcite) contains tuff? top at 1903.9 (0.3' thick), tuff is vuggy, punky and porous.
1906.1	1908.7	2.6	Marlstone, lt to med gray, varved and laminated, grade lean, contains small vugs filled with calcite, abundant particles and lenses of pyrite, punky and porous zones throughout, much of interval speckled white, Core badly broken

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2092.2	2095.3	3.1	Oil shale, tan to dk gray, laminated, grade mod. Several cavities filled with black, soft, organic matter and minor amounts of fine grained pyrite. Cavities are as much as 1" across. Tops of cavities at 2092.4, 2094.4 and 2095.0
95.3	98.0	2.7	Oil shale, tan to med gray, laminated, grade lean. Tufts, tan, thickness difficult to determine due to broken core (less than .2'). Tops of tufts are at about /2096.0, 2096.7, 2097.0 and 2097.5
98.0	2106.0	8.0	Core msg
2106.0	24.2	18.2	Oil shale, tan to med gray, varved and irr bedding, grade lean. Unit contains numerous irr tuff beds as much as 1/4" thick. Cavity (1/4" thick) at 2108.5 filled with bladed material, probably result of leaching of nahcolite. Lower 13' contains several white circular inclusions containing soft material that swells when wet (montmorillonite?). Lower 13' is slightly porous.
2124.2	2129.0	4.8	Oil shale, tan to med gray, laminated, grade fair with exception of lower 1' which is mod grade. Several tuff beds, generally less than 1/8" thick throughout interval. Concentration of numerous very thin tuff beds (interval 0.2' thick), top at 2125.7

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2129.0	2145.0	16.0	Gore msg
45.0	49.8	4.8	Oil shale, lt to dk gray, laminated, grade mod. Upper 0.7' badly broken
49.8	51.5	1.7	Oil shale, lt to med gray, laminated, grade lean
51.5	67.6	16.1	Oil shale, lt to dk gray, laminated, grade mod
67.6	79.0	11.4	Oil shale, lt to med gray, laminated with some varving, grade fair. Specks and inclusions (as much as 1/4" across) of a black, vitreous mineral occur from 2169.8 to 2172.7. Very irr tuff intrusion at 2177.4 (1/2" thick)
79.0	79.6	0.6	Oil shale, lt to dk gray, varved, grade mod. Very irr tuff intrusion at base (as much as 1/2" thick)
79.6	85.5	5.9	Oil shale, tan to lt gray, varved and laminated, grade lean. Tuffs, tan, tops at 2182.3 (1/4"), 2182.5 (3/4"), 2183.2 (1/2"), 2184.3 (1/4"), 2184.35 (1/8"), 2184.4 (3/8"), 2184.7 (1/4"), 2185.3 (1/4"), 2185.5 (1/4")
2185.5	2194.0	8.5	Oil shale, lt to dk gray, laminated, grade mod. Tuffs, dk brown, tops at 2185.7 (1/2"), 2186.3' (1/4"), 2186.4 (1"), 2186.7 (1/4"), 2187.6 (1/4"). Nahcolite occurs in thin irr beds from 2189.7 to 2189.9. At 2186.9 there is cavity 1-1/2" across

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2194.0	2196.8	2.8	Oil shale, tan to lt gray, varved and laminated, grade lean. Tuffs, tops at 2196.3 (3/8"), 2196.4 (1-1/4")
96.8	99.0	2.2	Oil shale, lt to med gray, laminated, grade fair. Contains <u>vuggy</u> zone with tuff inclusions. Some vugs, as much as 1-1/2" across. Top of vuggy zone 2197.9 (0.8' thick)
99.0	2200.6	1.6	Oil shale, lt to dk gray, grade rich
2200.6	07.4	6.8	Oil shale, tan to med gray, varved, grade lean. Lower 2' is <u>vuggy</u> , many vugs less than 1/4" across. Two vugs are 2" across. Vugs partially filled with what appears to be tuffaceous material. Lower .5' of core is broken
07.4	20.7	13.3	Oil shale, lt to dk gray, varved, grade fair
20.7	23.0	2.3	Oil shale, tan to lt gray, varved and laminated, grade lean. Slightly porous. From 2221.6 to 2222.6 there is a dike about 1/16" across. Some offsets. Dike is composed of white mineral with hardness less than 2.5, noncalcareous
2223.0	2223.4	0.4	Oil shale, lt to dk gray, varved, grade fair

CORE LOG

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DRILL HOLE Arco-Federal 2B

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LOGGED BY _____

TOTAL DEPTH _____

CASING _____

REMARKS: _____

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION	
2223.4	2225.6	2.2	Oil shale, tan to brown, laminated and varved, grade lean. Interval contains numerous thin (up 1/4") tuff beds. Tuffs contain black (carbonaceous?) material	
25.6	33.2	7.6	Oil shale, lt to dk gray, varved, grade fair. Several thin (as much as 1/8") tuffaceous lenses that contain a soft black (Carbonaceous?) mineral. From 2230.0 to 2232.6 black vitreous hydrocarbon (gilsonite?) on fractures.	
33.2	41.2	8.0	Oil shale, tan to med gray, varved, grade lean. Bladed. Xtals of nahcolite coat a vertical crack top at 2235.3 (.15' thick). Black vitreous hydrocarbon (gilsonite?) coats vertical crack at 2238.2 (.14' long). Inclusion (1" across) of black vitreous hydrocarbon (gilsonite?) at 2240.1	Core.msg 2233.9-2235.0
41.2	44.0	2.8	Oil shale, lt to dk gray, varved, grade fair. Tuff top at 2241.9 (1" thick), irr top and base	
44.0	49.0	5.0	Oil shale, lt to dk gray, varved, grade lean. Interval somewhat porous	
49.0	52.2	3.2	Oil shale, lt to dk gray, varved, grade fair	
52.2	54.3	2.1	Oil shale, tan to lt gray, varved, grade lean. Black vitreous hydrocarbon coats vertical crack at 2252.4 (0.2' long)	

Drill hole

CORE LOG

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2254.3	2267.2	12.9	Oil shale, tan to lt gray, varved, upper part - grade lean, lower part - grade fair. Evidently nahcolite is present through this interval, based on vigorous effervescence of core. Nahcolite definitely identified in thin layers (less than 1/2" thick) and inclusions (commonly an inch across). It may also be present as minute white and dk gray blebs which occur throughout this interval. There is one conspicuous dk brown inclusion of bladed nahcolite at 2266.5 (4" across). Interval contains many vugs (as much as 1" across) that are coated or are partly filled with nahcolite. Nahcolite may make up as much as 15-20% of the core.
67.2	69.0	1.8	Oil shale lt to dk gray, varved, grade mod. At 2268.0 there is 1/4" bed of black, resinous hydrocarbon
69.0	83.5	14.5	Oil shale, tan to med gray, grade fair. Interval is very pyritic. Pyrite occurs as blebs and irr stringers. Conspicuous pyritic zones, tops at 2272.4 (.3' thick), 2275.9 (.5' thick), 2277.6' (.3' thick) 2280.0 (.3' thick), 2283.2 (.3' thick)
83.5	84.2	0.7	Oil shale, gray to almost black, varved, grade rich
2284.2	2290.0	5.8	Oil shale, lt to dk gray, varved, grade mod. Conspicuous zone of pyrite stringers, top at 2285.3 (0.1' thick)

Drill hole

CORE LOG

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CASING

REMARKS:

FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2290.0	2292.0	2.0	Oil shale, lt to med gray, varved, grade fair. Few thin tuff intrusions (as much as 1/4" thick).
92.0	95.0	3.0	Oil shale, tan to med gray, varved and laminated, grade lean. Conspicuous zone of pyrite stringers (0.4' thick), top at 2293.6
95.0	2316.0	21.0	Core msg
2316.0	16.5	0.5	Oil shale, lt to dk gray, varved, grade fair to mod. Core somewhat broken
16.5	23.0	6.5	Core msg
23.0	31.5	8.5	Oil shale, lt to dk gray, varved, grade mod. Black vitreous mineral (gilsonite?) forms inclusions (1/4" across) and coats fractures in a 0.5' interval, top at 2330.5
31.5	33.5	2.0	Oil shale, med to dk gray, laminated, grade mod. Contains numerous thin layers (up to 3/16" thick) of very lt gray carbonate. Carbonate makes up 20-25% of core
2333.5	2340.0	6.5	Oil shale, med to dk gray, laminated, grade rich. Few very irr nahcolite inclusions (up to 1/2" across). Also small amount of pyrite

Drill hole

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2340.0	2344.0	4.0	Oil shale, lt to dk gray, varved, grade mod
44.0	45.6	1.6	Oil shale, tan, laminated, appears to be lean (assay 37 gal.). Interval includes several small tuff(?) inclusions (as much as 1/8" thick)
45.6	55.4	9.8	Oil shale, lt to dk gray, varved, grade mod. Numerous tuff intrusions and beds (as much as 1/3" thick). Tuff intrusion (3/16" thick), top 2351.7' has pyrite rims. Conspicuous pyrite stringers in series of zones, tops at 2345.6 (0.2' thick), 2347.8 (0.2' thick), 2348.7 (0.3' thick), 2349.3 (0.3' thick), 2351.2 (0.05' thick)
55.4	63.8	8.4	Oil shale, tan to dk gray, varved, grade fair. Unit contains numerous tuff beds and very irr tuff intrusions. Most as much as 1-1/2"
63.8	64.7	0.9	Oil shale, tan, irr bedded, grade lean
64.7	73.7	9.0	Oil shale, lt to dk gray, mostly laminated, some varying, grade fair. Conspicuous pyrite stringers in zone, top 2370.5 (.25' thick). Core is broken between 2370.8 and 2372.0'
2373.7	2375.2	1.5	Oil shale, tan to lt gray, laminated, grade lean

Drill hole

CORE LOG

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2375.2	2395.9	20.7	Oil shale, lt to dk gray, varved, grade mod. Numerous smooth tuff intrusions (as much as 1/2" thick in upper 5'). Tuff, lt brown, at 2383.2 (0.1' thick) conspicuous pyrite stringers in zone 0.2' thick, top at 2383.5. Conspicuous zone of tuff beds and intrusions (1.8' thick), top at 2385.2
95.9	97.3	1.4	Oil shale, tan to lt gray, laminated, grade lean
97.3	2403.4	6.1	Oil shale, dk gray, laminated, grade fair
2403.4	09.4	6.0	Oil shale, tan to dk gray, irr varved, grade fair. Contains numerous lt brown, calcareous, tuffaceous intrusions and beds. Some black vitreous hydrocarbon stains, vertical cracks in zone 0.1' thick, top at 2408.6
09.4	24.4	15.0	Oil shale, lt to dk gray, varved, grade fair. Core breaks readily along bedding planes, suggesting that it is quite argillaceous
2424.4	2470.4	46.0	Oil shale, lt to med gray, grade lean. Vertical cracks filled with breccia consisting of very small (less than 1/16") bits of lt gray oil shale set in a dk brown to black matrix that is probably hydrocarbon. This zone is 0.5' thick and top is at 2430.6. Interval is argillaceous. Vertical irr. cracks filled partly with lt gray calcareous mineral and at places with dk brown to black hydrocarbon. Crack is less than 1/16" wide. One crack extends 2.5' along core, top at 2435.0. Another extends 1' along core, top at 2436.6. Material in lower crack has been partially leached, and consists of breccia from adjacent oil shale. Core is somewhat porous below 2434.0. Crack similar to those described above found at 2445.7. Extends 0.15' along core

Drill hole

CORE LOG

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2544.4	2552.2	7.8	Oil shale, tan to dk gray, laminated, grade fair to mod, breaks readily along bedding planes
52.2	73.4	21.2	Oil shale, lt to dk gray, varved, some irr bedding, grade lean, numerous micro faults, tufts even tops and bases, tops at 2556.4 (0.1' thick), 2556.5 (0.05' thick), 2557.4 (0.05' thick), and 2564.6 (0.1' thick). Unit also contains numerous tuffaceous(?) laminae, lower 5' is not as evenly bedded as upper part
73.4	88.0	14.6	Oil shale, tan to dk brown, laminated and some varving, considerable disturbed bedding, grade lean, abundant tuffaceous(?) beds and laminae, unit contains bed of mod grade top at 2582.6 (0.2' thick), tan, noncalcareous, xtl mineral on fracture at 2576. Unit contains several stringers of fine grained pyrite. Tan irr tuff, top at 2585.5 (1/2" thick). Oil shale of mod value at 2585.9 (0.7' thick)
88.0	2625.0	37.0	Core msg
2625.0	27.9	2.9	Oil shale, dk gray, laminated, grade mod
2627.9	2630.1	2.2	Oil shale, tan to almost black, varved, some irr bedding, grade fair, numerous tuffaceous(?) beds and lenses

Drill hole

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2908.8	2917.3	8.5	Oil shale, lt gray to brownish gray, varved, grade lean. Interval argillaceous.
			Core breaks readily along bedding planes
2917.3	20.0	2.7	Oil shale, dk gray to dk grayish brown, laminated, grade mod. Tuff, tan, even top and base, top at 2918.4' (0.1' thick)
20.0	38.0	18.0	Oil shale, lt to med grayish brown, varved, grade lean. Interval argillaceous. Contains dk gray elongate nodules (less than 1/8" across). Contains a tuff, tan, top at 2927.5' (0.3' estimated thickness). Much of core badly broken
38.0	42.0	4.0	Oil shale, dk brownish gray, laminated, grade mod. Contains a few rounded black organic rich nodules (as much as 1" across)
42.0	48.8	6.8	Oil shale, brownish gray to med gray, varved and laminated, grade fair. Interval argillaceous
48.8	53.6	4.8	Oil shale, brownish gray to med gray, laminated, grade lean. Interval argillaceous
2953.6	2958.5	4.9	Oil shale, grayish brown to dk gray, laminated, grade fair. Interval contains a few rounded black, organic rich nodules as much as 0.1' across

Drill hole

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
2958.5	2960.5	2.0	Oil shale, brownish gray to dk gray, laminated, grade fair to lean. Core V badly broken
60.5	66.0	5.5	Core msg
66.0	83.4	17.4	Oil shale, lt gray to grayish brown, varved and laminated, grade fair. Interval argillaceous. Contains a few black rounded organic rich nodules up to 1/2" across. Tuffs tan, banded, tops at 2968.7' (0.05' thick), 2969.9 (0.05' thick). Core breaks readily along bedding planes. Lower 6' of core is badly broken
83.4	88.8	5.4	Oil shale, brown to dk gray, laminated, some irr bedding, grade mod. Minute lenses of tuffaceous(?) material along bedding planes. A bentonite(?) bed, yellowish brown, V irr, top at 2986.7' (1/4" thick)
88.8	3002.0	13.2	Oil shale, lt gray to grayish brown, varved, grade fair. Interval contains a zone of grade mod from 2995.6' to 2996.9'. Core breaks readily along bedding planes. Lower 4' of core is badly broken
3002.0	3009.0	7.0	Oil shale, grayish brown to dk gray laminated, grade mod. Tuffs grayish-brown, banded, contorted, w/some oil staining. Tops at 3007.1' (1" thick) 3008.0' (2" thick), 3008.3' (2" thick)

Drill hole

CORE LOG

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FROM	TO	THICK- NESS	LITHOLOGIC DESCRIPTION
3009.0	3011.2	2.2	Oil shale, brownish-gray to med gray, varved, grade fair. Upper 1' is badly broken
11.2	24.7	13.5	Oil shale, brownish gray to V dk gray, laminated, some varving, grade mod. Lower part contains numerous med gray lenses that are slightly more calcareous than adjacent rock. Lenses are up to 1/2" thick
24.7	57.0	32.3	Claystone to marlstone, med gray, laminated in part, grade lean. Core badly broken. Tuff, grayish-brown, V irr bedding, top at 3039.4' (0.2' thick). A silty zone top at 3055.3' (0.8' thick approximately). Entire interval contains zones that are slightly calcareous. This interval is the "Orange Marker Zone"
57.0	60.0	3.0	Core msg
60.0	80.0	20.0	Oil shale, tan to dk brownish-gray, laminated, some varving, grade fair. Contains stringers and blebs (up to 1/8" across) of dk gray, carbonaceous material that contains specks of pyrite. Some fractures and bedding planes coated w/ a black, lustrous hydrocarbon (gilsonite?)
80.0	3085.0	6.0	Oil shale, Brown to dk grayish brown, laminated, grade mod. Contains thin lenses and blebs of a dk gray, carbonaceous material. Lenses are as much as 1/8" thick
3086.0	3095.0	9.0	Oil shale, grayish-brown to dk gray, laminated, grade fair. Contains irr fracture fillings of tuff? up to 1/8" thick

Drill hole

