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PRIMARY OIL-SHALE RESOURCES OF THE GREEN RIVER
FORMATION IN THE EASTERN UINTA BASIN, UTAH

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ABSTRACT

Resources of potential oil in place in the Green River Formation are measured and estimated for the primary oil-shale resource area east of the Green River in Utah's Uinta Basin. The area evaluated (Ts 7-14 S, Rs 19-25 E) includes most of, and certainly the best of Utah's oil-shale resource. For resource evaluation the principal oil-shale section is divided into ten stratigraphic units which are equivalent to units previously evaluated in the Piceance Creek Basin of Colorado. Detailed evaluation of individual oil-shale units sampled by cores, plus estimates by extrapolation into uncored areas indicate a total resource of 214 billion barrels of shale oil in place in the eastern Uinta Basin.

INTRODUCTION

Lacustrine oil shales are known to occur over virtually the entire 6,500-square-mile area of the Eocene Green River Formation in the Uinta Basin of northeastern Utah (Figure 1). The oil-shale deposits range from thin, separate beds to nearly continuous oil-shale sections, up to 700 feet thick. The primary resources are in the Parachute Member of the Green River Formation, however some oil shales are also present in the Garden Gulch and Douglas Creek Members (Cashion, 1967). Exposed in bold cliffs and steep canyons in the southern and eastern parts of the basin, the oil shale beds dip northward under increasing thicknesses of overburden into the basin's structural and depositional axes where they reach depths of 4,000 to 8,000 feet. In the north-central part of the basin, drill cutting samples have indicated oil shale at depths of more than 10,000 feet.

Because of their potential for producing fuel and energy, these oil shales have been investigated by government agencies and private companies for at least sixty years. Beginning in the mid 1940's, the Bureau of Mines' Laramie Petroleum and Oil Shale Experiment Station (now the Department of Energy's Laramie Energy Technology Center) ran oil-yield analyses on Uinta Basin samples for companies and government agencies and published results in two Reports of Investigation (Stanfield and others, 1954 and 1964). Most of the Uinta Basin samples in these early reports were drill cuttings from oil and gas exploration wells. While these samples furnished some information on the occurrence of oil shales, they did not provide reliable richness values nor detailed stratigraphic data required for comprehensive resource evaluation. However, they did indicate that the primary oil-shale resources occur in the part of the

Figure 1. Map of the Green River Formation showing area of primary oil-shale resources in the Uinta Basin.

basin east of the Green River. Precise resource data was available only from outcrop samples and from the few cores drilled to sample shallow deposits around the eastern and southern margins of the basin. In recent years, additional coring by industry and government has substantially increased the data available for oil shales of the eastern Uinta Basin.

Oil-yield data from 80 coreholes (Figure 2, Map Nos. 1-80) provide the principal resource data for this report. All but one of these coreholes (Map No. 10) are east of the Green River in Ts 9-14 S, Rs 18-25 E. At the time these data were compiled only 12 cores, mostly of quite limited stratigraphic extent, were available outside the map area in the western part of the basin. Supplemental stratigraphic data for this report came from geophysical logs from the eighteen drill holes (Map Nos. 81-98) on Figure 2.

The area covered by the base maps (Figures 2 and 4-30) includes parts of Uintah and Duchesne Counties, Utah, and Garfield, Rio Blanco and (barely) Moffat Counties, Colorado. Virtually all of the basin's primary oil-shale resources are in Uintah County, Utah. The area on the maps falls within three U.S. Public Land Survey systems. Most of the area is within the Salt Lake Meridian Survey (Townships 6 through 14 South, Ranges 15 through 25 East). In the northwest part of the maps, Townships 2 through 6 South and Ranges 3 West through 3 East are in the Uinta Meridian Survey. The area of Colorado along the east side of the maps is in the 6th Principal Meridian Survey.

A preliminary summary of this resource evaluation was published in Colorado School of Mines' 15th Oil Shale Symposium Proceedings (Trudell and others, 1982). Shallow oil shales of the southeastern Uinta Basin were evaluated by Dana and others (1980), and geologic characteristics of the Green River Formation in the Uinta Basin have been published by Cashion (1967) and Smith and others (1972).

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RESOURCE EVALUATION PROCEDURES

Data Base

Fischer assay oil-yield data from the 80 coreholes shown on Figure 2 (Map Nos. 1-80) provide the primary data base for evaluating the oil shale resources in the Uinta Basin. Map numbers, names, locations, and elevations of the coreholes are compiled in Table 1. Seventy-nine of these coreholes are dispersed over an area of approximately 840 square miles, east of the Green River in Uintah County, Utah. Sinclair Oil and

Gas Company's Henderson 3 in T 10 S, R 15 E (Map No. 10) is included because it is the nearest corehole west of the Green River providing comprehensive correlated resource data. Most of the assays were performed at the Department of Energy's Laramie Energy Technology Center (LETC) using ASTM method D3904-80 (ASTM, 1980), however, samples from map locations 2,3,4 and 11 were assayed in other laboratories. The Fischer assay results were compiled in a data base on computer disk pack for automatic processing. This data base will be released to the Department of Commerce's National Technical Information Service for public distribution. For stratigraphic correlation the oil yields for each corehole were plotted as histograms (bar graphs) illustrating the vertical sequence of oil yields with depth. Additional data used for correlations include drill hole geophysical logs from oil and gas exploration wells (Figure 2 and Table 2, Map Nos. 81-98), lithologic descriptions from some of the cores, and Fischer assay oil yields of drill-cutting samples from numerous wells. The lithologic data are available in file books which can be inspected at LETC by appointment.

Cross-Section Correlations and Resource Units

Interpretation of the geographic and stratigraphic distribution and variability of an oil-shale resource requires precise definition of comparable sampled sections across the deposit. The time-stratigraphic correlation concept developed for the Piceance Creek Basin by Trudell, Beard and Smith (1970) applies equally well to oil shales of eastern Utah. In fact, the oil-shale resource units previously defined for the Piceance Basin (Smith and others, 1978) can be precisely correlated with the oil shales of the Uinta Basin. Figure 3 shows correlation of oil-yield histograms from Western Oil Shale Corporation's EX-1 corehole in the Uinta Basin (Map No. 1 on Figure 2 and Plate B-B') and BLM's Shale 2 corehole in the southern Piceance Creek Basin (Smith and others, 1978: Map No. 6 on Figure 1 and Plate B-B'). The correspondence of peaks and grooves and the overall similarity of oil-yield configurations on these two histograms provide a remarkable demonstration of the correlatability of Green River oil shales. The resource units indicated on Figure 3 are time-stratigraphic units because they are based on oil-yield correlations, which have been shown to define correlatable time sequences (Trudell and others, 1970). Because the oil shales between the unit boundaries were deposited contemporaneously, these resource units are directly comparable across the Uinta and Piceance Creek Basins, and variations in richness and thickness reflect differences in depositional conditions.

Plates A-A' through F-F' (in pocket) are cross sections illustrating correlated resource units in selected coreholes and wells along three west-east lines (A-A', B-B', C-C') and three south-north lines (D-D', E-E', F-F'). Locations of these cross section lines and the coreholes and wells correlated on them are indicated on Figure 4. For the coreholes (solid dots) oil-yield histograms were used for correlations and for the wells (open circles) sonic or density logs were used. Because their response is strongly determined by organic content in the rocks, sonic and density logs are directly correlatable with oil-yield histograms.

WESTERN OIL SHALE CORP.
PROJECT UTAH EX-1
SEC 36, T9S, R20E
Uintah County, Utah

U.S. BUREAU OF LAND MANAGEMENT
TRIANGULATION STATION SHALE #2
SEC 24, T7S, R97W
Garfield County, Colorado

Figure 3. Correlation of oil-shale resource units between the Uinta and Piceance Creek Basins.

This correlatability is nicely demonstrated by the histogram for WOSCO EX-3 (Map No. 5) and the sonic log for Continental's Federal No. 34-1 (Map No. 90) on Plate D-D'. On the cross section histograms, missing samples are plotted below the zero oil-yield line to distinguish them from barren rock.

Seven oil-shale resource units are identified on the cross-sections. From bottom to top these are Unit L1, the Mahogany zone, and Units I through V. The Mahogany zone and Units I through V are the same stratigraphic units evaluated in the Piceance Basin in RI-78/2 (Smith and others, 1978). Unit L1 was originally designated as a lower oil-shale unit on Naval Oil Shale Reserve No. 1 in the southeast part of the Piceance Basin (Smith and others, 1979). Also delineated on the cross sections is the stratigraphically defined "rich zone". Originally called the "rich section" of the Mahogany zone, this unit was described by Stanfield and others (1960) as follows:

As used in this report, the rich section is an arbitrary portion of the Mahogany zone that seems most suitable for underground mining. Proposed initially by Dr. Tell Ertl and utilized subsequently by other mining engineers, this rich section might be regarded as the optimum minable section in the Mahogany zone. It is composed of high-grade oil shale, and parting at the top and bottom is expected to yield satisfactory roof and floor stones.

Though originally selected on the basis of physical properties, the rich zone is now correlated purely by its histogram configuration. The two nearly barren marlstone zones, A-groove and B-groove, form natural boundaries for the Mahogany zone. Boundaries between Units I through V correlate with major clastic wedges which intertongue with the oil shales in the northern part of the Piceance Basin (Smith and others, 1978, p. 7).

Resource Data Tables

The ten stratigraphic units shown on cross sections A-A' through F-F' were correlated in each of the 80 coreholes where they were sampled. Only three coreholes (Map Nos. 1, 2 and 3) sampled the complete thickness of all ten units. Computer programs were developed and utilized for automatic processing to calculate and tabulate the resource values presented in Table 1. Oil-yield histograms were also generated by computer. On Table 1 depths of the top (TOP) and bottom (BOT) of each unit and the thickness (THK) are recorded, in feet, for each core. Depths were measured from the indicated ground elevations. Average oil yields (AVG), in gallons per ton, were computed by the standard LETC procedure that compensates for density differences in oil shale (Stanfield and others, 1957 and 1960). In-place shale-oil resource values (RES) are given in barrels per acre, assuming the section sampled in the core is representative. Table 2 presents depth and thickness data for stratigraphic units identified on eighteen geophysical well logs. Reliable oil-yield data were not available from these wells.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
1	WESTERN OIL SHALE CORP. PROJECT UTAH EX-1 SESWSE SEC 36 T9S R20E ELEV. 4941 GR	TOP BOT THK AVG RES	2449.0 2505.0 56.0 14.02 60880.	2360.0 2449.0 89.0 1.36 10440.	2294.0 2331.0 37.0 M 20.77M 74360.	2268.0 2360.0 92.0 MI 19.61M 134300.	2256.0 2268.0 12.0 6.03 55990.	2182.0 2256.0 74.0 I 14.85 84670.	2093.0 2182.0 89.0 14.35 98700.	2005.0 2093.0 88.0 I 11.78 81790.	1874.0 2005.0 131.0 8.71 92280.	1807.0 1874.0 67.0 10.22 54700.
2	TOSCO UTAH STATE NO. 1 NWNE SEC 26 T9S R21E ELEV. 4912 GR	TOP BOT THK AVG RES	2463.0 2530.0 67.0 15.70A 80550.A	2375.0 2463.0 88.0 2.48A 18650.A	2303.0 2344.0 41.0 35.20A 96600.A	2274.0 2375.0 101.0 23.67A 172900.A	2261.0 2274.0 13.0 6.75A 7213.A	2172.7 M 2261.0 88.3 15.71A 186200.A	2077.0 2172.7 95.7 14.54A 107500.A	1995.0 2077.0 82.0 11.26A 73100.A	1867.0 1995.0 128.0 8.57A 88850.A	1797.0 1867.0 70.0 9.20A 51800.A
3	SHELL OIL CO. UTAH STATE 14X-34 SWSW SEC 34 T9S R21E ELEV. 5047 GR	TOP BOT THK AVG RES	2435.0 2496.0 61.0 14.58A 68690.A	2342.0 2435.0 93.0 1.00A 14430.A	2279.0 2313.0 34.0 32.03A 74460.A	2252.0 2342.0 90.0 21.49A 142000.A	2239.0 2252.0 13.0 6.95A 7415.A	2160.0 2239.0 79.0 16.56A 99520.A	2064.0 2160.0 96.0 13.85A 103200.A	1982.0 2064.0 82.0 11.50A 74580.A	1848.0 1982.0 134.0 8.74A 94750.A	1774.0 1848.0 74.0 9.74A 57820.A
4	SHELL OIL CO. UTAH STATE 14-36 SWSW SEC 36 T9S R21E ELEV. 5100 GR	TOP BOT THK AVG RES	2359.0 2421.0 B 62.0 P 10.26A 50790.A	2270.0 2359.0 89.0 1.74A 13340.A	2202.0 2240.0 38.0 34.07A 87350.A	2179.0 2270.0 91.0 21.93A 146100.A	2165.0 2179.0 14.0 3.62A 4283.A	2000.0 2165.0 85.0 12.91A 85840.A	1992.0 2000.0 88.0 12.27A 84900.A	1910.0 1992.0 82.0 10.48A 68540.A	1850.0 T 1910.0 60.0 P 7.24A 35590.A	
5	WESTERN OIL SHALE CORP. COREHOLE EX-3 SWSW SEC 16 T9S R25E ELEV. 5813 GR	TOP BOT THK AVG RES	1144.0 1165.9 B 21.9 P 15.12 25460.	1097.0 1144.0 47.0 6.31 24490.	1015.0 1065.0 50.0 29.20 101900.	986.0 1097.0 110.2 22.69 182000.	975.0 986.0 M 11.8 7.85 7548.	904.0 975.0 71.0 13.32 73720.	809.0 904.0 95.0 12.33 91990.	719.0 809.0 90.0 10.11 72750.	613.0 719.0 106.0 8.58 73670.	462.0 613.0 151.0 G 4.34 55060.
6	SKYLINE OIL CO. STRINGHAM 1 SWSWNE SEC 23 T9S R25E ELEV. 5879 GR	TOP BOT THK AVG RES			470.6 516.0 45.4 27.23 87250.	443.4 548.0 B 104.6 P 20.56 158900.	430.9 443.4 12.5 4.95 5175.	366.0 430.9 64.9 13.44 67920.	272.0 366.0 94.0 11.25 83770.	184.5 272.0 87.5 9.95 69690.	73.1 184.5 111.4 8.47 76450.	50.0 T 73.1 23.1 P 4.42 8569.
7	NATIONAL FARMERS UNION EXPLORATION COREHOLE 2 SW SEC 32 T9S R25E ELEV. 5507 GR	TOP BOT THK AVG RES			505.0 554.0 49.0 29.00 101300.	475.0 560.0 B 94.2 P 24.92 150400.	463.9 475.0 11.9 4.96 4932.	392.0 463.9 71.9 13.50 75540.	305.3 392.0 86.7 12.47 84850.	224.6 305.3 80.7 11.17 71490.	116.0 224.6 108.6 8.64 75940.	30.0 T 116.0 86.0 PG 6.40 45430.
8	DOE/LETC COWBOY CANYON 1 NENWNE SEC 33 T9S R25E ELEV. 5871 GR	TOP BOT THK AVG RES	607.9 675.0 67.1 14.44 74910.	568.0 607.9 39.9 4.02 13530.	492.7 538.0 46.1 30.23 96420.	463.9 568.0 104.1 22.14 168500.	451.6 463.9 12.3 4.73 4871.	440.0 T 451.6 11.6 P 17.41 15260.				

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
9	DOE/LETC COWBOY CANYON 2 NENENW SEC 33 T9S R25E ELEV. 5745 GR	TOP BOT THK AVG RES			488.5 520.5 B 32.0 P 31.03 68340.	461.2 520.5 B 59.3 P 25.33 107400.	449.4 461.2 11.8 4.65 4594.	391.0 T 449.4 58.4 P 13.72 62290.				
10	SINCLAIR OIL AND GAS CO. HENDERSON 3 SENUSE SEC 16 T10S R15E ELEV. 7077 GR	TOP BOT THK AVG RES	2463.4 2538.0 B 74.6 PI 6.77 41550.	2402.0 2463.4 61.4 I .84 4499.	2331.0 2362.0 31.0 15.16 36140.	2279.3 2402.0 122.7 MG 7.56 75730.	2200.0 T 2279.3 79.3 PM .50 3480.					
11	WESTERN OIL SHALE CORP. COREHOLE 2 SESW SEC 31 T10S R21E ELEV. 5345 GR	TOP BOT THK AVG RES	1745.0 1799.0 54.0 12.81A 54160.A	1689.0 1745.0 56.0 1.46A 7054.A	1640.0 1664.0 24.0 30.32A 50320.A	1616.0 1689.0 73.0 18.68A 102100.A	1604.0 1616.0 12.0 3.98A 4029.A	1551.0 1604.0 82.0 12.78A 53030.A	1469.0 1551.0 82.0 12.37A 79670.A	1391.0 1469.0 78.0 10.28A 64010.A	1290.0 T 1391.0 101.0 P 7.92A 65120.A	
12	SHELL OIL CO. UTAH STATE 22X-12 SENU SEC 12 T10S R22E ELEV. 5190 GR	TOP BOT THK AVG RES	1994.0 2054.0 60.0 14.63 67760.	1920.0 1994.0 74.0 M 3.16 19890.	1848.0 1889.0 41.0 35.50 97470.	1819.0 1920.0 101.0 23.50 172300.	1807.0 1819.0 12.0 5.75 5726.	1727.0 1807.0 80.0 14.51 89680.	1643.0 1727.0 84.0 13.84 90290.	1559.0 1643.0 84.0 10.99 73270.	1500.0 T 1559.0 59.0 P 8.59 41060.	
13	SHELL OIL CO. COREHOLE 1 SESWNE SEC 2 T10S R24E ELEV. 5035 GR	TOP BOT THK AVG RES				689.0 704.0 B 15.0 P 20.85 23070.	678.0 689.0 11.0 5.25 4013.	604.0 678.0 74.0 13.90 79830.	515.5 604.0 88.5 12.92 89390.	427.5 515.5 88.0 11.43 79580.	322.5 427.5 105.0 9.20 77810.	200.5 322.5 114.0 G 7.49 69760.
14	GULF MINERAL RESOURCES CO. EVACUATION 1 NUNWSW SEC 13 T10S R24E ELEV. 5435 GR	TOP BOT THK AVG RES		863.0 898.7 B 34.9 P 4.92 14350.	784.3 834.0 49.7 30.29 104100.	756.0 863.0 107.8 22.29 175400.	745.4 756.0 10.6 4.74 4203.	675.0 745.4 70.4 13.10 72020.	588.0 675.0 87.0 11.98 82120.	504.0 588.0 84.0 10.76 71920.	465.0 T 504.0 39.0 P 8.15 25830.	
15	GULF MINERAL RESOURCES CO. SOUTHAM 4 SWSESW SEC17 T10S R24E ELEV. 5061 GR	TOP BOT THK AVG RES			953.0 1004.0 51.0 30.82 100300.	925.0 1036.9 B 111.9 P 22.65 104600.	914.0 925.0 11.0 4.93 4535.	910.0 T 914.0 4.0 P 20.66 6104.				
16	GULF MINERAL RESOURCES CO. SOUTHAM 1 NESENU SEC 22 T10S R24E ELEV. 5242 GR	TOP BOT THK AVG RES	1002.0 1074.0 72.0 13.67 76550.	956.0 1002.0 46.0 I 4.48 17200.	876.0 925.0 49.0 29.64 100900.	849.0 956.0 106.2 22.24 172500.	838.0 849.0 11.8 5.11 5031.	816.9 T 838.0 21.1 P 16.53 26550.				

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued):

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
17	GULF MINERAL RESOURCES CO. EVACUATION 3 NUNWNE SEC 26 T10S R24E ELEV. 5433 GR	TOP BOT THK AVG RES	938.0 939.9 B 1.9 P 11.33 1704.	919.2 938.0 18.8 6.42 9957.	846.4 888.4 42.0 31.42 98580.	889.7 919.2 189.5 21.49 172800.	797.4 809.7 12.3 4.09 4235.	736.0 797.4 61.4 12.91 61990.	652.7 736.0 83.3 12.29 80480.	575.0 652.7 77.7 10.54 65280.	474.3 575.0 100.7 8.71 70980.	432.5 T 474.3 41.8 P 5.95 28590.
18	GULF MINERAL RESOURCES CO. SOUTHAM 3 SUNWNE SEC 29 T10S R24E ELEV. 5334 GR	TOP BOT THK AVG RES		1115.0 1130.0 B 15.0 P1 5.65 7040.	1043.0 1087.0 44.0 32.73 98010.	1016.0 1115.0 99.0 23.47 168300.	1004.2 1016.0 11.8 4.86 4801.	961.0 T 1004.2 43.2 P 13.90 46620.				
19	GULF MINERAL RESOURCES CO. SOUTHAM 2 NENUNW SEC 34 T10S R24E ELEV. 5432 GR	TOP BOT THK AVG RES		942.0 958.0 B 16.8 P 5.14 7289.	873.0 918.3 45.3 32.68 100800.	846.0 942.0 96.0 23.19 161500.	835.0 846.0 11.0 4.44 4105.	821.0 T 835.0 14.0 P 18.01 18980.				
20	GENERAL PETROLEUM CORP. CORHOLE 37-4 NUSSEW SEC 4 T10S R25E ELEV. 5881 GR	TOP BOT THK AVG RES		471.0 486.3 B 15.3 P 6.30 7964.	397.5 441.5 44.0 29.31 89770.	370.0 471.0 181.0 22.10 163200.	358.0 370.0 12.0 4.79 4815.	291.0 358.0 67.0 13.04 68240.	218.5 291.0 72.5 11.94 68230.	141.5 218.5 77.0 10.90 66700.	33.5 141.5 188.0 8.08 71010.	22.0 T 33.5 11.5 PM 6.90 6518.
21	LARSON SHALE CO. COREHOLE 42-12 SENESE SEC 12 T10S R25E ELEV. 6473 GR	THK BOT TOP AVG RES	260.0 267.0 B 7.0 P 16.99 9021.	225.0 260.0 35.0 4.80 11790.	159.0 199.0 40.0 28.54 79870.	131.7 225.0 93.3 21.24 145700.	119.0 131.7 12.7 4.21 4501.	55.0 119.0 64.0 12.70 63660.	21.0 T 55.0 34.0 P 10.57 28630.			
22	LARSON SHALE CO. COREHOLE 55-15 NUNWSE SEC 15 T10S R25E ELEV. 6312 GR	TOP BOT THK AVG RES			93.9 133.2 39.3 29.37 80310.	68.4 146.3 B 77.9 P 23.05 130400.	56.9 68.4 11.5 4.12 3988.	5.0 T 56.9 51.9 P 12.65 51440.				
23	GULF MINERAL RESOURCES CO. EVACUATION 2 NUSWSE SEC 18 T10S R25E ELEV. 5435 GR	TOP BOT THK AVG RES	624.0 695.0 71.0 13.13 72798.	584.6 624.0 39.4 5.52 18080.	588.5 554.0 45.5 30.22 95130.	482.0 584.6 182.6 22.00 165100.	470.0 482.0 12.0 4.61 4636.	402.0 470.0 68.0 12.17 65070.	350.0 T 402.0 52.0 P 11.02 45480.			
24	GULF MINERAL RESOURCES CO. BONANZA 7 SUNWSE SEC 20 T10S R25E ELEV. 5720 GR	TOP BOT THK AVG RES			457.6 584.0 46.4 29.09 94080.	431.0 519.7 B 88.7 P 23.15 149000.	420.0 431.0 11.0 4.59 4231.	354.0 420.0 66.0 12.66 65460.	299.3 T 354.0 54.7 P 11.22 48650.			

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
25	LARSON SHALE CO.	TOP		448.0	382.0	357.0	347.0	285.0	212.0	142.0	44.0	5.0 T
	COREHOLE 35-28	BOT		450.0 B	421.0	448.0	357.0	347.0	285.0	212.0	142.0	44.0
	NWNE SW SEC 28 T10S R25E	THK		2.0 P	39.0	91.0	10.0	62.0	73.0	70.0	98.0	39.0 PG
	ELEV. 6173 GR	AVG		5.74	30.67	21.44	4.19	11.63	10.95	9.65	7.26	2.30
		RES		953.	82500.	143300.	3527.	56980.	63480.	54200.	58270.	7698.
26	NATIONAL FARMERS UNION	TOP	737.2	700.0	627.5	603.4	593.9	532.0	454.2	380.4	284.0	240.0 T
	EXPLORATION COREHOLE 9	BOT	802.0	737.2	670.8	700.0	603.4	593.9	532.0	454.2	380.4	284.0
	NW SEC 32 T10S R25E	THK	64.8	37.2	43.3	96.6	9.5	61.9	77.8	73.8	96.4	44.0 P
	ELEV. 5746 GR	AVG	13.36	5.60	31.56	22.46	4.72	12.47	11.77	10.82	9.07	5.76
		RES	67490.	17320.	93720.	158200.	3757.	60500.	72250.	63510.	70540.	21020.
27	GULF MINERAL RESOURCES CO.	TOP		214.0	158.0	136.0	127.0	90.0 T				
	BONANZA 6A	BOT		220.1 B	192.0	214.0	136.0	127.0				
	SWNE SW SEC 34 T10S R25E	THK		6.1 P	34.0	78.0	9.0	37.0 P				
	ELEV. 6560 GR	AVG		7.06	30.59	21.50	3.73	11.84				
		RES		3532.	71790.	123100.	2834.	34550.				
28	SHELL OIL CO.	TOP			511.0	488.0	477.0	428.0	360.0	292.0	202.0	138.0
	COREHOLE 2	BOT			540.0 B	540.0 B	488.0	477.0	428.0	360.0	292.0	202.0
	NENWNE SEC 17 T11S R24E	THK			29.0 P	52.0 P	11.0	49.0	68.0	68.0	90.0	64.0
	ELEV. 5347 GR	AVG			34.53	26.87	4.40	12.77	12.50	10.70	8.99	9.79
		RES			67370.	98840.	4068.	48990.	66680.	57900.	65270.	50240.
29	NATIONAL FARMERS UNION	TOP				640.8	632.0	592.0	538.0	480.0	399.3	375.0 T
	EXPLORATION COREHOLE 10	BOT				660.0 B	640.8	632.0	592.0	538.0	480.0	399.3
	NESESW SEC 32 T11S R24E	THK				19.2 P	8.8	40.0	54.0	58.0	80.7	24.3 P
	ELEV. 6215 GR	AVG				16.77	3.95	10.88	11.23	9.63	7.40	6.79
		RES				24460.	2931.	34590.	48050.	44830.	48850.	13570.
30	SKYLINE OIL CO.	TOP		460.0	397.4	374.3	365.5	308.0	242.0	170.0	77.6	50.0 T
	WATSON 3	BOT		468.0 B	432.0	460.0	374.3	365.5	308.0	242.0	170.0	77.6
	NENESE SEC 3 T11S R25E	THK		8.0 P	34.6	85.7	8.8	57.5	66.0	72.0	92.4	27.6 P
	ELEV. 6338 GR	AVG		7.31	32.13	22.00	4.05	12.03	11.30	10.41	8.26	3.92
		RES		4785.	75960.	137900.	3000.	54480.	59070.	59770.	61990.	9126.
31	SKYLINE OIL CO.	TOP			438.0	411.2	401.2	344.0	267.0	194.0	101.0	20.0 T
	WATSON 1	BOT			470.0 B	470.0 B	411.2	401.2	344.0	267.0	194.0	101.0
	NENESW SEC 5 T11S R25E	THK			32.0 P	58.0 P	10.0	57.2	77.0	73.0	93.0	81.0
	ELEV. 5533 GR	AVG			35.70	27.40	4.31	12.55	11.72	10.73	8.66	7.24
		RES			76280.	113900.	3621.	56310.	71260.	62340.	66560.	48050.
32	SKYLINE OIL CO.	TOP	543.6	510.0 T								
	WATSON 1-A	BOT	603.7	543.6								
	NENESW SEC 5 T11S R25E	THK	60.1	33.6 P								
	ELEV. 5532 GR	AVG	13.83	4.05								
		RES	64570.	11460.								

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
33	GULF MINERAL RESOURCES CO. BONANZA 5 SESUNE SEC 13 T11S R25E ELEV. 6700 GR	TOP		136.8	82.0	61.0	52.0	30.0 T				
		BOT		137.5 B	113.0	136.8	61.0	52.0				
		THK		.7 P	31.0	75.8	9.0	22.0 P				
		AVG		4.90	31.22	20.92	3.73	12.56				
		RES		287.	66530.	116900.	2840.	21660.				
34	SKYLINE OIL CO. WATSON 2 NUNWSW SEC 16 T11S R25E ELEV. 5905 GR	TOP		431.9	376.6	356.0	348.1	298.5	231.0	161.5	70.6	35.0 T
		BOT		455.0 B	409.9	431.9	356.0	348.1	298.5	231.0	161.5	70.6
		THK		23.1 P	33.3	75.9	7.9	49.6	67.5	69.5	90.9	35.6 PG
		AVG		3.67	33.44	23.19	4.75	11.99	11.99	10.73	9.00	3.73
		RES		7164.	75440.	127700.	3140.	46850.	63730.	59320.	66000.	11220.
35	SKYLINE OIL CO. WATSON 4 NENUNE SEC 22 T11S R25E ELEV. 6144 GR	TOP			371.3	350.6	342.0	292.0	226.0	154.0	61.0	20.0 T
		BOT			406.4	425.0 B	350.6	342.0	292.0	226.0	154.0	61.0
		THK			35.1	75.2 P	8.6	50.0	66.0	72.0	93.0	41.0 PG
		AVG			29.17	21.05	4.13	11.35	10.93	10.22	8.10	3.93
		RES			71340.	116600.	2980.	44930.	57330.	58780.	61240.	13610.
36	LARSON SHALE CO. COREHOLE 18-29 SWSUSW SEC 29 T11S R25E ELEV. 6110 GR	TOP		344.0	301.0	280.0	270.0	231.0	173.0	114.0	31.0	3.0 T
		BOT		360.6 B	332.0	344.0	280.0	270.0	231.0	173.0	114.0	31.0
		THK		16.6 PI	31.0	64.0	10.0	39.0	50.0	59.0	83.0	28.0 P
		AVG		6.23	29.39	21.25	3.93	11.24	10.66	9.71	8.13	5.65
		RES		8542.	63390.	100000.	3316.	34730.	49230.	45980.	54040.	13150.
37	GULF MINERAL RESOURCES CO. BONANZA 4 SESUSW SEC 31 T11S R25E ELEV. 6295 GR	TOP		459.0	411.0	389.0	380.0	356.0 T				
		BOT		464.9 B	441.0	459.0	389.0	380.0				
		THK		5.9 P	30.0	70.0	9.0	24.0 P				
		AVG		4.37	30.14	19.99	3.37	12.91				
		RES		2165.	62590.	103000.	2574.	24220.				
38	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 13 NENW SEC 2 T12S R10E ELEV. 5041 GR	TOP			107.9	64.0	52.0 T					
		BOT			147.9	154.4 B	64.0					
		THK			40.0	90.4 P	12.0 P					
		AVG			21.02	14.13	1.50					
		RES			63940.	98970.	1555.					
39	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 12 SWNW SEC 4 T12S R10E ELEV. 5100 GR	TOP			115.5	54.0 T						
		BOT			156.3	181.5 B						
		THK			40.8	126.7 PG						
		AVG			18.50	10.35						
		RES			56600.	104700.						
40	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 14 NUNW SEC 13 T12S R10E ELEV. 5298 GR	TOP			106.3	57.6	51.7 T					
		BOT			150.2	173.2 B	57.6					
		THK			43.9	115.6 P	5.9 P					
		AVG			17.02	10.85	1.40					
		RES			56600.	99690.	714.					

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
41	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 15 NWSE SEC 26 T12S R18E ELEV. 5690 GR	TOP BOT THK AVG RES			68.2 143.6 75.4 G 10.67 63970.	30.9 166.6 B 135.7 PG 9.34 102000.	29.9 T 30.9 1.0 P .00 6957.					
42	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 3 NWSW SEC 1 T12S R19E ELEV. 5410 GR	TOP BOT THK AVG RES			504.1 546.7 42.6 24.59 75270.	480.0 T 557.0 B 77.0 P 17.68 102700.						
43	WESTERN OIL SHALE CORP. CORE TEST 1-2 NESESW SEC 2 T12S R19E ELEV. 5420 GR	TOP BOT THK AVG RES		634.5 635.5 B 1.0 P 0.70 61.	564.5 608.5 44.0 24.09 76420.	533.5 634.5 101.0 15.85 122500.	491.5 533.5 42.0 1.60 5814.	436.0 491.5 55.5 7.15 32520.	400.0 T 436.0 36.0 PG 3.57 10880.			
44	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 2 SENW SEC 24 T12S R19E ELEV. 5546 GR	TOP BOT THK AVG RES			268.4 T 316.2 B 47.8 P 19.94 70760.	268.4 T 316.2 B 47.8 P 19.94 70760.						
45	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 1 SESE SEC 36 T12S R19E ELEV. 5658 GR	TOP BOT THK AVG RES			73.5 116.5 43.0 23.33 72710.	65.0 T 125.6 B 60.6 P 17.87 81600.						
46	H.M. BYLLESBY AND CO. WINDY COREHOLE SWNWSEC SEC 24 T12S R20E ELEV. 5503 U	TOP BOT THK AVG RES		247.2 265.2 B 18.0 P .74 1155.	170.8 213.8 43.0 21.23 67150.	137.4 247.2 109.8 13.29 113800.	106.8 137.4 30.6 1.60 4423.	51.0 106.8 55.8 6.51 29940.	10.0 T 51.0 41.0 P 3.59 12470.			
47	H.M. BYLLESBY AND CO. JUNIPER COREHOLE NNWNW SEC 28 T12S R20E ELEV. 5872 GR	TOP BOT THK AVG RES								206.0 220.2 B 14.2 P 3.92 4691.	90.6 206.0 115.4 3.70 36140.	33.5 90.6 57.1 4.16 20010.
48	ERDA/LERC SOUTHERN UINTA BASIN 1 NENENE SEC 30 T12S R21E ELEV. 5496 GR	TOP BOT THK AVG RES	219.6 259.0 B 39.4 P 7.67 24670.	196.1 219.6 23.5 .85 1746.	123.2 163.0 39.8 20.95 61450.	88.9 196.1 107.2 12.96 108600.	61.0 88.9 27.9 2.06 4930.	19.5 T 61.0 41.5 P 6.47 22140.				

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
49	ERDA/LERC SOUTHERN UINTA BASIN 2 SESUNE SEC 35 T12S R21E ELEV. 5829 GR	TOP BOT THK AVG RES	211.5 240.2 B 28.7 P 8.00 20580.	195.1 211.5 16.4 1.05 1496.	122.2 160.1 37.9 21.56 59970.	86.5 195.1 108.6 12.83 109100.	59.3 86.5 27.2 1.62 3810.	18.8 T 59.3 40.5 P 6.16 20620.				
50	NATIONAL FARMERS UNION EXPLORATION COREHOLE 5 S2 SEC 2 T12S R24E ELEV.6059GR	TOP BOT THK AVG RES	228.4 270.0 B 41.6 PI 7.52 25560.	219.8 228.4 8.6 4.40 3179.	173.0 205.0 32.0 32.46 70820.	153.4 219.8 66.4 22.67 109600.	150.0 T 153.4 3.4 P 3.66 1051.					
51	U.S. GEOLOGICAL SURVEY CRU-1 NENE SEC 3 T12S R24E ELEV. 6137 GR	TOP BOT THK AVG RES			459.2 490.8 31.6 27.76 61690.	435.2 497.8 B 62.6 P 21.29 98000.	425.2 435.3 10.1 4.28 3635.	388.0 425.2 37.2 11.38 33520.	333.4 388.0 54.6 10.90 47270.	277.0 333.4 56.4 9.65 43680.	194.7 277.0 82.3 8.06 53960.	142.6 194.7 52.1 8.33 35200.
52	GULF MINERAL RESOURCES CO. BONANZA 1 NW1/4 SEC 14 T12S R24E ELEV. 6165 GR	TOP BOT THK AVG RES	97.8 150.7 B 52.9 PI 7.13 30930.	88.2 97.8 9.6 3.63 2946.	42.4 72.0 29.6 31.59 64120.	30.0 T 88.2 58.2 P 21.75 92770.						
53	GULF MINERAL RESOURCES CO. BONANZA 2 NESUSW SEC 22 T12S R24E ELEV. 6225 GR	TOP BOT THK AVG RES		181.5 184.6 B 3.1 P 4.38 1141.	133.3 162.9 29.6 32.55 65650.	107.0 181.5 74.5 21.39 117100.	97.0 107.0 10.0 5.85 4850.	80.0 T 97.0 17.0 P 13.11 17410.				
54	GULF MINERAL RESOURCES CO. BONANZA 9 SWSENE SEC 34 T12S R24E ELEV. 6450 GR	TOP BOT THK AVG RES			93.0 126.0 33.0 30.37 69270.	69.0 136.3 B 67.3 P 22.08 108600.	60.3 69.0 8.7 3.42 2519.	59.4 T 60.3 .9 P 17.20 1172.				
55	GULF MINERAL RESOURCES CO. BONANZA 3 NESENE SEC 7 T12S R25E ELEV. 6540 GR	TOP BOT THK AVG RES	350.0 392.0 B 42.0 PI 6.90 24060.	340.0 350.0 10.0 3.29 2791.	296.2 324.3 28.1 29.72 57970.	277.7 T 340.0 62.3 P 20.42 94110.						
56	GULF MINERAL RESOURCES CO. BONANZA 8 NWSESW SEC 18 T12S R25E ELEV.6340 GR	TOP BOT THK AVG RES	138.0 196.2 B 58.2 PI 5.16 25060.	129.0 138.0 9.0 3.81 2896.	84.0 113.0 29.0 31.62 62870.	63.0 129.0 66.0 20.89 101700.	53.0 63.0 10.0 3.58 3029.	36.0 T 53.0 17.0 P 12.08 16160.				

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
57	GENERAL PETROLEUM CORP. COREHOLE 42-29 SENESE SEC 29 T12S R25E ELEV. 6799 GR	TOP BOT THK AVG RES			15.5 44.0 28.5 30.20 59570.	0.0 T 62.2 B 62.2 P 19.92 91970.						
58	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 18 SWSW SEC 7 T13S R19E ELEV. 6275 GR	TOP BOT THK AVG RES			105.2 138.4 33.2 18.57 46210.	15.0 145.7 B 130.7 PG 5.30 58540.	10.0 T 15.0 5.0 P .90 391.					
59	U.S. GEOLOGICAL SURVEY NAVAL RESERVE 2 NO. 8 SWNW SEC 14 T13S R19E ELEV. 6247 GR	TOP BOT THK AVG RES			156.0 189.4 33.4 21.81 53370.	139.3 T 191.6 B 52.3 P 13.92 56510.						
60	H.M. BYLLESBY AND CO. AGENCY COREHOLE SWNESE SEC 1 T13S R20E ELEV. 5936 GR	TOP BOT THK AVG RES	257.0 260.5 B 3.5 P 9.03 2550.	232.7 257.0 24.3 I 1.64 3440.	157.4 195.8 38.4 20.96 59310.	112.2 232.7 120.5 11.76 111000.	88.2 112.2 24.0 2.02 4162.	16.0 88.2 72.2 6.42 38240.	14.5 T 16.0 1.5 P 3.30 420.			
61	H.M. BYLLESBY AND CO. GREEN CANYON COREHOLE NWNESE SEC 8 T13S R20E ELEV. 5964 GR	TOP BOT THK AVG RES			157.7 196.2 38.5 19.86 56800.	90.6 232.8 B 142.2 PG 9.35 107000.	75.1 90.6 15.5 2.22 2945.	0.0 T 75.1 75.1 P 6.04 37550.				
62	GEOKINETICS, INC. AGENCY DRAW 3 SENESE SEC 11 T13S R20E ELEV. 5908 GR	TOP BOT THK AVG RES			69.0 105.0 36.0 20.93 55540.	19.0 120.4 B 101.4 P 11.94 95410.	0.0 T 19.0 19.0 P .80 1453.					
63	H.M. BYLLESBY AND CO. PINON COREHOLE NWNESE SEC 14 T13S R20E ELEV. 6038 GR	TOP BOT THK AVG RES		228.5 253.0 B 24.5 PI .70 1490.	151.2 187.5 36.3 19.49 52680.	96.8 228.5 131.7 G 10.14 106800.	77.2 96.8 19.6 2.24 3766.	15.4 T 77.2 61.8 P 6.81 34610.				
64	GEOKINETICS, INC. AGENCY DRAW 4 SESWW SEC 26 T13S R20E ELEV. 6388 GR	TOP BOT THK AVG RES			71.0 103.0 32.0 18.08 43540.	10.0 T 110.1 B 100.1 PG 8.06 65630.						

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
65	GEOKINETICS, INC. AGENCY DRAW 5 SESWNW SEC 31 T13S R21E ELEV. 6457 GR	TOP BOT THK AVG RES			62.0 90.0 28.0 18.79 39370.	10.0 T 110.4 B 100.4 PG 7.26 59710.						
66	ERDA/LERC SOUTHERN UINTA BASIN 3 SESWNW SEC 17 T13S R22E ELEV. 6183 GR	TOP BOT THK AVG RES	174.6 201.2 B 26.6 P 8.18 17690.	163.5 174.6 11.1 1.70 1623.	94.0 128.8 34.8 22.60 57310.	56.4 163.5 107.1 13.37 111600.	33.8 56.4 22.6 2.16 4183.	20.7 T 33.8 13.1 P 11.50 11920.				
67	ERDA/LERC SOUTHERN UINTA BASIN 6 NWNENE SEC 31 T13S R22E ELEV. 6628 GR	TOP BOT THK AVG RES	223.5 235.5 B 12.0 PI 9.54 9194.	213.0 223.5 10.5 I 2.09 1887.	142.0 173.6 31.6 21.88 50620.	97.6 213.0 115.4 I 11.09 101500.	81.4 97.6 16.2 2.24 3115.					
68	GEOKINETICS, INC. COREHOLE 32-1 NESW SEC 32 T13S R22E ELEV. 6651 GR	TOP BOT THK AVG RES			67.0 99.0 32.0 21.45 50400.	50.0 T 110.4 B 60.4 P 13.83 64890.						
69	GEOKINETICS, INC. COREHOLE 32-2 SESE SEC 32 T13S R22E ELEV. 6755 GR	TOP BOT THK AVG RES			106.0 139.0 33.0 19.29 47470.	66.0 140.2 B 74.2 P 14.23 81730.	48.0 66.0 18.0 2.43 3747.	10.0 T 48.0 38.0 P 9.96 30290.				
70	ERDA/LERC SOUTHERN UINTA BASIN 4 NESWNE SEC 35 T13S R22E ELEV. 6700 GR	TOP BOT THK AVG RES	189.0 217.4 B 28.4 PI 8.47 19500.	180.1 189.0 8.9 I 5.62 4157.	115.0 144.3 29.3 25.76 53800.	77.3 180.1 102.0 13.72 109600.	60.2 77.3 17.1 2.24 3277.	12.4 T 60.2 47.8 P 8.37 32460.				
71	ERDA/LERC SOUTHERN UINTA BASIN 5 NESWSE SEC 35 T13S R22E ELEV. 6727 GR	TOP BOT THK AVG RES	123.7 137.2 B 13.5 P 7.01 7767.	115.1 123.7 8.6 I 4.31 3114.	47.0 75.7 28.7 23.97 49650.	11.4 115.1 103.7 12.50 102300.	.5 T 11.4 10.9 P 1.57 1478.					
72	ERDA/LERC SOUTHERN UINTA BASIN 8 NENESW SEC 26 T13S R23E ELEV. 6419 GR	TOP BOT THK AVG RES	91.0 111.5 B 20.5 P 7.45 12480.	84.9 91.0 6.1 M 2.33 1217.	26.3 58.6 32.3 25.94 59650.	5.0 T 84.9 79.9 P 17.75 106900.						

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

MAP NO.	COREHOLE	1)	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
73	NATIONAL FARMERS UNION EXPLORATION COREHOLE 6 SW SEC 2 T13S R24E ELEV. 6789 GR	TOP BOT THK AVG RES	165.7 178.0 B 12.3 P 7.51 7545.	158.8 165.7 6.9 I 6.43 3658.	112.5 144.0 31.5 29.29 64230.	89.9 158.8 68.9 21.14 107200.	81.0 89.9 8.9 3.49 2633.	37.4 81.0 43.6 11.26 38900.	30.0 T 37.4 7.4 P 9.86 5849.			
74	ERDA/LERC SOUTHERN UINTA BASIN 9 NWSW SEC 6 T13S R24E ELEV. 6268 GR	TOP BOT THK AVG RES	246.4 276.2 B 29.8 PI 6.10 15850.	237.4 246.4 9.0 4.53 3421.	180.1 217.1 37.0 29.01 74870.	153.5 237.4 83.9 20.10 125100.	143.3 153.5 10.2 3.91 3361.	100.4 143.3 42.9 11.10 37700.	35.0 T 100.4 65.4 P 10.35 54020.			
75	FRANK A. AND F. ALLEN BREWER COREHOLE 8-1 CNWSW SEC 8 T13S R24E ELEV. 6322 GR	TOP BOT THK AVG RES	126.4 227.7 B 101.3 PI 4.05 34540.	116.3 126.4 10.1 4.12 3507.	61.0 98.4 37.4 26.34 69950.	37.8 116.3 78.5 20.07 116800.	27.5 37.8 10.3 4.57 3945.	0.0 T 27.5 27.5 P 9.38 20750.				
76	FRANK A. AND F. ALLEN BREWER COREHOLE 9-1 CSWNE SEC 9 T13S R24E ELEV. 6497 GR	TOP BOT THK AVG RES	138.4 236.0 B 97.6 PG 4.92 40130.	129.3 138.4 9.1 6.12 4603.	79.2 113.4 34.2 25.98 63250.	55.0 129.3 74.3 19.79 109200.	45.3 55.0 9.7 3.29 2705.	0.0 T 45.3 45.3 P 10.17 36830.				
77	ERDA/LERC SOUTHERN UINTA BASIN 10 SWSW SEC 10 T13S R24E ELEV. 6677 GR	TOP BOT THK AVG RES	206.2 231.6 B 25.4 PI 6.98 14550.	198.2 206.2 8.0 3.93 2653.	150.7 181.8 31.1 30.66 65790.	126.0 198.2 72.2 21.15 112400.	117.4 126.0 8.6 3.68 2677.	72.7 117.4 44.7 11.54 40790.	8.0 72.7 63.9 10.73 54570.	5.0 T 8.0 3.8 P 10.07 3060.		
78	GEOKINETICS, INC. COREHOLE W-14 NWNNE SEC 2 T14S R22E ELEV. 6721 GR	TOP BOT THK AVG RES	112.3 133.4 B 21.1 P 5.96 10410.	103.2 112.3 9.1 I 1.37 1075.	39.4 69.3 29.9 23.00 49970.	10.0 T 103.2 93.2 P 13.30 96660.						
79	GEOKINETICS, INC. EXPLORATION 3 NWSW SEC 2 T14S R22E ELEV. 6829 GR	TOP BOT THK AVG RES			66.0 95.0 29.0 22.48 47520.	27.0 112.0 B 85.0 P 14.04 92500.	11.0 27.0 16.0 2.27 3119.	0.0 T 11.0 11.0 P 10.69 9360.				
80	ERDA/LERC SOUTHERN UINTA BASIN 7 NWNNE SEC 14 T14S R22E ELEV. 6989 GR	TOP BOT THK AVG RES	124.2 138.5 B 14.3 P 7.75 9041.	118.6 124.2 5.6 I 5.29 2470.	49.0 76.3 27.3 21.76 43530.	11.0 118.6 107.6 I 11.39 96970.	5.0 T 11.0 6.0 P .57 300.					

1) Symbols and measurement units defined in footnotes at end of table.

TABLE 1. Oil-shale resource data for coreholes in the Uinta Basin (continued).

FOOTNOTES	
SYMBOL -----	MEANING -----
A	FISCHER ASSAYS WERE NOT DONE BY LETC
B	BOTTOM OF ASSAYED CORE SAMPLES
G	UNIT INTERRUPTED BY A GAP OF 25 FEET OR MORE OF ROCK YIELDING LESS THAN 5 GALLONS PER TON
I	UNIT INCLUDES TAR IMPREGNATED' ROCKS
M	CORE SAMPLES MISSING FROM SIGNIFICANT PART OF UNIT
P	UNIT IS ONLY PARTLY REPRESENTED BECAUSE CORE STARTS OR ENDS WITHIN UNIT
T	TOP OF ASSAYED CORE SAMPLES
TOP	TOP OF UNIT, FEET
BOT	BOTTOM OF UNIT, FEET
THK	THICKNESS OF UNIT, FEET
AVG	AVERAGE OIL YIELD, GALLONS PER TON
RES	IN-PLACE OIL RESOURCE, BARRELS PER ACRE

TABLE 2. Stratigraphic thickness data from selected well logs in the Uinta Basin

MAP NO.	WELL	1/ TOP BOT THK	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
81	Shell Oil Co.	TOP	7005	6924	6818	6777	6755	6610	6290	Q	Q	Q
	Meagher Trust 1-20-B2E	BOT	7130?	7005	6883	6924	6777	6755	6610			
	NENE Sec 20 T2S R2E	THK	125	81	65	147	22	145	320			
Elev. 5145 KB												
82	Gulf Oil Co. - USA	TOP	5020	4888	4828	4801	4783	4694	4580	4451	4317	Q
	Meridian 1	BOT	5080	5020	4859	4888	4801	4783	4694	4580	4451	
	SESE Sec 27 T3S R1W	THK	60	132	31	87	18	89	114	129	134	
Elev. 4993 KB												
83	Gulf Oil Co. Et A1	TOP	5149	5040	4952	4920	4901	4793	4667	4542	4382	4282
	Randlett 1	BOT	5220	5149	5005	5040	4920	4901	4793	4667	4542	4382
	SESW Sec 30 T3S R2E	THK	71	109	53	120	19	108	126	125	160	100
Elev. 5051 KB												
84	Pan American Petr. Corp.	TOP	4012	3959	3885	3854	3840	3780	3678	3570	3457	3367
	Pelican Lake 3	BOT	4089	4012	3927	3959	3854	3840	3780	3678	3570	3457
	Sec 34 T7S R21E	THK	76	53	42	105	14	60	102	108	113	90
Elev. 4785 KB												
85	McLish and Luff	TOP	Q	Q	4196	4139	4128	4058	3949	3840?	Q	Q
	Government 1	BOT	Q		Q	Q	4139	4128	4058	3949		
	Sec 5 T7S R22E	THK					11	70	106	109		
Elev. 4949 KB												
86	Belco Petroleum Corp.	TOP	3819	3770	3698	3660	3649	3580	3470	3360	3251?	3162
	White River 15-9	BOT	3890	3819	3746	3770	3660	3649	3580	3470	3360	3251?
	NESE Sec 9 T8S R22E	THK	71	49	48	110	11	69	110	110	109	89
Elev. 5020 KB												
87	Chorney Oil Co.	TOP	3125	3058	2971	2941	2929	2842	2732	2605	2497	2415
	S. Red Wash Fed. 1-23	BOT	3181	3125	3023	3058	2941	2929	2842	2732	2605	2497
	SWSW Sec 25 T8S R23E	THK	56	67	52	117	12	87	110	127	108	82
Elev. 5147 KB												
88	Chevron-Belco	TOP	2197	2138	2041	2010	1998	1917	1809	1693	1580	1486
	Federal 1 (33-34P)	BOT	2243	2197	2098	2138	2010	1998	1917	1809	1693	1580
	NWSE Sec 34 T8S R24E	THK	46	59	57	128	12	81	108	116	113	94
Elev. 5287 KB												

1/ Symbols and measurement units defined at end of table.

TABLE 2. Stratigraphic thickness data from selected well logs in the Uinta Basin (continued)

MAP NO.	WELL	1/ L1	OIL SHALE UNIT									
			L1	B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V
89	Pan American Petr. Corp. East Red Wash Unit 1 SWSW Sec 4 T8S R25E Elev. 5527 KB	TOP	2568	2530	2441	2404	2379	2289	2114	Q	Q	Q
		BOT	2639	2568	2489	2530	2404	2379	2289			
		THK	71	38	48	126	25	90	175			
90	Continental Oil Co. Federal 34-1 NWNW Sec 34 T8S R25E Elev. 5590 KB	TOP	1583	1532	1453	1421	1409	1328	1206	1082	961	Q
		BOT	1631	1583	1502	1532	1421	1409	1328	1206	1082	
		THK	48	51	49	111	12	81	122	124	121	
91	G. S. Campbell Government 4-1 Sec 4 T9S R17E Elev. 5150 KB	TOP	3082	2970	2890	2794	2765	2710	2648	2727?	Q	Q
		BOT	3138	3082	2920	2970	2794	2765	2710	2648		
		THK	56	112	30	176	29	55	62	121		
92	Davis Oil Co. Pariette Bench 5 SESE Sec 9 T9S R18E Elev. 4490 KB	TOP	2978	2848	2798	2774	2758	2699	2618	2531	2400?	2307?
		BOT	3031	2978	2823	2848	2774	2758	2699	2618	2531	2400?
		THK	53	130	25	74	16	59	81	87	131	93
93	Shamrock Oil & Gas Corp. Phillips-State 1 Sec 16 T9S R19E Elev. 4695 KB	TOP	2812	2687	2640	2618	2605	2542	2459	2365	2238	2162
		BOT	2862	2812	2665	2687	2618	2605	2542	2459	2365	2238
		THK	50	125	25	69	13	63	83	94	127	76
94	Belco Petroleum Corp. Chapita Wells 38-9 Sec 9 T9S R22E Elev. 4770 KB	TOP	2788	2710	2611	2575	2561	2468	2366	2275	2157?	2080
		BOT	2862	2788	2665	2710	2575	2561	2468	2366	2275	2157?
		THK	74	78	54	135	14	93	102	91	118	77
95	Belco Petroleum Corp. Eightmile Unit 1-6E Sec 6 T10S R18E Elev. 5323 KB	TOP	2419	2321	2269	2236	2208	2140	2039	1961	Q	Q
		BOT	2478	2419	2299	2321	2236	2208	2140	2039		
		THK	59	98	30	85	28	68	101	78		
96	Shell Oil Co. Southman Canyon 7 NWNW Sec 24 T10S R23E Elev. 4943 KB	TOP	1138	1090	1011	984	975	904	821	739	635? S	
		BOT	1206	1138	1057	1090	984	975	904	821	739	
		THK	68	48	46	106	9	71	83	82	104	

1/ Symbols and measurement units defined at end of table.

TABLE 2. Stratigraphic thickness data from selected well logs in the Uinta Basin (continued)

MAP NO.	WELL	1/ L1	OIL SHALE UNIT									
			B-GR	RICH ZONE	MAHOGANY ZONE	A-GR	I	II	III	IV	V	
97	Phillips Petroleum Co.	TOP	1932	1858	1791	1748	1655	1563	1478	Q	Q	Q
	Uteland Butte 1975 ST	BOT	2001	1932	1829	1858	1748	1655	1563			
	NWNW Sec 5 T11S R17E	THK	69	74	38	110	93	92	85			
	Elev. 6333 KB											
98	Texaco Inc. Et Al	TOP	422	416	346	312	292	240	180	120	Q	N
	Government B(NCT 1) No. 1	BOT	501	422	380	416	312	292	240	180		
	Sec 23 T13S R22E	THK	79	6	34	104	20	52	60	60		
	Elev. 6632 KB											

1/ See footnotes below.

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FOOTNOTES

<u>SYMBOL</u>	<u>MEANING</u>
?	Location of unit boundary uncertain
N	Unit not present
Q	Unit boundary not recognizable
S	Top of unit is top of well log
TOP	Top of unit, feet
BOT	Bottom of unit, feet
THK	Thickness of unit, feet

These oil-shale resource data were accumulated in English units and are reported in these units. Conversion factors useful for expressing these results in metric units are: 1 foot = .3048 meter; 1 acre = 0.4047 hectare; 1 gallon per ton = 4.17 liter/tonne or approximately 3.45 kg/tonne; 1 barrel = 0.159 cubic meters or approximately 0.145 tonne; 1 barrel per acre = 0.3928 cubic meter/hectare or approximately 0.36 tonne/hectare.

Contour Maps and Resource Calculations

The thickness, average-oil-yield, and resource data on Tables 1 and 2 were plotted and contoured to chart the geographic variations of each resource unit (Figures 5-30). The thicknesses of A-Groove and B-Groove were also contoured. Each contour map shows the location of coreholes and wells contributing data. Only core data were used for oil-yield and resource contouring, while thicknesses were determined from correlation of both corehole histograms and borehole geophysical logs. The contours (or isopleths) are lines along which all points have the value of the contour label, as determined by interpolation or extrapolation of the values measured from the cores and logs. Contours were plotted by hand. The area of measured core resource data is bounded by heavy lines labelled "Limit of Measured Resource" on the average-oil-yield and resource maps. Essentially no quantitative oil-yield data from cores are available outside these lines. The contour maps also show a broken sawtooth line symbol indicating the approximate limit of the continuous oil-shale unit. Outside this limit the continuity of the oil shale in the unit is interrupted by one or more barren interval, at least 25 feet thick and yielding less than 5 gallons of oil per ton (Smith and others, 1978, p. 9). The outcrop line shown on the maps is for the Mahogany bed, the richest and most prominent oil-shale ledge in the rich section of the Mahogany zone. Contour map figure numbers are as follows:

<u>Unit</u>	<u>Figure Number</u>		
	<u>Thickness</u>	<u>Avg. Oil Yield</u>	<u>Resource</u>
L1	5	6	7
B-Groove	8	-	-
Rich Zone	9	10	11
Mahogany Zone	12	13	14
A-Groove	15	-	-
Unit I	16	17	18
Unit II	19	20	21
Unit III	22	23	24
Unit IV	25	26	27
Unit V	28	29	30

Finally, to summarize the resource data contained on the contour maps, areas were measured by planimetry on a computerized digitizing board. Areas between contour lines, and bounded by the Mahogany bed outcrop and the "Limit of Measured Resource" lines were measured. These are the "measured" areas discussed below. Table 3 shows areas of average-

0 5 10 MI.
0 5 10 KIL.

Figure 7. Unit L1 resource contours.

Figure 8. B-groove thickness contours.

Figure 10. Rich zone average oil-yield contours.

Figure 12. Mahogany zone thickness contours.

0 5 10 MI.
0 5 10 KIL.

Figure 21. Unit II resource contours.

Table 3. Areas of average-oil-yield contour intervals for oil-shale units in the eastern Uinta Basin.

Average oil yield contour interval, gal per ton	OIL SHALE UNIT									
	L1		Rich-Zone		Mahogany Zone		I		II	
	1000		1000		1000		1000		1000	
	acres	%	acres	%	acres	%	acres	%	acres	%
34-36	--	--	66.8	12.5	--	--	--	--	--	--
32-34	--	--	89.6	16.7	--	--	--	--	--	--
30-32	--	--	78.5	14.6	--	--	--	--	--	--
28-30	--	--	72.4	13.5	--	--	--	--	--	--
26-28	--	--	57.5	10.7	--	--	--	--	--	--
24-26	--	--	51.1	9.5	6.8	1.6	--	--	--	--
22-24	--	--	41.1	7.7	103.5	24.0	--	--	--	--
20-22	--	--	34.9	6.5	105.4	24.4	--	--	--	--
18-20	--	--	35.4	6.6	71.8	16.7	--	--	--	--
16-18	--	--	5.0	.9	52.1	12.1	1.9	.4	--	--
14-16	55.2	13.7	.9	.2	39.5	9.2	21.7	4.7	25.7	9.0
12-14	107.4	26.7	1.9	.4	28.8	6.7	133.1	28.6	103.2	36.1
10-12	47.6	11.8	.9	.2	15.0	3.5	152.0	32.7	151.2	52.9
8-10	44.7	11.1	--	--	8.3	1.8	85.1	18.3	5.7	2.0
6-8	54.0	13.4	--	--	--	--	41.6	8.9	--	--
4-6	42.5	10.6	--	--	--	--	29.8	6.4	--	--
2-4	51.3	12.7	--	--	--	--	--	--	--	--
TOTAL	402.7	100.0	536.0	100.0	431.2	100.0	465.2	100.0	258.8	100.0

Average oil yield contour interval, gal per ton	OIL SHALE UNIT					
	III		IV		V	
	1000		1000		1000	
	acres	%	acres	%	acres	%
12-13	1.6	.6	--	--	--	--
11-12	64.0	25.0	--	--	--	--
10-11	87.9	34.3	--	--	6.1	4.3
9-10	79.5	31.0	45.8	20.1	57.2	40.3
8-9	23.3	9.1	95.5	41.8	30.1	21.2
7-8	--	--	82.2	36.1	21.9	15.4
6-7	--	--	4.7	2.0	11.1	7.8
5-6	--	--	--	--	9.3	6.5
4-5	--	--	--	--	3.1	2.2
3-4	--	--	--	--	3.3	2.3
TOTAL	402.7	100.0	228.2	100.0	142.1	100.0

oil-yield contour intervals for each resource unit. Table 4 presents areas and total resources for resource contour intervals. Total resource values, in billions of barrels of shale oil in place, were calculated by multiplying the area by the midvalue of the contour interval.

RESOURCE EVALUATION

The procedures described above were used to calculate the resource data summarized in Tables 3 and 4. These values represent the resources within the "Limit of Measured Resource" lines, based on core oil-yield data. They refer to the potential oil in place in Green River Formation oil shales, without consideration for physical or economic constraints to recovery. Average oil-yield contour intervals range from as little as 2-4 gallons per ton in Units L1 and V to more than 34 gallons per ton in the rich zone (Table 3). Resource contours span the range of 10 to 190 thousand barrels per acre (Table 4). The grand total in-place resource calculated for all units is 153.1 billion barrels of shale oil. Of this total "measured" resource, the Mahogany zone contains 54.9 billion barrels, or 35.9%. Estimates for additional resources outside the "measured" area, east of the Green River, total 61 billion barrels in all seven units. General characteristics of the oil-shale resource zones, determined from analysis of the contour maps (Figures 5-30) and Tables 1-4, are summarized below.

Unit L1

Only ten coreholes completely penetrated Unit L1; however, another 24 cores sampled part of the unit. These coreholes are spread over 402,700 acres, the area of "measured resource" bounded by the heavy line on Figures 6 and 7. Within this area Unit L1 ranges in thickness from 54.0 feet in Western Oil Shale's Corehole 2 (Figure 2 and Table 1, Map No. 11) in the northwest part to 101.3 feet in Brewer's Corehole 8-1 (Map No. 75) in the southeast part. The unit thickens to the south and to the north (outside the area of measured resource) due to increased clastic content. In Shell's Meagher Trust 1-2-B2E well (Map No. 81) in the northwest part of the map area Unit L1 is 125 feet thick.

Average oil yields in essentially complete sampled sections range from 4.0 gallons per ton in Brewer Corehole 8-1 (Map No. 75) to 15.7 gallons per ton in TOSCO's Utah State No. 1 (Map No. 2). In-place shale-oil resources calculated for these two coreholes are, respectively, 34,540 bbl/acre and 80,550 bbl/acre. Fifty-two percent of the area of measured resource has oil yields greater than 10 gallons per ton and 13% averages 14-16 gallons per ton. Total shale-oil resource in place in the measured area of Unit L1 is calculated as 18.4 billion barrels. Approximately fifty-seven percent of this resource is in areas yielding more than 50,000 barrels per acre. Resources north of the measured area are conservatively estimated at 70,000 acres yielding 70,000 bbl/acre, or an additional 4.9 billion barrels. This would make a total of 23.3 billion barrels for the unit.

Table 4. In-place shale-oil resources in the eastern Uinta Basin.
Numbers are for the area of measured resource.

Resource contour interval, 1000 bbl/acre	OIL SHALE UNIT											
	L1			Rich Zone			Mahogany Zone			I		
	Area		Resource	Area		Resource	Area		Resource	Area		Resource
	1000 acres	%	10 ⁹ bbl	1000 acres	%	10 ⁹ bbl	1000 acres	%	10 ⁹ bbl	1000 acres	%	10 ⁹ bbl
180-190	--	--	--	--	--	--	9.3	2.2	1.72	--	--	--
170-180	--	--	--	--	--	--	20.4	4.7	3.57	--	--	--
160-170	--	--	--	--	--	--	19.1	4.4	3.15	--	--	--
150-160	--	--	--	--	--	--	20.3	4.7	3.15	--	--	--
140-150	--	--	--	--	--	--	29.5	6.8	4.28	--	--	--
130-140	--	--	--	--	--	--	29.6	6.9	4.00	--	--	--
120-130	--	--	--	--	--	--	64.5	15.0	8.06	--	--	--
110-120	--	--	--	--	--	--	195.0	45.2	22.40	--	--	--
100-110	--	--	--	23.8	4.4	2.50	43.5	10.1	4.57	--	--	--
90-100	--	--	--	41.9	7.8	3.98	--	--	--	5.3	1.1	.50
80-90	--	--	--	52.2	9.7	4.44	--	--	--	30.7	6.6	2.61
70-80	37.9	9.4	2.84	114.9	21.4	8.62	--	--	--	43.5	9.4	3.26
60-70	41.4	10.3	2.69	177.6	33.1	11.54	--	--	--	46.5	10.0	3.02
50-60	88.6	22.0	4.87	98.5	18.4	5.42	--	--	--	39.6	8.5	2.18
40-50	85.7	21.3	3.86	27.1	5.2	1.22	--	--	--	109.0	23.4	4.90
30-40	69.1	17.1	2.42	--	--	--	--	--	--	167.8	36.1	5.87
20-30	51.9	12.9	1.30	--	--	--	--	--	--	22.8	4.9	.57
10-20	28.1	7.0	.42	--	--	--	--	--	--	--	--	--
TOTAL	402.7	100.0	18.40	536.0	100.0	37.72	431.2	100.0	54.90	465.2	100.0	22.91

Resource contour interval, 1000 bbl/acre	OIL SHALE UNIT											
	II			III			IV			V		
	Area		Resource	Area		Resource	Area		Resource	Area		Resource
	1000 acres	%	10 ⁹ bbl	1000 acres	%	10 ⁹ bbl	1000 acres	%	10 ⁹ bbl	1000 acres	%	10 ⁹ bbl
100-110	6.6	2.3	.70	--	--	--	--	--	--	--	--	--
90-100	34.7	12.1	3.30	--	--	--	10.5	4.6	1.00	--	--	--
80-90	48.8	17.1	4.15	.7	.3	.06	24.7	10.8	2.10	--	--	--
70-80	44.2	15.5	3.32	63.3	24.7	4.75	74.8	32.8	5.61	--	--	--
60-70	43.0	15.0	2.80	76.2	29.7	4.95	61.1	26.8	3.97	30.9	21.7	2.01
50-60	36.2	12.7	1.99	56.1	21.9	3.09	40.6	17.8	2.23	67.2	47.3	3.70
40-50	52.2	18.3	2.35	32.1	12.5	1.44	16.5	7.2	.74	19.4	13.7	.87
30-40	20.1	7.0	.70	27.9	10.9	.56	--	--	--	12.5	8.8	.44
20-30	--	--	--	--	--	--	--	--	--	12.1	8.5	.18
TOTAL	285.8	100.0	19.31	256.3	100.0	14.85	228.2	100.0	15.56	142.1	100.0	7.20

GRAND TOTAL: 153.13 billion barrels

B-groove

Thirty-three coreholes completely penetrated B-groove. Thicknesses within the cored area range from 5.6 feet in ERDA/LERC S.U.B. 7 (Map No. 80) in the southern part to 93.0 feet in Shell's Utah State 14X-34 (Map No. 3) in the northwest. B-groove continues to thicken to the northwest into what appears to be a delta, reaching a maximum of 130 feet at Map No. 92. Average oil yields range from less than one gallon in the southwest in ERDA/LERC S.U.B. 1 (Map No. 48) to 6.4 gallons per ton in Gulf's Evacuation 3 (Map No. 17) in the eastern part. Tar-impregnated rocks ("tar sands") were reported in the lithologic description of some B-groove cores and these occurrences are noted by the letter "I" on Table 1. Tar sands are probably also present in many of the cores which were not described. They are responsible for at least some anomalously high oil yields.

Mahogany Zone

The Mahogany zone was completely sampled in 44 coreholes and partly sampled in another 32, providing quantitative data on the unit's resources over a "measured" area of 431,200 acres. Thicknesses range from 66.0 feet in Gulf's Bonanza 8 (Map No. 56) in the southeast to 135.7 feet in Naval Reserve 2 No. 15 (Map No. 41) in the southwest part. An axis of minimum thicknesses trends NW-SE from near the corner common to Ts 9-10 S, Rs 18-19 E to approximately the quarter-corner between T 12 S, Rs 24-25 E. Northward from this axis increased organic content thickens the Mahogany zone into a depositional center in T 9 S, R 23 E; and southward from the axis the unit increases in thickness as a result of increasing clastic content. To the west of the "measured" area clastics interfingering with and replacing the oil shales increase the thickness to 176 feet in G.S. Campbell's Government 4-1 (Map No. 91). The character of the sonic log from Shell's Meagher Trust 1-20-B2E (Map No. 81, Plate F-F') indicates the Mahogany zone is predominantly oil shale rather than clastics at this northwest extremity.

Average oil yields in the Mahogany zone vary from 10.1 gallons per ton at Byllesby's Pinon Corehole (Map No. 63) in the southwest to 23.7 gallons per ton at TOSCO's Utah State No. 1 (Map No. 2) in the northern part. The average is 7.6 gallons per ton at Sinclair's Henderson 3 (Map No. 10) at the extreme west end of the map area. Eighty-six percent of the "measured" area has oil-yield averages greater than 14 gallons per ton, and half of the area exceeds 20 gallons per ton. Shale-oil resources range from 96,970 bbl/acre at Map No. 80 in the south (outside the limit of measured resource) to 172,900 bbl/acre at Map No. 2. Total resource for the zone is calculated to be 54.9 billion barrels, all in sections exceeding 100,000 bbl/acre. Nearly sixty-four percent of this total is in sections yielding 100,000-130,000 bbl/acre.

Contour maps of the Mahogany zone (Figures 12-14) indicate a resource maximum in T 9 S, Rs 22-24 E, around the unit's depocenter, north of the "measured" resource. A conservative estimate for this additional resource

at about three townships (70,000 acres) yielding 180,000 bbl/acre is 12.6 billion barrels. This would raise the total resource for the unit to 67.5 billion barrels of shale oil in place.

The rich zone, which embodies the optimum oil-shale section in the Mahogany zone, is the most wide-spread oil-shale unit in the Uinta Basin. Because it was usually the main target of coring operations, it was completely sampled in more coreholes (72) than any other unit. Total area of the "measured" resource is 536,000 acres. The rich zone was deposited during the maximum expansion of Lake Uinta, and the thicknesses were therefore least influenced by clastic influx. Thicknesses range from 24.0 feet in Western Oil Shale's Corehole 2 (Map No. 11) in the northwest to 51.0 feet in Gulf's Southam 4 (Map No. 15) in the northeast, and 75.4-plus feet at Naval Reserve 2 No. 15 (Map No. 41) where clastics were locally introduced from the San Rafael Swell in the southwest. The zone is only 31 feet thick far to the west in Henderson No. 1 (Map No. 10).

Average oil yields for the rich zone range from 10.7 gallons per ton in Naval Reserve 2 No. 15 to 35.6 gallons per ton in Shell's Utah State 22X-12 (Map No. 12) in the north-central part of the area. Average oil yield at Map No. 10 is 15.2 gallons per ton. In 77.5% of its "measured" area the rich zone averages better than 24 gallons per ton, and 43.8% averages more than 30 gallons per ton. Shale-oil resources range from 43,530 bbl/acre in the south at ERDA/LERC S.U.B. 7 (Map No. 80) to 108,300 bbl/acre in Gulf's Southam 4 (Map No. 15) in the north-central part. Total shale-oil resource in the measured area of the rich zone is 37.7 billion barrels, more than half of which is in areas yielding 60,000-80,000 bbl/acre. Additional resources of 70,000 acres yielding 100,000 bbl/acre probably exist in the rich zone north of the cored area, which would bring the total to 44.7 billion barrels. The rich zone appears to be the only oil-shale unit with economically significant resources west of the Green River.

A-groove

A-groove was completely sampled in 56 coreholes. Thicknesses range from 7.9 feet in the eastern part of the area in Skyline's Watson 2 (Map No. 34) to 42.0 feet in the southwest in Western Oil Shale's Core Test 1-2 (Map No. 43). Across most of the area thicknesses are between 10 and 20 feet. Average oil yields range from 1.6 gallons per ton at Map No. 43 to 7.8 gallons per ton at Western Oil Shale's EX-3 (Map No. 5) in the northeast.

Unit I

Thirty-two coreholes sampled the complete section of Unit I and 23 sampled parts of the unit. Total "measured" area is 465,200 acres. Thicknesses in Unit I show the same pattern of variations as the Mahogany zone. The minimum complete cored thickness is 37.2 feet in USGS CRU-1

(Map No. 51) in the southeast part and the maximum is 88.3 feet in TOSCO's Utah State No. 1 (Map No. 2) in the northwest.

Average oil yields of complete core sections range from 6.4 gallons per ton in Byllesby's Agency Corehole (Map No. 60) in the southwest to 16.6 gallons per ton in the northwest in Shell's 14X-34 (Map No. 3). Nearly two-thirds of the area has oil yields higher than 10 gallons per ton, but only about 5% exceeds 14 gallons. In-place resources range from 29,940 bbl/acre (Map No. 46) to 106,200 bbl/acre (Map No. 2). Total measured shale oil is 22.9 billion barrels, most of which is fairly evenly distributed between 30,000 and 90,000 bbl/acres. Additional resources of 6.3 billion barrels are estimated for the area north of the cored area.

Unit II

Unit II was completely sampled by 27 coreholes and partly sampled by eight. The measured resource area covers 285,800 acres. Unit thicknesses range from 54.0 feet in National Farmers Union Exploration 10 (Map No. 29) in the southeast part to 96.0 feet at Shell's 14X-34 (Map No. 3) in the northwest. Marginal unit thickening indicates clastic influx from the northwest, northeast and southwest. Outside the cored area thicknesses increase to a maximum of 320 feet at Map No. 81 in the northwest.

Average oil yields in full-section cores range from 10.7 gallons per ton in the southeast in ERDA/LERC S.U.B. 10 (Map No. 77) to 14.5 gallon per ton in the northwest in TOSCO's Utah State No. 1 (Map No. 2). Eighty-nine percent of the area is between the 10 and 14 gallon-per-ton contours and only 9% is richer than 14 gallons. Resources range from 47,270 bbl/acre at USGS CRU-1 (Map No. 51) to 107,500 bbl/acre at Map No. 2. Total resource in the cored area of Unit II is 19.3 billion barrels of shale oil in place. Nearly sixty percent is in areas yielding more than 70,000 bbl/acre. Additional resources of 12 to 18 billion barrels may be present outside the area of "measured" resource.

Unit III

Unit III was sampled by 25 coreholes - 23 complete and 2 partial. The area of "measured" resource is 256,300 acres. Thicknesses range from 56.4 feet in USGS CRU-1 (Map No. 51) in the southeast to 90 feet in Western Oil Shale's EX-3 (Map No. 5) in the northeast. Thicknesses increase outside the cored area to more than 130 feet in the northeast and northwest.

Average oil yields range from 9.6 gallons per ton in the southeast in NFU No. 10 (Map No. 29) to 11.8 gallons per ton in the northwest Western Oil Shale's EX-1 (Map No. 1). Sixty percent of the area has average oil yields greater than 10 gallons per ton. Resources range from 43,680 bbl/acre in Map No. 51 to 81,790 bbl/acre in Map No. 1.

Total shale-oil resource in the measured area is 14.8 billion barrels. Resources north of the cored area are probably on the order of 5-10 billion barrels.

Unit IV

Twenty-one coreholes sampled all of Unit IV and four holes sampled part of the unit. Measured resource area is 228,200 acres. Clastic encroachments from the southwest and northeast are evident from the placement of "Limit of Continuous Oil Shale Unit" symbols on the maps. Thicknesses range from 80.7 feet in the southeast in NFU No. 10 (Map No. 29) to 134.0 feet in the northwest in Shell's 14X-34 (Map No. 3). Maximum thickness outside the cored area is 160 feet at Gulf's Randlett 1 (Map No. 83) in the northwest.

Average oil yields in full sections range from 7.4 gallons per ton in the southeast (Map No. 29) to 9.2 gallons per ton in Shell's Corehole 1 (Map No. 13) in the northeast. Resources represent 48,850 bbl/acre in Map No. 29 to 94,750 bbl/acre in Map No. 3. Nearly sixty percent of the area has resources of 60,000 to 80,000 bbl/acre, and the total is 15.6 billion barrels. Additional resources outside the cored area might reach 10 billion barrels.

Unit V

Only nine coreholes sampled the entire thickness of Unit V and eleven sampled part of the unit, providing quantitative resource data for a mere 142,100 acres. The maps show clastic encroachments from all directions save the southeast. Thicknesses range from 52.1 feet in the southeast (Map No. 51) to 151.0 feet in the northeast (Map No. 5).

Average oil yields range from 4.3 gallons per ton in the northeast (Map No. 5) to 10.2 gallons per ton in the west (Map No. 1). Resources range from 20,010 bbl/acre in Byllesby's Juniper Corehole (Map No. 47) to 69,760 bbl/acre in Shell's Corehole 1 (Map No. 13). Total "measured" resource is 7.2 billion barrels. An equal amount might be present beyond the limit of measured resource.

SUMMARY

Resources of potential oil in place in the Green River Formation oil shales are measured in the primary oil shale resource area of Utah's Uinta Basin. This area in Rs 19-25 E, Ts 7-14 S includes most of, and certainly the best of Utah's oil shale resource. The evaluation, conducted by methods pioneered by the authors in conjunction with the Laramie Energy Technology Center (Trudell and others, 1970 and Smith and others, 1978), uses available oil yield and stratigraphic data to measure the oil shale resource in place. Oil-shale resource units stratigraphically equivalent to and directly comparable with those previously

evaluated in Colorado's Piceance Creek Basin were evaluated. These resource units break the total oil-shale section, which can attain thicknesses to 700 feet, into convenient, easily comparable parts. Developability of the Uinta Basin oil-shale units is comparable to the same units in the Piceance Basin. For example, at any site the optimum section for mining is probably the section of Mahogany zone oil shale called the rich zone. This section is overlain by successively lower grade sections, whose commercial development pose similar problems in either the Uinta or Piceance Basins.

Measurement of resources from core analyses plus extrapolation into areas where only stratigraphic data are available provide estimates of total in-place shale-oil resources east of the Green River in the Uinta Basin. These resource values are tabulated below for each stratigraphic unit. The table lists the measured resources determined from core data, the estimated resources by extrapolation, and the sums of these values.

Table 5. Summary of measured and estimated shale-oil resources in the eastern Uinta Basin

Oil Shale Unit	In-place resource (10 ⁹ bbl)		Total
	Measured	Estimated	
L1	18	5	23
Mahogany zone	55	13	68
(Rich zone)	(38)	(7)	(45)
I	23	6	29
II	19	15	34
III	15	7	22
IV	16	8	24
V	7	7	14
TOTAL	153	61	214

() Values included in Mahogany zone values.

The total measured resource is 153 billion barrels and the total estimated resource is 61 billion barrels. The grand total shale-oil resource in place in the Green River Formation of the eastern Uinta Basin, both measured and estimated, is 214 billion barrels.

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A
WEST

A'
EAST

PLATE A-A'- West-East Correlation Cross Section of the Oil Shale Resource in the Green River Formation, Uinta Basin, Utah

B
WEST

B'
EAST

PLATE B-B'- West-East Correlation Cross Section of the Oil Shale Resource in the Green River Formation, Uinta Basin, Utah

C'
EAST

83
GULF OIL CO. ET.AL.
Randlett 1
Sec.30 T3S R2E
Elev. 5051 KB

86
BELCO PETROLEUM CORP.
White River No. 15-9
Sec. 9 T8S R22E
Elev. 5020 KB

84
PAN AMERICAN PETROLEUM CORP.
Pelican Lake 3
Sec. 34 T7S R21E
Elev. 4785 KB

87
CHORNEY OIL CO.
S. Red Wash Federal No. 1-23
Sec. 23 T 8 S R 23 E
Elev. 5147 KB

88
CHEVRON-BELCO
Federal No. 1 (33-34P)
Sec. 34 T 8 S R 24 E
Elev. 5287 KB

90
CONTINENTAL OIL CO.
Federal No. 34-1
Sec. 34 T 8 S R 25 E
Elev. 5590 KB

PLATE C-C'- West-East Correlation Cross Section of the Oil Shale Resource in the Green River Formation, Uinta Basin, Utah

D
SOUTH

D'
NORTH

89

PAN AMERICAN PETROLEUM CORP.

E. Red Wash Unit No. 1
Sec. 4 T8S R25E
Elev. 5527 KB

90
CONTINENTAL OIL CO.

Federal No. 34-1
Sec. 34 T8S R25E
Elev. 5590 KB

7
NATIONAL FARMERS UNION

Exploration Corehole 2
Sec. 32 T9S R25E
Elev. 5507 GR

16

GULF MINERAL RESOURCES CO.

Southam 1
Sec. 22 T10S R24E
Elev. 5242 GR

13
SHELL OIL CO.
Corehole 1
Sec. 2 T10S R24E
Elev. 5035 GR

5
WESTERN OIL SHALE CORP.
Corehole EX-3
Sec. 16 T9S R25E
Elev. 5813 GR

51

U.S. GEOLOGICAL SURVEY

CRU-1
Sec. 3 T12S R24E
Elev. 6137 GR

50

NATIONAL FARMERS UNION

Exploration Corehole 5
Sec. 2 T12S R24E
Elev. 6059 GR

28

SHELL OIL CO.

Corehole 2
Sec. 17 T11S R24E
Elev. 5347 GR

74

ERDA/LERC

Southern Uinta Basin 9
Sec. 6 T13S R24E
Elev. 6268 GR

72

ERDA/LERC

Southern Uinta Basin 8
Sec. 26 T13S R23E
Elev. 6419 GR

PLATE D-D'- South-North Correlation Cross Section of the Oil Shale Resource in the Green River Formation, Uinta Basin, Utah

PLATE E-E'- South-North Correlation Cross Section of the Oil Shale Resource in the Green River Formation, Uinta Basin, Utah