DOE/PC/30259-1
Vol. 1 of 2

AN EVALUATION OF HEAVY OIL MINING

Final Report

Volume I

Work Performed for the Department of Energy
Under Contract No. DE-AC03-80PC30259

Date Published—March 1983

Energy Development Consultants/
Stone & Webster Engineering Corporation
Golden, Colorado

U. S. DEPARTMENT OF ENERGY

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Distribution Category UC-92a

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UNITED STATES DEPARTMENT OF ENERGY

1.3.7 Placerita Field, Los Angeles County, California (Upper and Lower Kraft Reservoir)

The Placerita Field was chosen for detailed study on the basis of a ranking of S-120 and M-126. This is due to the shallow depth of the producing formations (600-1,700 ft), an overburden/interburden ratio ranging from 3:1 to 6:1, and a high oil saturation of 1263 bbl/ac-ft. In addition, it covers 700 acres and has 378,857 bbl/acre. This field would be best developed by a combination of surface mining and mining for access technology. See Table 1-10 for a summary of reservoir characteristics.

The Placerita Field is about two miles west of the town of Newhall in the new part of Los Angeles County. It is situated along Placerita Canyon and is easily accessible by the Sierra Highway, which crosses the field. The field is within the Angeles National Forest in an area of rolling hills rising 500 ft above the valley floor. The land is used predominantly for grazing.

1.3.7.1 Historical Production

Four wells were drilled in the area between 1920 and 1938 which yielded a maximum of 10 barrels of oil per day of heavy black crude. The field itself was not discovered until 1948, when Nelson-Phillips completed Kraft No. 1, which yielded 100 barrels of oil per day of 16 degrees API oil. The area was named the Kraft-York Area, and in 1949, completion of Juanita #1 well, which yielded 340 barrels of oil per day of 22 degrees API oil, opened up another area, the Juanita Area. Primary production was completed by 1954 and secondary production was initiated with a water flooding program by Crown Central Petroleum Corp. Tertiary production was begun in 1964 by experimenting with cyclic steam and in situ combustion. Cyclic steam proved to the most successful and was carried out until 1971. The field currently has over 200 producing wells and 700 productive acres. It is believed only 14 percent of the original oil in place has been recovered, leaving up to 265 million barrels of oil remaining in place.

1.3.7.2 Geology

Three important geologic provinces adjoin in the Placerita Canyon area, which complicates the geology of the area. The field itself lies at the eastern end of the Ventura Basin but is also adjacent to the western edge of the San Gabriel Mountains and the northwest portion of the Los Angeles Basin.

Please refer to Section 1.3.3.3 of this report for a description of the regional geology, Figure 1-39 for a structure contour map, and Figure 1-40 for a geologic section of the field.

The stratigraphy of the area consists of Tertiary and Quaternary sediments which are semi-consolidated to unconsolidated sandstones, conglomerates, siltstones, and shales. The detailed stratigraphy is outlined below:

STRATIGRAPHY

AGE	FORMATION	DESCRIPTION
Recent	Alluvium	These stream deposits of the Santa Clara River consist mostly of sands and gravels up to 100 ft thick.
Upper Pleistocene	Terrace Deposits	These deposits overlie much of the Placerita Field and consist of coarse, poorly sorted conglomerate, gravel and sand with an approximate thickness of 675 ft.
Lower Pleistocene	Saugus	The Saugus overlies the producing zones and consists mostly of light colored

conglomerates and coarse sandstone, much of which is cross-bedded and unconsoli- dated. The approximate thick- ness is 2,000 ft.

Upper Pliocene	Sunshine Ranch Member	The Sunshine Ranch consists of continental and blackish water conglomerates, green sandstone and mudstone, thin freshwater limestone, and red beds which reach a maximum thickness of 1,300 ft.
Upper Pliocene	Upper Pico Member	The Upper Pico consists of well-stratified light-colored coarse sandstone, conglomerate, and interbedded fossiliferous siltstone up to 1,000 ft thick.
Middle Pliocene	Lower Pico	The Lower Pico includes white pebble conglomerate, coarse sandstone with fine sandstone lenses, thin, brown siltstone beds, much of which is cross bedded. It reaches 700 ft thick.
Lower Pliocene	Repetto	The Repetto is divided into an upper siltstone member and the lower member which consists of marine sandstone and conglomerate with a maximum thickness of 400 ft.

387x

Upper Miocene	Mint Canyon	This formation consisting of continental deposits appears only north of the San Gabriel fault and is up to 2,400 ft thick.
Eocene	Domengine Martinez	The oldest sedimentary deposits in the area consist of well indurated shale, sandstone, and conglomerate.

Structural deformation of the sedimentary deposits began in Middle Miocene time with uplift of the San Gabriel Mountains causing tilting of the beds 18 degrees to the northwest. Two major fault zones border the field: the San Gabriel and the Whitney. The San Gabriel Fault Zone is the limit of production to the north and has a general strike of N65W. It is parallel to the San Andreas Fault System and is closely related with 700 feet of throw and at least 2 1/2 miles of horizontal displacement. The San Fernando earthquake occurred along the San Gabriel Fault Zone in 1971 and caused great structural damage. The Whitney Fault strikes north-south and represents the limit of production to the east. The west block was upthrown relative to the east side in Upper Pliocene time. Minor faults such as the Orwig have no bearing on the trapping mechanism but separate pools of differing gravity. The terrace deposits overlying the field are highly faulted.

1.3.7.3 Reservoir Characteristics

The producing zones have been named the Upper and Lower Kraft and appear to lie in the basal Sunshine Ranch and Upper Pico. The Upper Kraft Zone is overlain by a well-defined shale 70-100 ft thick which has been named the Upper Kraft Shale. The Upper Kraft Zone itself varies from 170 to 250 ft thick. In between the Upper and Lower Kraft zones is a fairly uniform shale 20-50 ft thick which has been named the Lower Kraft Shale. The Lower Kraft Zone varies from 300 to 450 ft thick. The Upper and Lower Kraft

zones are highly lenticular and consist of cross-bedded sandstone, siltstone, sandy mudstone, and conglomerate. The Upper and Lower Kraft shales are highly variable with varying amounts of shale. Underlying the productive zones are shales, sandstones, and conglomerates of Pico age.

The reservoir itself has an average porosity of 33 percent, permeability of 2,500 millidarcies, and average borehole temperature of 99 degrees. The initial oil saturation was 60 percent and is currently 50 percent with a gas-oil ratio of 16 percent. There are no active drives in the reservoir and most production was due to gravity drainage.

The oil has an API gravity of 16 degrees, viscosity of 320 centipoise at borehole temperature, sulfur content of 0.3 percent and a carbon residue of 0.3 percent. The water contains 2,600 ppm of total dissolved solids.

1.3.7.4 Groundwater

Data was not available for groundwater in the Placerita Field.

1.3.7.5 Rock Mechanics

Little can be inferred about rock mechanics from the information available; however, from the description of the rock, it appears most of the material is unconsolidated and highly variable. The rock varies from siltstone to sandstone, to poorly sorted conglomerate. The overlying terrace deposits and Saugus Formation could be easily excavated using low cost surface mining equipment such as draglines and bucketwheel excavators. As much as half of the field could be developed as a surface mine and then the rest could be developed using mining for access technology. A review of existing well data would be required to determine the best place to drill the shaft and tunnels in underlying formations due to the highly variable nature of the formations. The Lower and Upper Kraft shales and the underlying Pico formations are all possibilities. All the mine workings would require considerable support due to the unconsolidated nature of the rock.

1.3.7.6 Conclusions

The Placerita Field is a target for mining of heavy oil. The major obstacle is that the field lies just south of a major active fault system and could experience severe ground shaking during the active project life. All the mine workings would require a considerable safety factor against the earthquake hazard. In addition, it is uncertain if there is a conflict of land use at this time. The Sierra Highway crossing the field would have to be rerouted.

TABLE 1-10

PLACERITA OIL FIELD, LOS ANGELES COUNTY, CALIFORNIA

GENERAL INFORMATION

Reservoir Name:	Upper & Lower Kraft		
Discovery Year:	1948	No of Wells:	205
Formation:	Saugus-Pico	Area, Acres:	700
Geologic Age:	Pliocene	Land Use:	Grazing

RESERVOIR INFORMATION

General		Structure	
Avg. Depth, ft:	1527	Faulting:	Two major faults, several minor
Gross Pay, ft:	450 to 900	Folding:	Regional Dip
Net Pay, ft:	300 to 450	Dip, °:	18
No of Pay Zones:	3	Conditions	
Lithology:	Sand/Conglomerates	BHT, °F:	99
Consolidation:	Unconsolidated	Initial Oil Sat.%:	60
Heterogeneity:	High	Current Oil Sat.%:	50
Porosity, %:	33	Current Wtr. Sat.%:	16
Permeability, md:	2,500		
Trap Type:	Structural-faulted homocline		

TABLE 1-10 (cont'd)

ROCK MECHANICS PARAMETERS

Unconfined Compressive Strength, psi:	Low
Elastic Modulii:	Low
Hardness:	Low

FLUID CHARACTERISTICS

Oil Gravity, °API:	16 (Range: 9 to 23)
Viscosity @ BHT, cp:	320
Sulfur Content, %:	.3
Carbon Residue, %:	.3
Water Salinity, ppm:	2600

CHARACTERISTICS OF OVERLYING ROCK

Geologic Formation(s):	Terrace Deposits, Sagus
Geologic Age:	Pleistocene
Lithology:	San & Gravel, Conglomerates and Sandstone
Thickness,ft:	Terrace Deposits (up to 675) Sagus (up to 2000)
Consolidation:	Unconsolidated
Heterogeneity:	High
Structure:	Highly Faulted
Unconfined Compressive Strength, psi:	Low
Elastic Modulii:	Low
Hardness:	Low

TABLE 1-10 (cont'd)

CHARACTERISTICS OF UNDERLYING ROCK

Geologic Formation(s):	Lower Pico
Geologic Age:	Middle Pliocene
Lithology:	Pebble Conglomerate and Coarse Sandstone
Thickness,ft:	700
Consolidation:	Unconsolidated
Heterogeneity:	High
Unconfined Compressive Strength, psi:	Low
Elastic Modulii:	Low
Hardness:	Low to moderate

PRODUCTION DATA

Original Oil in Place, stb:		307,700,000
Cum. Prod. (12/31/77):	Oil, bbl:	42,016,974
	Gas, mcf:	6,795,000
Oil Remaining in Place, stb:		265,200,000
Bbl/acre:		1263
Secondary Production (Year, Type):		1954, waterflood
Tertiary Production (Year, Type):		1964, cyclic steam

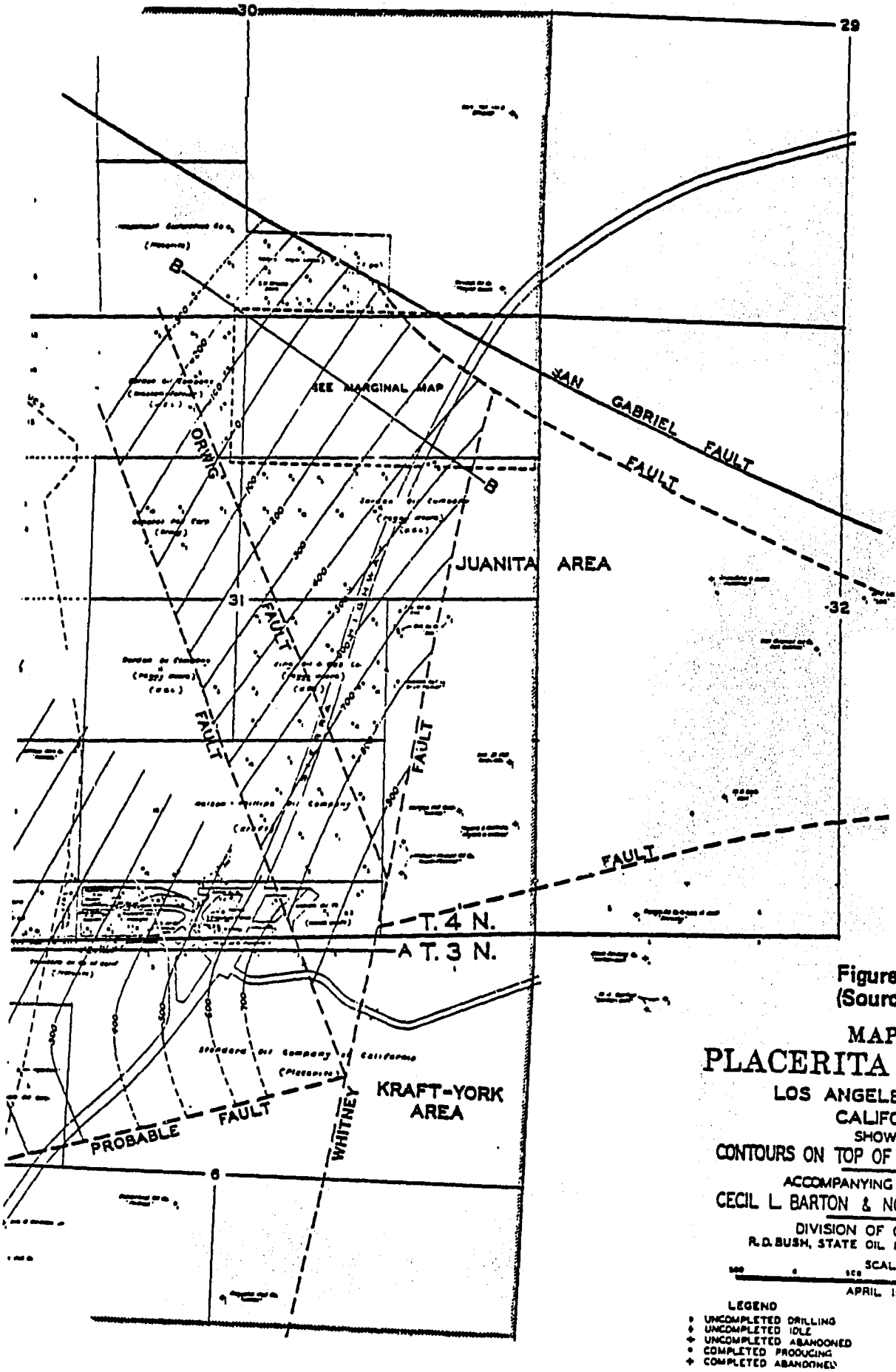

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Figure 1-39
(Source: 53)

MAP OF
PLACERITA OIL FIELD
LOS ANGELES COUNTY
CALIFORNIA
SHOWING
CONTOURS ON TOP OF LOWER KRAFT ZONE
ACCOMPANYING REPORT BY
CECIL L. BARTON & NORMAN N. SAMPSON
DIVISION OF OIL & GAS
R. D. BUSH, STATE OIL & GAS SUPERVISOR
SCALE
APRIL 1950

LEGEND
- UNCOMPLETED DRILLING
- UNCOMPLETED IDLE
- UNCOMPLETED ABANDONED
- COMPLETED PRODUCING
- COMPLETED ABANDONED

DATUM = SEA LEVEL
CONTOUR INTERVAL 100 FT.

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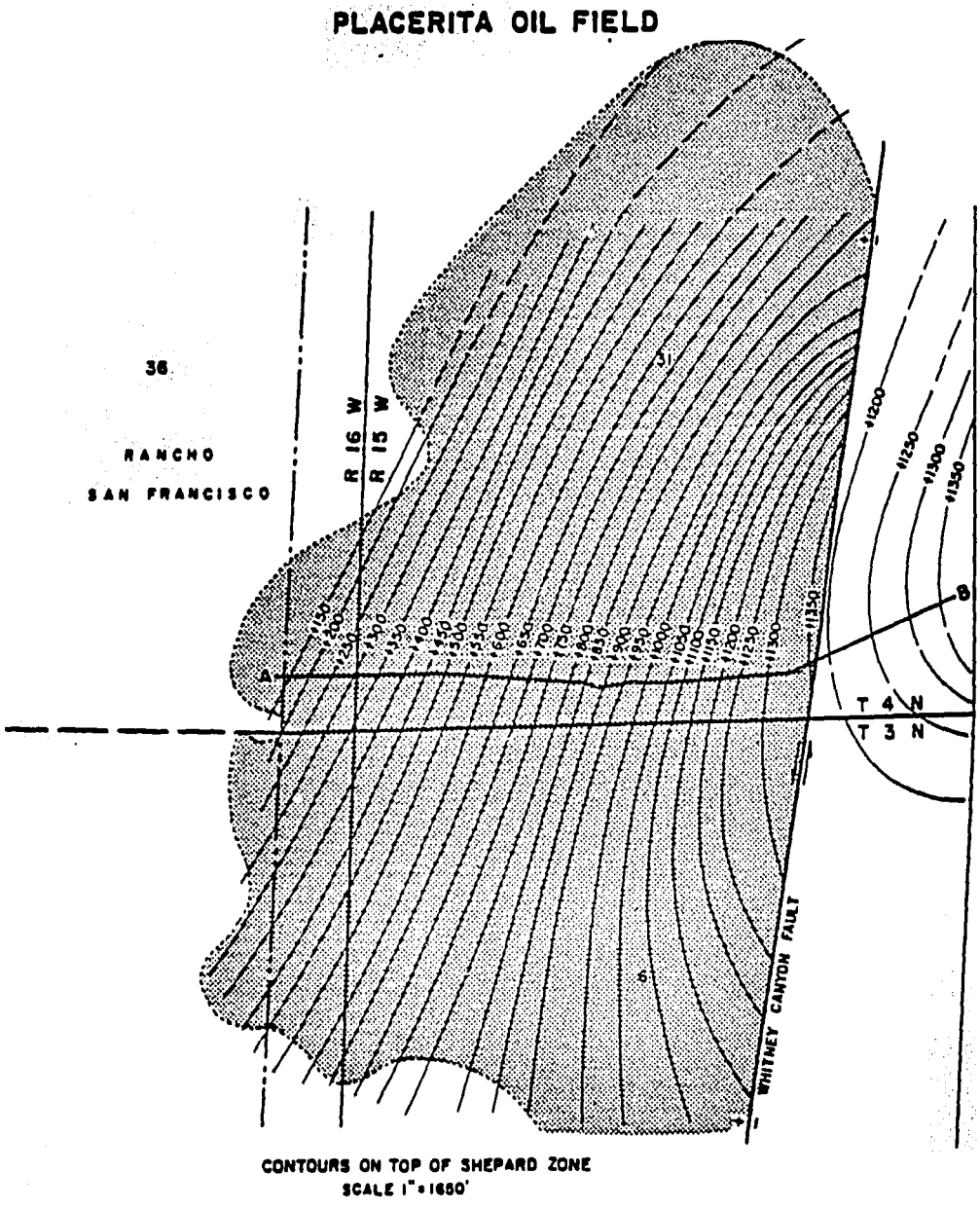

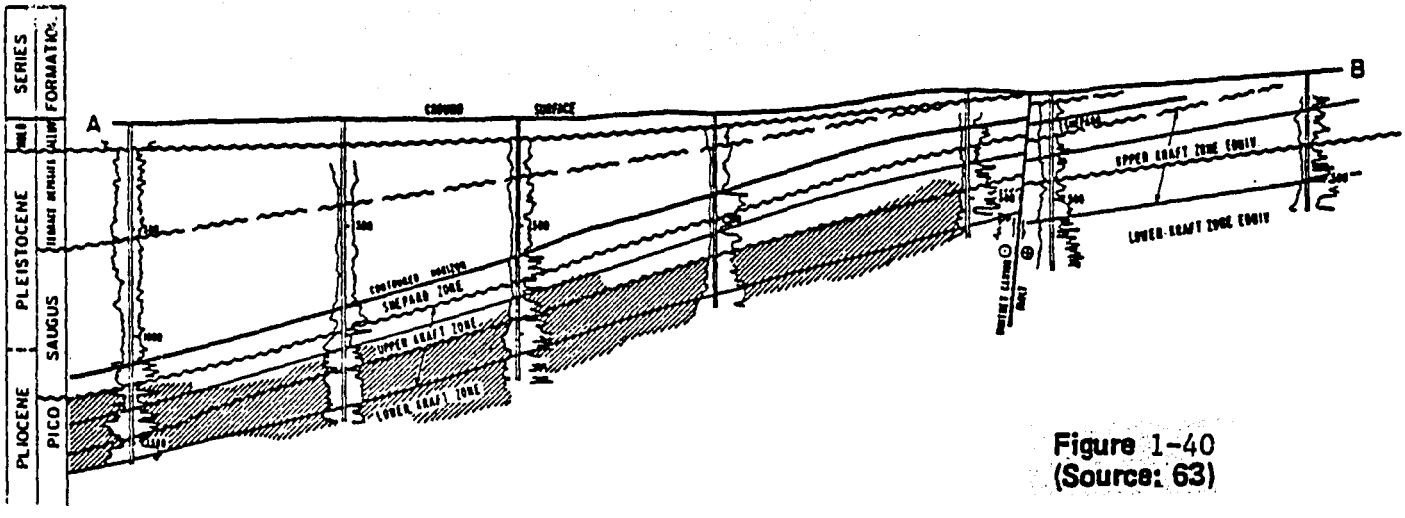

Figure 1-40
(Source: 63)