UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Basic data and preliminary density and porosity profiles for twelve borehole gravity surveys made in the Los Angeles, San Joaquin, Santa Maria and Ventura Basins, California

by

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INTRODUCTION

This report presents a brief summary of the borehole gravity method, a description of the data reduction and error estimate procedures, and preliminary density and porosity profiles for twelve borehole gravity surveys made in California by the U.S. Geological Survey. A brief description of the geologic setting and petroleum field characteristics for each surveyed well is also included.

The borehole gravity surveys were made with the Geological Survey's borehole gravity meter (LaCoste and Romberg BHGM #6) and well-logging equipment to gather in situ density and porosity data to support a variety of on-going research studies of sedimentary rocks in California basins. The names and locations of the surveyed wells are given in Table 1.

BOREHOLE GRAVITY METHOD

Smith (1950) recognized that borehole gravity measurements are responsive primarily to the vertical density variations in the rocks traversed by the survey and secondarily to lateral rock density variations (anomalous density structure) of detectable magnitudes that may occur in the region surrounding the surveyed well. However, the development of a reliable borehole gravity meter with high precision came much later and the use of surveys for reservoir evaluation soon followed (McCulloh et al, 1967a, 1967b; McCulloh et al, 1968).

Borehole gravity surveys are conducted by stopping and reading the borehole gravity meter at a series of downhole stations that have been previously selected from examination of well logs to meet the survey objectives. This technique leads to a set of gravity difference (Δg) and depth difference (Δz) measurements that constitute the interval vertical gradient of gravity ($\Delta g/\Delta z$) between successive stations (Fig. 1). In many geologic settings interval density (ρ) is the only factor that significantly affects $\Delta g/\Delta z$ because the formations surrounding the borehole are level or nearly so and possess relatively uniform densities in lateral directions. In such areas, borehole gravity data are easily converted to highly accurate and unique (gravimetric) interval density profiles.

Lateral density variations may be significant where folded strata, faults, unconformities, intrusions, or lateral variations in lithology, porosity or pore fluids (due to selective depositional or post-depositional processes) intersect or occur within detectable distances of the borehole. Analysis of the borehole gravity data in these cases is more difficult because equal density surfaces generally are poorly known and may be complex in shape. In this preliminary report lateral rock density variations have been ignored in the calculations of density and porosity profiles from the borehole gravity measurements. This simplifying assumption (disregard of possible ΔG_g effects) is valid for most but not all of the surveys presented here.

Interval density is defined in the Glossary of Geology (Bates and Jackson, 1980) as "in a wellbore, the density of an interval intergrated from gamma-gamma log data or determined by a borehole gravity meter." Apparent density is defined in the Glossary of Geology as "rock density calculated from

gravity measurements in boreholes." The term apparent density should be reserved for those cases where anomalous effects (the ΔG_g term) are large enough to significantly affect calculated ρ. Interval density should apply to cases where ΔG_g is negligibly small or its value has been determined.

Interval density is the gravitational average density of the horizontal layer and, in theory, can be caused by an infinite number of different density distributions in the horizontal layer. In practice, ρ is a representative measure of the density in situ of individual beds or groups of beds in which density is reasonably constant in horizontal directions for radial distances of at least 5 to 10 times the interval thickness Δz. Under these circumstances ρ can, in effect, be considered a linear average of any vertical variations of density over the Δz interval.

Interval densities and porosities determined from borehole gravity measurements are particularly important because of the large volume of formation investigated and high relative or absolute accuracy that is inherent and unique to the borehole gravity method. For example, comparative radial distances from the borehole and corresponding rock volumes investigated by conventional cores, gamma-gamma log, neutron log, sonic log, and borehole gravity meter over a 10-foot interval are shown in Table 2. There is no doubt that the borehole gravity meter provides a unique glimpse of the rocks surrounding the borehole and can be very important where conventional logs give faulty or ambiguous results.

A very important economic application of borehole gravity surveys is the accurate and representative evaluation of formation or reservoir porosity in the vicinity of the well. Interval porosities are calculated from interval densities using the familiar equation for porosity.

$$\phi = 100\ (\rho_g - \rho)/(\rho_g - \rho_f) \qquad (1)$$

where ϕ = total porosity in percent

ρ = interval density in g/cm^3

ρ_g = average grain or matrix density of the solid constituents of the rocks contained in the interval in g/cm^3

ρ_f = average pore-fluid density in the interval in g/cm^3

According to eq. 1 if ρ is provided from the borehole gravity survey, any two of the remaining three variables must be independently determined in order to solve for the third. For example, ρ_g and ρ_f must be estimated from independent data if porosity ϕ is to be calculated. Similarly, ρ_g and ϕ must be estimated from independent data if interval pore-fluid density ρ_f is to be calculated.

The maximum likely error in calculated interval density due to errors in Δg and Δz measurements is given by

$$\rho = 1/4\pi k\ (\Delta g/\Delta z)\ (\Delta z_{error}/\Delta z + \Delta g_{error}/\Delta g) \qquad (2)$$

These errors were carefully estimated for each survey reported here and are given in the data summaries. Maximum likely error in calculated interval porosity is given by

$$\phi_{error} = \frac{100}{(\rho_g - \rho_f)}\left[(1-\phi)|\rho_{g\,error}| + \phi|\rho_{f\,error}| + |\rho_{error}|\right] \quad (3)$$

where $\rho_{g\ error}$, $\rho_{f\ error}$, and ρ_{error} represent the errors or uncertainies in the value of grain density, pore-fluid density and interval density expressed in g/cm^3 and ϕ is given fractionally. ϕ_{error} is the resultant error or uncertainty in calculated interval porosity expressed in porosity percent. Absolute values of $\rho_{g\ error}$, $\rho_{f\ error}$ and ρ_{error} are summed in eq. (3) to give the maximum error case. In practice, the signs of these three errors may cause some compensation so that ϕ_{error} actually may be less than estimated from eq. 3. Note that the magnitude of each error on the right side depends on the inverse value of $(\rho_g - \rho_f)$ which, for practically all economically important sedimentary rocks, ranges from about 0.77 to 0.35 $(g/cm^3)^{-1}$. Also, $\rho_{g\ error}$ is larger in lower porosity rocks than in higher porosity rocks and the converse is true for $\rho_{f\ error}$. ρ_{error} is independent of porosity. Careful borehole gravity surveying and the acquisition of sufficient independent downhole data to describe mineralogy and pore fluids will minimize errors so that errors in calculated porosity will almost always be less than 3 and frequently less than 1.5 porosity percent. In this preliminary report $\rho_{g\ error}$ and $\rho_{f\ error}$ have been each set equal to 0.02 g/cm^3.

Suggested references for the theory and mechanics of borehole gravity surveys are Smith (1950), Beyer (1971), Rasmussen (1973), Rasmussen (1975), and Beyer (1983). Applications of borehole gravity surveys include formation evaluation, reservoir engineering, well log and core analysis evaluation, surface gravity and seismic studies, and engineering or rock property investigations. Useful references for applications include Smith (1950), McCulloh (1966), McCulloh and others (1968), Jageler (1976), Bradley (1976), Beyer and Clutsom (1978a, 1978b), Schmoker (1979), Robbins (1979), and Tucci et al (1983).

EXPLANATION OF DATA SETS

The following data set for each borehole gravity survey includes a brief description of the oil field or geologic setting, small scale plots of preliminary density and porosity profiles (see figures 6-23) and a tabulation of the borehole gravity data (see tables 3 through 14). Index maps are included for each basin to show the locations of the surveyed wells (see figures 2 through 5).

Density values have been calculated with the assumptions that anomalous gravity effects are negligibly small, rock layers are horizontal and of great lateral extent, and boreholes are vertical. (Data for the "Taylor" 635 well have been corrected for the strong deviation from the vertical of this well.) Porosity values have been calculated from the density data with the additional assumptions that grain (or matrix) density is 2.65 g/cm^3 and pore fluid density is 1.00 g/cm^3. Maximum likely errors in calculated density and porosity, based on eqs. (2 and 3), are displayed as error bars on the plotted profiles. These error estimates do not include uncertainties due to anomalous

gravity (ΔG_g) effects which for most wells are less than 2 percent but may be as great as 10 percent for portions of several of the surveys.

An explanation of columns 1 through 21 of the tabulated data follows.

Column 1

Sequential numbers for borehole gravity stations

Column 2

Elevation of borehole gravity station calculated from surveyed elevation at well site (feet). Values are not corrected for borehole deviation from the vertical except for the "Taylor" 635 well.

Column 3

Measured depth of borehole gravity station relative to the Kelly bushing (KB) or other original log datum (feet).

Column 4

Terrain corrections calculated out through Hayford-Bowie zone O using variable terrain density (Beyer and Corbato, 1972) (milligals).

Column 5

Relative gravity with uppermost station set equal to zero (milligals). Corrections for tidal gravity, instrument drift and terrain have been applied.

Column 6

Estimated uncertainty in gravity value of column 5 based on quality of reading or reading at station (milligals).

Column 7

Gravity difference (Δg) between successive stations (milligals).

Column 8

Uncertainty in gravity difference (Δg_{error}) that is the sum of gravity station uncertainties (column 6) plus .003 milligals for uncertainties of gravity meter repeatability and drift correction (milligals).

Column 9

Depth difference (Δz) between successive borehole gravity stations (feet). Values are corrected for borehole deviation from the vertical for the "Taylor" 635 well.)

Column 10

Estimated uncertainty (Δz_{error}) in depth difference (feet). Δz_{error} is estimated to be .05 feet for Δz <50 feet and .15 feet for Δz > 50 feet.

Column 11

Interval vertical gradient ($\Delta g/\Delta z$) (milligals/foot).

Column 12

Theoretical free-air vertical gradient (F) for latitide and elevation of borehole gravity station (milligals/foot). Values are calculated from

$$\partial\gamma/\partial h = .094112 - .000134 \sin^2\phi - .134 \times 10^{-7} h$$

where ϕ is latitude and h is elevation in feet. Equation is from Heiskanen and Moritz (1967) with constants of the 1967 Geodetic Reference System.

Column 13

Interval or apparent density (ρ) calculated from

$$\Delta g/\Delta z = F - 4\pi k\rho$$

where k is the gravitational constant (g/cm^3). Assuming a mean value for F, this equation becomes

$$\rho = 3.680 - 39.127\ (\Delta g/\Delta z)$$

Column 14

Maximum likely error in interval density (ρ_{error}) calculated from

$$\rho = 1/4\pi k\ (\Delta g/\Delta z)\ (\Delta z_{error}/\Delta z + \Delta g_{error}/\Delta g) \qquad (g/cm^3)$$

Column 15

Assumed grain (or matrix) density (ρ_g) (g/cm^3).

Column 16

Assumed uncertainty of 0.02 in grain density ($\rho_{g\ error}$) (g/cm^3).

Column 17

Assumed pore fluid density (ρ_f) (g/cm^3).

Column 18

Assumed uncertainty of 0.02 in pore fluid density ($\rho_{f\ error}$) (g/cm^3).

Column 19

Interval or apparent porosity (ϕ) calculated from

$$\phi = 100(\rho_g - \rho)/(\rho_g - \rho_f) \qquad (\%)$$

where ρ_g is set equal to 2.65 g/cm^3 and ρ_f is set equal to 1.00 g/cm^3

Column 20

Maximum likely error in interval porosity (ϕ_{error}) due to uncertainties $\rho_{g\ error}$ $\rho_{f\ error}$ and ρ_{error}. Error equation for (ϕ_{error}) is

$$\phi_{error} = \frac{100}{(\rho_g - \rho_f)}\left[(1-\phi)\left|\rho_{g\,error}\right| + \phi\left|\rho_{f\,error}\right| + \left|\rho_{error}\right|\right]$$

where ϕ is decimal porosity and ϕ_{error} is in porosity percent.

Column 21

Sequential numbers for borehole intervals between successive gravity stations.

WELL: "Long Beach Unit" A860I (Figure 6, Table 3)

The THUMS Long Beach Company "Long Beach Unit" A860I well is located slightly to the north of the axis of the Wilmington anticline in the southeast part of the Wilmington oil field on Grissom (A) artificial island in Long Beach Harbor (Figure 2). The well was drilled in 1980 for water injection to the base of the "Upper Terminal" producing zone (upper Puente Formation). In this part of the Wilmington field, the "Tar" zone (middle Repetto) and "Ranger" zone (uppermost Puente and lowermost Repetto Formations) were originally oil-bearing while the "Upper Terminal" zone (upper Puente Formation) was originally wet. Water injection with both pressure and fluid flux effects in the "Ranger" and "Upper Terminal" zones in the vicinity of the A860I well was underway by mid-1968. The borehole gravity survey was conducted to 3,659 feet in early 1981.

WELL: "Long Beach Unit" D630 (Figures 7 and 8, Table 4)

The THUMS Long Beach Company "Long Beach Unit" D630 well is located slightly to the south of the axis of the Wilmington anticline in the southeast part of the Wilmington oil field on Freeman (D) artificial island in Long Beach harbor (Figure 2). The well was drilled in 1968 through the entire stratigraphic section into the Catalina Schist basement. Intervals opened to initial production were from

1) 8,275 to 8,897 feet in the lower Puente Formation (possibly including about 100 feet of underlying upper middle Miocene strata), the "black shale member" or "fractured shale zone" of the "237" production zone of local usage (Truex, 1972) and
2) 8,941 to 9,038 feet in a schist conglomerate or breccia and the underlying Catalina Schist

In this part of the Wilmington field, the overlying "Union Pacific" and "Ford" producing zones (Puente Formation) and the "Ranger" zone (uppermost Puente and lowermost Repetto Formations) also are oil productive. The "Upper Terminal" and "Lower Terminal" zones (Puente Formation) are wet. Water injection into oil productive zones began in the late 1960's. The borehole gravity survey was run in early 1981 to 8,806 feet where well temperatures exceeded the operating limit of the gravity meter.

WELL: "KCL-L" 45-25 (Figures 9 and 10, Table 5)

The ARCO Oil and Gas Company "KCL-L" 45-25 well is located in the North Tejon oil field near the southern margin of the San Joaquin Basin (Figure 3). The North Tejon oil field is a highly faulted, north-plunging anticlinal nose whose north end plunges steeply against the White Wolf fault zone and which has domal closure at depth (Park, 1961; Porter, 1965).

The "KCL-L" 45-25 was drilled as on oil production well and was dually completed in the Lower Miocene (10 intervals from 8,275 to 10,584 feet in the "Vedder" sands) and in the Eocene (11,355 to 11,488 feet in the "Metralla" sandstone). Initial comingled production was 112 barrels of oil and 1,438 Mcf gas per day with a 27% water cut. The borehole gravity survey was run from ground surface down through the Oligocene section but not through the Eocene where a 5" slotted liner was too small for the logging tool.

WELL: "White Wolf Deep" 26x-28 (Figures 11 and 12, Table 6)

The Tenneco Oil Company "White Wolf Deep" 26x-28 is located 28 miles south-southwest of Bakersfield and 3 miles south of the San Emidio oil field (Figure 3). This well was drilled in 1979-1980 as a wildcat to test the upper Miocene (Stevens) sandstones that are productive in the nearby Yowlumne and San Emidio oil fields. A number of drill stem tests of intervals below 13,000 feet were conducted and the well was productive for a short time. At the time of this writing (December 1984) the well is listed as temporarily abandoned.

The borehole gravity survey, originally programmed to reach the upper Miocene sandstones, was run only to 10,989 feet where higher than expected temperatures forced termination of measurements.

WELL: "South Belridge" 548E-34 (Figures 13 and 14, Table 7)

The Shell California Production Inc. "South Belridge" 548E-34 is located in the southern part of the South Belridge oil field approximately 40 miles west-northwest of Bakersfield (Figure 3). The South Belridge oil field is located on a narrow, north-northwest-trending anticline. Younger formations dip gently on the flanks of the fold while older rock units are more sharply folded (Ritzius, 1950). At structurally high positions Pleistocene rocks unconformably overlie the Belridge diatomite, an uppermost Miocene diatomaceous facies of the Reef Ridge Shale (John A. Barron, personal comm., 1984). On the flanks, marine Pliocene rocks are present between Pleistocene and upper Miocene formations.

Oil production in the South Belridge field comes mostly from two distinctly different types of reservoirs. Productive rocks of the Pleistocene Tulare Formation are unconsolidated, usually poorly sorted, lenticular, non-marine sands with an aggregate thickness of about 250 feet high on the structure and about 600 feet in favorable locations on the flanks (Ritzius, 1950). These sands are interbedded with poorly consolidated claystone and siltstone. Oil entrapment is largely controlled by permeability variations and is stratigraphically augmented by the westward lensing out of sand in the Tulare (Colvin, 1968). Oil gravity ranges from 12° to 15° API.

Oil production is also obtained from the upper part of the Belridge diatomite, a sequence that ranges downward from diatomite to diatomaceous mudstone and shale (with thin sand and silt partings and lenses) to porcelaneous and siliceous shale (Ritzius, 1950; Schwartz et al, 1981). Production wells are completed in the Belridge diatomite by hydraulically fracturing large intervals of the uppermost 2,000 feet of the Reef Ridge Shale to improve permeability (Strubhar et al, 1984). Oil gravities range from 20° to 35° API in the Belridge diatomite.

The Tulare sand reservoir is thermally stimulated, principally by steam displacement. The Tulare Formation accounts for about 80 percent of the present production while the Belridge diatomite contributes about 20 percent. Limited production comes from the modestly explored siliceous rocks of the Monterey Formation below the Belridge diatomite and minor production comes from isolated Pliocene sands on the flanks of the anticline.

The "South Belridge" 548E-34 well was drilled by Shell California Production Inc. in 1980 to a total depth of 8,800 feet, penetrating the top of the productive "Tulare oil sands" zone at 444 feet and the Belridge diatomite at 770 feet. The borehole gravity survey was run in this well to a depth of 6,390 feet, a short distance above a bridge plug.

WELL: "Monte Cristo" 164 (Figure 15, Table 8)

The Chevron U.S.A. Inc. "Monte Cristo" 164 is located near the southern end of the Lost Hills oil field approximately 42 miles northwest of Bakersfield (Figure 3). The Lost Hills oil field is located on the Lost Hills anticline (English, 1921), a long, narrow, slightly asymmetric, northwest-trending, doubly plunging anticline that is the southern portion of an anticlinal trend that extends northwestward through Kettleman Hills (Scouler, 1952; Seiden, 1964). The axial plane of the Lost Hills anticline is steeply inclined toward the west, the eastern flank is steeper than the western flank and dips increase with depth on both flanks (Follansbee, 1943).

At structurally high positions on the Lost Hills anticline, non-marine Pleistocene rocks of the Tulare Formation unconformably overlie shallow water marine deposits of the lower Pliocene Etchegoin Formation which, in turn, unconformably overlie clayey and siliceous rocks of the upper Miocene. On the flanks of the structure, brackish to fresh water deposits of the upper Pliocene San Joaquin Formation conformably overlie the Etchegoin Formation. These rocks are truncated high on the structure by the unconformity at the base of the Tulare Formation.

Oil was discovered in 1910 and has been produced from a variety of rocks through many stages of field development. One principal group of productive units includes lenticular sandstones and their encasing rocks which range downward from Pliocene claystone and clayey silstone to uppermost Miocene diatomaceous mudstone and diatomite (McCabe, 1924; Ayers, 1939; Hardoin, 1967; Stosur and David, 1976; Graham et al, 1982). Permeable sandstone reservoirs were produced many years before waterflood and thermal stimulation was introduced in the 1950's and 1960's. Later, oil production was obtained from less permeable diatomaceous zones by hydraulic fracturing. These units belong to a Mio-Pliocene sequence of the uppermost Reef Ridge Shale and overlying Etchegoin Formation.

A second major group of older productive rocks, belonging to the Reef Ridge Shale and McLure Shale Member of the Monterey Formation, includes interbedded porcelanite, siliceous shale and silty or siliceous claystone with limited dolomitization and limited to rare amounts of chert (Ganong, 1952; Hardoin, 1963, 1967; Williams, 1982; McGuire et al, 1983). The informally named "Cahn" zone and recently discovered south extension of the field, although somewhat different reservoirs, produce from these rocks. "Antelope" and "McDonald" shale are informal names for the upper and lower parts of the McLure Shale Member of the Monterey Formation. The more brittle lithologies, apparently restricted to the silica-rich and carbonate-rich units, are partly naturally fractured but hydraulic fracturing is routinely undertaken during well completion to increase production rates (Knauss et al, 1983; Al-Khatib et al, 1984).

The "Monte Cristo" 164 was drilled during development of the south extension of the field in early 1981 to a total depth of 6,348 feet, penetrating the Reef Ridge Shale and McLure Shale Member of the Monterey Formation at about 3,830 feet, and 4,940 feet respectively. Oil and gas is produced from the interval 4,940 to 5,125 feet after stimulation by hydraulic fracturing. The borehole gravity survey was run to 5,785 feet, a short distance above a bridge plug.

WELL: "Arellanes" 2 (Figure 16, Table 9)

The Union Oil Company of California "Arellanes" 2 is located on the Casmalia anticline in the northwest part of the Casmalia oil field approximately 7 miles southwest of Santa Maria (Figure 4). The Casmalia anticline is a northwest-trending, broad, faulted, asymmetrical fold whose north flank dips steeply toward the Santa Maria Valley syncline and is terminated by a fault or faults of large displacement (Porter, 1943; Woodring and Bramlette, 1950; Crawford, 1971; Pisciotto, 1978). This fault or fault zone, evident north of the Casmalia oil field from subsurface data only, was shown by Crawford (1971), who used the name Orcutt Frontal fault, to extend southeastward from the coast to the east side of the Orcutt oil field. Sylvester and Darrow (1979) show the same fault, labeled Pezzoni-Casmalia, and explain their rationale for connecting faults mapped intermittently at the surface with faults evidenced from subsurface data. Hall (1982) shows, without supportive evidence, the Casmalia and Orcutt Frontal faults as separate ruptures north of the Casmalia oil field.

Reservoir rocks in the Casmalia field are principally hard, siliceous, partly calcareous fractured shale with thin interbeds of siltsone and, secondarily, fractured chert and limestone of the upper part of the Monterey Formation. Very minor production was obtained from sandstone in the Point Sal Formation and from fractured calcareous sandstone in the Lospe Formation.

The "Arellanes" 2 was drilled by the Bell-Casmite Oil Company in 1946 to a total depth of 5,950 feet, penetrating the lower part of the Sisquoc, the top of the Monterey and Point Sal Formations at about 735 and 2,605 feet respectively, and 1,730 feet of the underlying Lospe Formation. Initial production was from 4,082 to 4,305 feet and 4,595 to 4,801 feet in the Lospe Formation, the first production in the Santa Maria Basin from this formation. Later, oil and gas were produced from 1,890 to 2,000 feet and 2,310 to 2,570 feet from the Monterey Formation. The borehole gravity survey was run down through the uppermost 168 feet of the Lospe Formation but not deeper due to an unidentified obstruction in the well.

WELL: "Newlove" 108 (Figure 17, Table 10)

The Union Oil Company of California "Newlove 108 is located in the southwest part of the Orcutt oil field approximately 8 miles south of Santa Maria (Figure 4). The Orcutt field is located on a broad, faulted, dome-like structure that is slightly elongate in a west-northwest direction and is dominated by the Graciosa anticline (Woodring and Bramlette, 1950). Dips increase gradually down the flanks of this dome but steepen abruptly on the

north and northeast sides where units are cut by a fault or faults of large displacement (Dreyer, 1943; Woodring and Bramlette, 1950). This fault zone, termed the Orcutt Frontal fault by Crawford (1971), has a dip-slip component of as much as 8,000 feet and unknown strike-slip displacement (Krammes and Curran, 1959; Hall, 1982; Katherman, 1983).

Oil and gas production began in 1901 and has been obtained from 1) basal Sisquoc sand and fractured shale down the south flank, 2) fractured siliceous and carbonate-rich rocks of the lower part of the Monterey Formation throughout most of the field, and 3) thin-bedded, lenticular sandstone interbedded with siltstone and shale in the upper part of the Point Sal Formation.

The "Newlove" 108 was drilled as a replacement to the nearby "Newlove" 12 well in 1980 to a total depth of 3,975 feet, penetrating the tops of the Monterey and Point Sal formations at about 2,395 and 3,125 feet respectively. Oil is produced from the interval 3,232 to 3,971 feet in the Point Sal Formation. The borehole gravity survey was run to a depth of 3,879 feet.

WELL: "Union Bell Fee" 156 (Figure 18, Table 11)

The Union Oil Company of California "Union Bell Fee" 156 well is located in the southeast part of the West Cat Canyon oil field approximately 12 miles southeast of Santa Maria (Figure 4). The West Cat Canyon oil field is located on the Los Flores anticline, a complex northwest-trending, doubly-plunging fold with structural highs at both the northwest and southeast ends (Manlove, 1943; Woodring and Bramlette, 1950; Huey, 1954) The western flank dips more steeply than the east flank and the Monterey Formation is more extensively faulted and folded than are the unconformably overlying Pliocene and younger rocks. A north-northwest trending, east-dipping fault with about 300 feet of apparent dip-slip displacement and unknown strike-slip displacement cuts the east flank of the Los Flores anticline, passing within about 1,400 feet northeast of the "Union Bell Fee" 156 at the top of the Monterey Formation (Huey, 1954; Redwine, 1981).

The "Union Bell Fee" 156 was drilled by the Humble Oil and Refining Company in 1971 to a total depth of 6,000 feet, penetrating the Sisquoc Formation at 1,745 feet and the Monterey Formation at approximately 4,231 feet. The well was cored almost continuously in the Monterey Formation from 4,952 to 5,783 feet but with only 58 percent recovery.

Oil and gas are produced from two distinctly different types of reservoirs in the West Cat Canyon oil field. Productive rocks of the Sisquoc Formation are a series of marine sandstones interbedded with claystone and siltstone. Individual sands are neither uniformly developed nor productive everywhere in the field but are laterally continuous for considerable distances. Many of these sands are now being produced with enhanced recovery methods. In "Union Bell Fee" 156 the overall Sisquoc sandstone interval extends from 2,440 to 3,605 feet but only sands S_2, S_3, S_5, S_6, and S_{6a} are productive in this part of the West Cat Canyon field. Water injection of sands S_2 through S_6 has been underway since 1964 and nearby wells were producing 8 to 16 API gravity oil with 89 to 99% water cut when the borehole

gravity survey was made. Sands S_7, S_{8a} and S_{9a} which are wet in this part of the field, are shown to be more dense and probably are less porous than are the overlying productive sands.

Fractured, fine-grained rocks of the Monterey Formation also produce oil and gas. These are quartz-bearing, silica-rich, carbonate-rich or phosphatic rocks, some of which have been partially or completely dolomitized (Regan and Hughes, 1949; Pisciotto, 1978; Redwine, 1981). Petroleum production has been from the more brittle silica-rich and dolomite-rich zones that have been pervasively fractured or brecciated (Redwine, 1981; Roehl, 1981). Dolomitization and fracturing apparently were not entirely strata-bound and cores together with dipmeter data from the "Union Bell Fee" 156 indicate contortion of bedding in the lower zones (Redwine, 1981). Intervals opened to production in the "Union Bell Fee" 156 were 5,372 to 5,875 feet and 5,918 to 5,995 feet. Initial production is not significant because the Monterey reservoir had been extensively produced by the time the 156 well was completed. The borehole gravity survey was run in the "Union Bell Fee" 156 to a depth of 5,941 feet.

WELL: "Morrison" 23-7 (Figures 19 and 20, Table 12)

The Chevron U.S.A. Inc. "Morrison" 23-7 is located 3 miles north-northeast of the center of the Orcutt oil field and immediately south of the Bradley and west of the Clark areas of the Santa Maria Valley oil field (Figure 4). This location is near the axial region of the eastern end of the Santa Maria Valley syncline. Oil and gas are produced from 1) basal sandstones of the Sisquoc Formation (sometimes locally referred to as the "Santa Margarita" sands) and 2) fractured siliceous and calcareous rocks in the Monterey Formation in the nearby Bradley and Clark Avenue areas.

The "Morrison" 23-7 was drilled in 1979 by Chevron U.S.A. Inc. to a total depth of 8,426 feet, penetrating the top of the Sisquoc Formation at about 5,040 feet and the top of the Monterey Formation at about 7,140 feet. Oil and gas were intermittently producted from 7,768 to 8,237 feet and 8,366 to 8,415 feet until the well was abandoned in 1983. The borehole gravity survey was conducted to 7,562 feet where the combination of well temperature and deviation from the vertical terminated the survey.

WELL: "Rosenblum" 6 (Figure 21, Table 13)

The Union Oil Company of California "Rosenblum" 6 well is located immediately east of the city of Santa Maria in the eastern part of the main area of the Santa Maria Valley oil field (Figure 4). The main area of the Santa Maria Valley field is located on the north limb of the Santa Maria Valley syncline (Woodring and Bramlette, 1950). Oil is trapped in a generally east-west trending, northward-thinning homoclinal sequence by transgressive overlap so that the Point Sal and Monterey Formations are buttressed against the overlying Sisquoc Formation (Canfield, 1939). Faulting and folding prior to deposition of the Sisquoc add structural complications. Reservoir rocks are principally fractured siliceous shale and chert, and secondarily, fractured phosphatic shale, basal sandstone of the Monterey, fractured

calcareous sandstone of the Point Sal, and fractured calcareous sandstone and sandy limestone of the Knoxville Formation (Woodring and Bramlette, 1950).

The "Rosenblum" 6 was drilled in 1944 by the Hancock-Bush Oil Company to a total depth of 4,674 feet, penetrating the tops of the Sisquoc Formation at 3,062 feet, the Monterey Formation at 3,495 feet and the Point Sal Formation at 4,210 feet. Initial production was 4,170 barrels of oil and 1,250 Mcf of gas per month from 3,522 to 4,673 feet. The borehole gravity survey was run to 4,566 feet.

WELL: "Taylor" 635 (Figures 22 and 23, Table 14)

The Shell California Production Inc. "Taylor" 635 is located in the western part of the Ventura oil field slightly to the south of the axis of the Ventura anticline, approximately 3 miles northwest of Ventura (Figure 5). The Ventura anticline is a long, narrow, east-west trending, complexly faulted fold that formed during late Quaternary (Hertel, 1928; Thoms and Bailey, 1943; Hacker, 1969; Lajoie et al, 1979). The north flank is steeper than the south flank, both at the surface and at depth, so that the axial plane of the fold dips steeply toward the south. Vertical closure exceeds 7,500 feet over a horizontal distance of 5 miles between north- and south-bounding synclines (Hacker, 1969).

Complex faulting in the subsurface in the axial region of the Ventura anticline has been interpreted from drillhole data to consist of two major types (Schneider, 1972). One type consists of high-angle, south-dipping reverse faults on the south flank that are subparallel to the fold axis. These faults gradually flatten upward into thrust faults that often disappear into bedding planes on the north flank. A second type consists of bedding-plane reverse faults at depth on the north flank, also subparallel to the fold axis, that flatten into thrust faults across the fold axis and continue upward at low angle, cutting strata and faults on the south flank. Less common, mostly northwest-southeast-trending cross faults are also present but generally do not cut the major reverse (thrust) faults. Faulting increases with depth in the axial region high on the structure where strata are severely disrupted (Hacker, 1969). The extent of possible lateral movement on faults is not well-known.

Oil and gas have been produced on a sustained basis since 1919 in the Ventura oil field from the Pico Formation (upper Pliocene), "Repetto" formation (lower Pliocene) and "Santa Margarita" formation (Mio-Pliocene transition). Productive rocks consist of sandstone, sandy siltsone and clayey siltstone (with an average net thickness of about 7,300 feet) that are part of a much thicker deepwater turbidite sequence (Cartwright, 1928; Hacker, 1969; Hsu, 1977). Eight productive zones and 4 separate fault blocks are recognized in the Ventura field, leading to more than 20 separate reservoirs, each with independent fluid pressure behavior caused by impermeable shale beds and fault zones. Abnormal reservoir fluid pressures were encountered in the deeper reservoirs and reached values as high a 8,300 psi at a subsurface depth of 9,200 ft (Watts, 1948). Oil gravities range from 29° to 34° API.

The borehole gravity survey was run to a measured well depth of 11,359 feet (11,218 feet vertical depth). Detailed measurements could not be made between measured well depths of 8,479 and 9,430 feet where drillhole deviation from the vertical exceed the leveling capabilities of the gravity meter.

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REFERENCES

Al-Khatib, A. M., King, A. R., and Wilson, M. S., 1984, Hydraulic fracturing design and evaluation: A case history: 1984 California Regional Meeting Society of Petroleum Engineers of AIME Proceedings, p. 9-18.

Antkiw, S., 1976, Depth of investigation of the dual-spacing thermal neutron decay time logging tool: SPWLA 17th Annual Logging Symposium Transactions, p. CC1-CC10.

Ayars, R. N., 1939, Williamson area of the Lost Hills oil field: Summary of Operations, California Oil Fields, Division of Oil and Gas, v. 24, no. 3, p. 78-90.

Baker, L. J., 1981, The effect of the invaded zone in full waveform acoustic logging [abs.]: Geophysics, v. 47, p. 478.

Bates, R. L., and Jackson, J. A., 1980, Glossary of Geology, Amer. Geological Institute, Falls Church, Virginia, 2nd edition, 751 p.

Beyer, L. A., 1971, The vertical gradient of gravity in vertical and near-vertical boreholes: U.S. Geological Survey Open-File Report 71-42, 229 p.

_____, 1983, Borehole gravity surveys: Theory, mechanics, and nature of measurements: U.S. Geological Survey Open-File Report 82-76, 91 p., 43 figs.

Beyer, L. A., and Corbato, C. E., 1972, A Fortran IV computer program for calculating borehole gravity terrain corrections: U.S. Geological Survey Open-File Report, 30 p.; available as report PB-208-679 from Nat'l Tech. Inform. Service, Springfield, Virginia.

Beyer, L. A., and Clutsom, F. G., 1978a, Borehole gravity survey in the Dry Piney Oil and Gas Field, Big Piney-LaBarge area, Sublette County, Wyoming: U.S. Geological Survey Oil and Gas Investigation Chart OC-84, 2 pl., 12p.

_____, 1978b, Density and porosity of oil reservoirs and overlying formations from borehole gravity measurements, Gebo Oil Field, Hot Springs County, Wyoming: U.S. Geological Survey Oil and Gas Investigations Chart OC-88, 3 pl., 16 p.

Bradley, J. W., 1976, The commercial application and interpretation of the borehole gravimeter, in Jantzen, R. W., ed., Tomorrow's Oil from Today's Provinces: American Assoc. Petro. Geologists, Pacific Section, Miscellaneous Pub. 24, p. 98-109.

Cartwright, L. D., Jr., 1928, Sedimentation of the Pico Formation in the Ventura quadrangle, California: Amer. Assoc. of Petroleum Geologists Bull., v. 12, no. 3, p. 235-269.

Canfield, C. R., 1939, Subsurface stratigraphy of Santa Maria Valley oil field and adjacent parts of Santa Maria Valley, California: Amer. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 45-81.

Colvin, R. G., 1968, South Belridge oil field, in S. E. Karp, ed., Geology and Oilfields, West Side Southern San Joaquin Valley: 1968 Guidebook, Pacific Section, AAPG-SEG-SEPM, p. 64-67.

Crawford, F. D., 1971, Petroleum potential of Santa Maria province, California, in Cram, I. H., ed., Future Petroleum Provinces of the United States--Their Geology and Potential: Amer. Assoc. Petroleum Geologists Memoir 15, p. 316-328.

Dreyer, F. E., 1943, Santa Maria (Orcutt) oil field, in, Jenkins, O. P., ed., Geologic Formations and Economic Development of the Oil and Gas Fields of California: Calif. Div. Mines Bull. 118, p. 431.

English, W. A., 1921, Geology and petroleum resources of northwestern Kern County, California: U.S. Geological Survey Bull. 721, 48 p.

Follansbee, G. S., Jr., 1943, Lost Hills oil field, in Jenkins, O. P., ed., Geologic Formations and Economic Development of the Oil and Gas Fields of California: California Division of Mines Bull. 118, p. 494-496.

Ganong, R. A., 1952, Cahn pool of Lost Hills oil field, in Laiming, B., ed., Field Trip Routes, Oil Fields, Geology: Guidebook, AAPG-SEPM-SEG Joint Annual Meeting, Los Angeles, March 1952, p. 166-168.

Graham, S. A., Williams, L. A., Bate, M., and Weber, L. S., 1982, Stratigraphic and depositional framework of Monterey Formation and associated coarse clastics of the central San Joaquin Basin, in Williams, L. A., and Graham, S. A., eds., Monterey Formation and Associated Coarse Clastic Rocks, Central San Joaquin Basin, California: Pacific Section SEPM Guidebook, October 9, 1982, p. 3-16.

Hall, Clarence A., Jr., 1982, Pre-Monterey subcrop and structure contour maps, western San Luis Obispo and Santa Barbara Counties, south-central California: U.S. Geological Survey Miscellaneous Field Studies, MF-1384, 28 p., 6 sheets.

Hacker, R. N., 1969, Ventura Avenue oil field in, Geology and Oilfields of Coastal Areas, Ventura and Los Angeles Basins, California: Guidebook, Pacific Sections, AAPG-SEG-SEPM, 44 Annual Mtg., March 1969, p.22-29, 52, 54.

Hardoin, J. L., 1963, Cahn pool of Lost Hills oil field: Summary of Operations, California Oil Fields, Division of Oil and Gas, v. 49, no. 2, p. 39-44.

_____ 1967, Northwest Lost Hills oil field: Summary of Operations, California Oil Fields, Division of Oil and Gas, v. 53, no. 2, pt. 2, p. 43-48.

Heiskanen, W. A., and Moritz, H., 1967, Physical Geodesy: W. H. Freeman & Co., San Francisco, 364 p.

Hertel, F. W., 1928, Ventura Avenue oil field, Ventura County, California: Amer. Assoc. of Petroleum Geologists Bull., v. 12, no. 7, p. 721-742.

Hsu, K. J., 1977, Studies of Ventura field, California, II: Lithology, compaction and permeability of sands: Amer. Assoc. Petroleum Goelogists Bull., v. 61, no. 2, p. 169-189.

Huey, W. F., 1954, West Cat Canyon area of Cat Canyon oil field: Summary of Operations, California Oil Fields, Division of Oil and Gas, v. 40, no. 1, p. 14-21.

Isaacs, C. M., 1981, Porosity reduction during diagenesis of the Monterey Formation, Santa Barbara coastal area, California, in R. E. Garrison, et al, eds., The Monterey Formation and Related Siliceous Rocks of California: Pacific Section SEPM Special Publication, p. 257-271.

Jageler, A. H., 1976, Improved hydrocarbon reservoir evaluation through use of borehole gravimeter data: Jour. Petroleum Technology, v. 28, no. 6, p. 709-718.

Katherman, C. E., 1983, Recent oil developments in the Monterey Formation of the Santa Maria Basin [abs.], in Isaacs, C. M., and Garrison, R. E., eds., Petroleum Generation and Occurrence in the Miocene Monterey Formation, California: Pacific Section SEPM, May 20-22, 1983, p.224.

Knauss, M. E., Field, B. J., and Bartel, J. E., 1983, Completion interval selection in the Lost Hills field, southeast flank, Kern County, California: 1983 California Regional Meeting Society of Petroleum Engineers of AIME Proceedings, p. 315-322.

Krammes, K. F., and Curran, J. F., 1959, Correlation section across Santa Maria Basin: Pacific Section, AAPG, 1 sheet.

Lajoie, K. R., Kern, J. P., Wehmiller, J. F., Kennedy, G. L., Mathieson, S. A., Sarna-Wojcicki, A. M., Yerkes, R. F., and McCrory, P. F., 1979, Quaternary marine shoreline and crustal deformation, San Diego to Santa Barbara, California, in Abbott, P. L., ed., Geological Excursions in the Southern California Area: Dept. Geol. Sciences, San Diego State Univ., p. 3-15.

Manlove, C., 1943, West Cat Canyon area of the Cat Canyon oil field, in, Jenkins, O. P., ed., Geologic Formations and Economic Development of the Oil and Gas Fields of California: Calif. Div. Mines Bull. 118, p. 432-434.

McCabe, R. E., 1924, Lost Hills oil field, Minor oil fields of Kern County, part 2: Summary of Operations, California Oil Fields, California State Mining Bureau, v. 10, no. 1, p. 5-10.

McCulloh, T. H., 1966, The promise of precise borehole gravimetry in petroleum exploration and exploitation: U.S. Geological Survey Circular 531, 12 p.

McCulloh, T. H., La Coste, L. J. B., Schoellhamer, J. E., and Pampeyan, E. H., 1967a, The U. S. Geological Survey-La Coste and Romberg precise borehole gravimeter system--instrumentation and support equipment, in Geological Survey Research 1967: U.S. Geol. Survey Prof. Paper 575-D, p. D92-D100.

McCulloh, T. H., Schoellhamer, J. E., Pampeyan, E. H., and Parks, H. B., 1967b, The Geological Survey-La Coste and Romberg precise borehole gravimeter system--Test results, in Geological Survey Research 1967: U.S. Geol. Survey Prof. Paper 575-D, p. D101-D112.

McCulloh, T. H., Kandle, J. R., and Schoellhamer, J. E., 1968, Application of gravity measurements in wells to problems of reservoir evaluation: SPWLA 9th Annual Logging Symposium Trans., p.01-029.

McGuire, M. D., Bowersox, J. R., and Earnest, L. J., 1983, Diagenetically enhanced entrapment of hydrocarbons--Southeastern Lost Hills fractured shale pool, Kern County, California, in Isaacs, C. M., and Garrison, R. E., eds., Petroleum Generation and Occurrence in the Miocene Monterey Formation, California: Pacific Section SEPM Special Publication, p. 171-183.

Park, W. H., 1961, North Tejon oil field: Summary of Operations, California Oil Fields, Division of Oil and Gas, v. 40, no. 2, p. 13-22.

Pisciotto, K. A., 1978, Basinal sedimentary facies and diagenetic aspects of the Monterey Shale, California: unpublished Ph.D. thesis, University of California, Santa Cruz, California, 450 p.

Porter, F. E., 1965, North Tejon field, main and highway areas, in Geology of Southeastern San Joaquin Valley, California: 1965 Guidebook, Pacific Section AAPG-SEG-SEPM Meeting, April 1-3, 1965 Bakersfield, California.

Porter, W. W., II, 1943, Casmalia oil field, in, Jenkins, O. P., ed., Geologic Formations and Economic Development of the Oil and Gas Fields of California: Calif. Div. Mines Bull. 118, p. 430.

Putnam, W. C., 1942, Geomorphology of the Ventura region, California: Geol. Soc. America Bull., v. 53, p. 691-754.

Rasmussen, N. F., 1973, Borehole gravity survey planning and operations: SPWLA 14th Annual Logging Symposium Trans., Q1-Q28.

_____ 1975, The successful use of the borehole gravity meter in northern Michigan: The Log Analyst, v. 16, no. 5, p. 3-10.

Redwine, L. E., 1981, Hypothesis combining dilation, natural hydraulic fracturing, and dolomitization to explain petroleum reservoirs in Monterey Shale, Santa Maria area, California, in, Garrison, R. E., Douglas, R. G., Pisciotto, K. E., Isaacs, C. M., and Ingle, J. C., eds., The Monterey Formation and Related Siliceous Rocks of California, Pacific Section SEPM Special Publication, p. 221-248.

Regan, L. J., and Hughes, A. W., 1949, Fractured reservoirs of Santa Maria district, California: Amer. Assoc. Petroleum Geologists, Bull. v. 33, no. 1, p. 32-51.

Ritzius, D. E., 1950, South Belridge oil field: Summary of Operations, California Oil Fields, Division of Oil and Gas. v. 36, no. 1, p. 18-24.

Robbins, S. L. 1979, Density determinations from borehole gravity data from a shallow lignite zone within the Denver Formation near Watkins, Colorado: SPWLA, 20th Annual Logging Symposium Trans., p. JJ1-JJ20.

_____ 1981, Reexamination of the values used as constants in calculating rock density from borehole gravity data: Geophysics, v. 46, no. 2, p. 208-210.

Roehl, P. O., 1981, Dilation brecciation--A proposed mechanism of fracturing, petroleum expulsion and dolomitization in the Monterey Formation, California, in, Garrison, R. E., Douglas, R. G., Pisciotto, K. E., Isaacs, C. M., and Ingle, J. C., eds., The Monterey Formation and Related Siliceous Rocks of California: Pacific Section SEPM Special Publication, p. 285-315.

Schmoker, J. W., 1979, Interpretation of borehole gravity surveys in a native-sulfur deposit, Culberson County, Texas: Economic Geol., v. 74, p. 1462-1470.

Schneider, J. J., 1972, Geological factors on the design and surveillance of waterfloods in the thick structurally complex reservoirs in the Ventura field, California: 47th Annual Mtg., Society of Petroleum Engineers of AIME, paper SPE 4049, 8 p.

Schwartz, D. E., Hottman, W. E., and Sears, S. O., 1981, Geology and diagenesis of Belridge Diatomite and brown shale, San Joaquin Valley, California [abs.]: Amer. Assoc. Petroleum Geologists Bull., v. 65, no. 5, p. 988-989.

Schouler, A. B., 1952, Lost Hills oil field, in Laiming, B., ed., Field Trip Routes, Oil Fields, Geology: Guidebook, AAPG-SEPM-SEG, Joint Annual Meeting, Los Angeles, California, March, 1952, p. 164-167.

Seiden, H., 1964, Kettleman Hills area: San Joaquin Geological Society Selected Papers, v. 2, p. 46-53.

Sherman, H., and Locke, S., 1975, Depth of investigation of neutron and density sondes for 35-percent-porosity sand: SPWLA 16th Annual Logging Symposium Transactions, p. Q1-Q14.

Smith, N. J., 1950, The case for gravity data from boreholes: Geophysics, v. 15, no. 4, p. 605-636.

Stosur, J. J., and David, A., 1976, Petrophysical evaluation of the diatomite formation of the Lost Hills field, California: Journal of Petroleum Technology, v. 28, p. 1138-1144.

Strubhar, M. K., Medlin, W. L., Nabi, S. M., and Andreani, F. S., Fracturing results in diatomaceous earth formations, South Belridge field, California: Journal of Petroleum Technology, v. 36, no. 3, p. 495-502.

Sylvester, A. C., and Darrow, A. C., 1979, Structure and neotectonics of the western Santa Ynez fault system in southern California: Tectonophysics, v. 52, p. 389-405.

Thomas, C. C., 1926, Production and utilization of gas from Ventura field: Summary of Operations, California Oil Fields, California State Mining Bureau, v. 11, no. 10, p. 5-10.

Thoms, C. C., and Bailey, W. C., 1943, Ventura Avenue oil field, in Jenkins O. P., ed., Geologic Formations and Economic Development of the Oil and Gas fields of California: California Division of Mines Bull. 118, p. 391-393.

Truex, J. N., 1972, Fractured shale and basement reservoir, Long Beach Unit, California: Amer. Assoc. Petroleum Geologists Bull., v. 56, no. 10, p. 1931-1938.

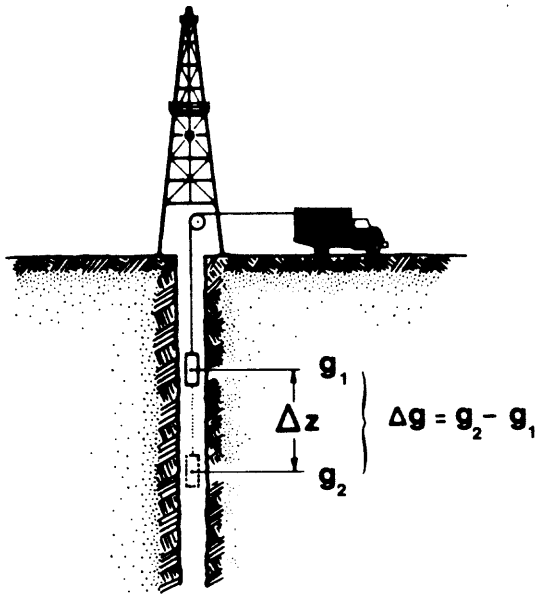
Tucci, P., Schmoker, J. W., and Robbins, S. L., 1983, Density of basin-fill deposits calculated from borehole gravity data in four basins in central and southern Arizona: Expanded Abstracts with Biographies, 1983 Technical Program, Society of Exploration Geophysicists, 53rd Annual International Meeting, September 11-15, 1983, Las Vegas, Nevada, p. 28-31

Watts, E. V., 1948, Some aspects of high pressures in the D-7 zone of the Ventura Avenue field: Am. Inst. Mining Metal Engineers, Petroleum Development and Technology, Trans., v. 174, p. 191-205.

Williams, L. A., 1982, Lithology of the Monterey Formation (Miocene) in the San Joaquin Valley of California, in Williams, L. A. and Graham, S. A., eds., Monterey Formation and Associated Coarse Clastic Rocks, Central San Joaquin Basin, California: Pacific Section SEPM Guidebook, October 9, 1982, p. 17-35.

Woodring, W. P., and M. N. Bramlette, 1950, Geology and paleontology of the Santa Maria district, California: U.S. Geological Survey Professional Paper 222, 185 p.

Yerkes, R. F., Wagner, H. C., and Yenne, K. A., 1969, Petroleum development in the Santa Barbara Channel region, in Geology, Petroleum Development and Seismicity of the Santa Barbara Channel Region, California: U.S. Geol. Survey Prof. Paper 679-B, p. 13-27.



$$\Delta g/\Delta z = F - 4\pi k\rho + \Delta G_g + \Delta G_t + \Delta G_b$$

Figure 1. Schematic diagram showing measurement of gravity (Δg) and depth differences (Δz) in the borehole. The basic equation relates the borehole gravity measurements ($\Delta g/\Delta z$) to the lateral (interval) density of the formation ρ and to anomalous gravity effects ΔG_g due to lateral density variations in the area of the well. Corrections for gravitational effects due to the borehole (ΔG_b) and topography (ΔG_t) usually are not needed or can be easily calculated with high accuracy. F is the free-air vertical gradient, in effect a constant (Robbins, 1981), and k is the universal gravitational constant.

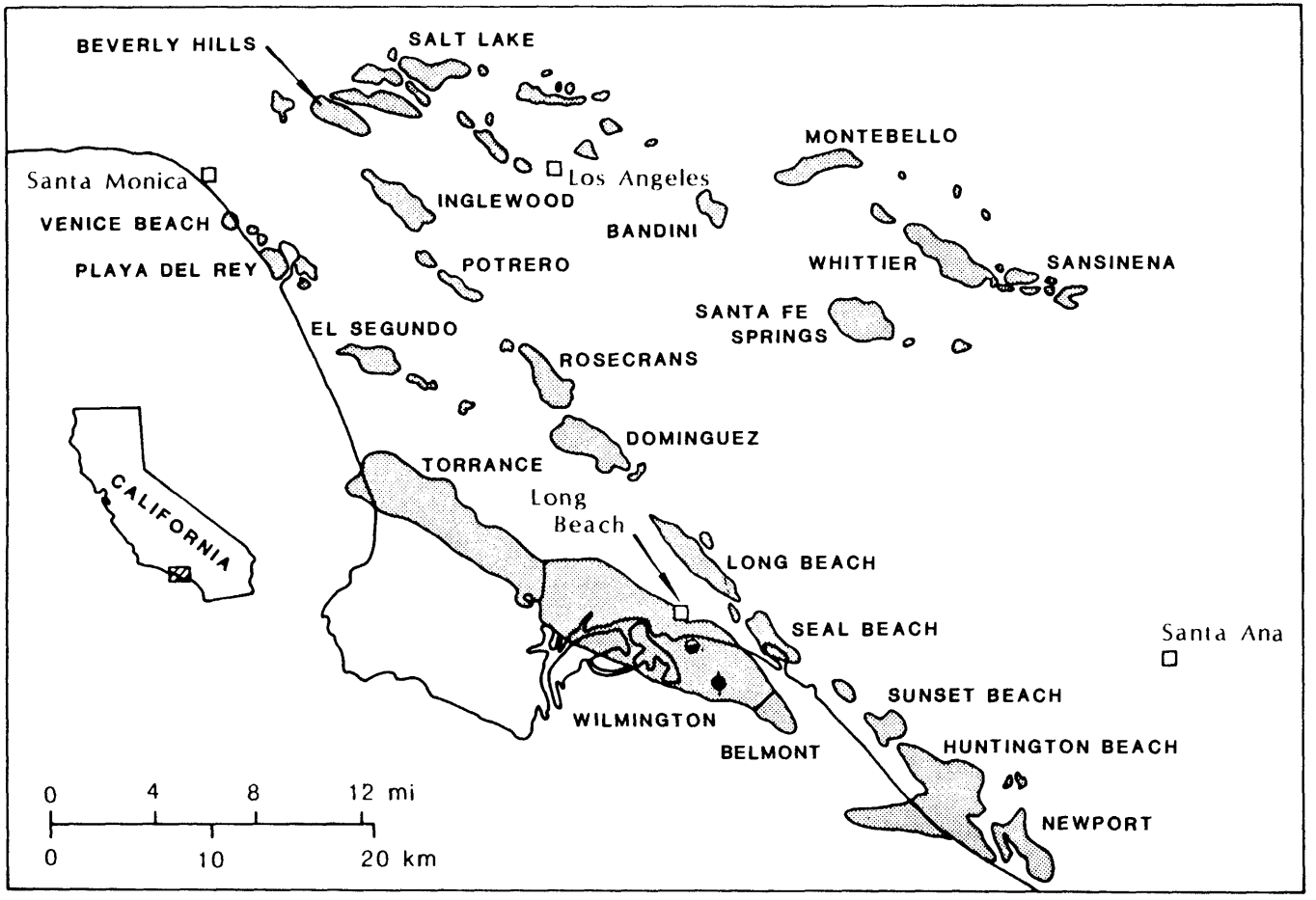


Figure 2. Index map of Los Angeles basin and vicinity showing locations of major oil fields, including the Wilmington oil field south of Long Beach.

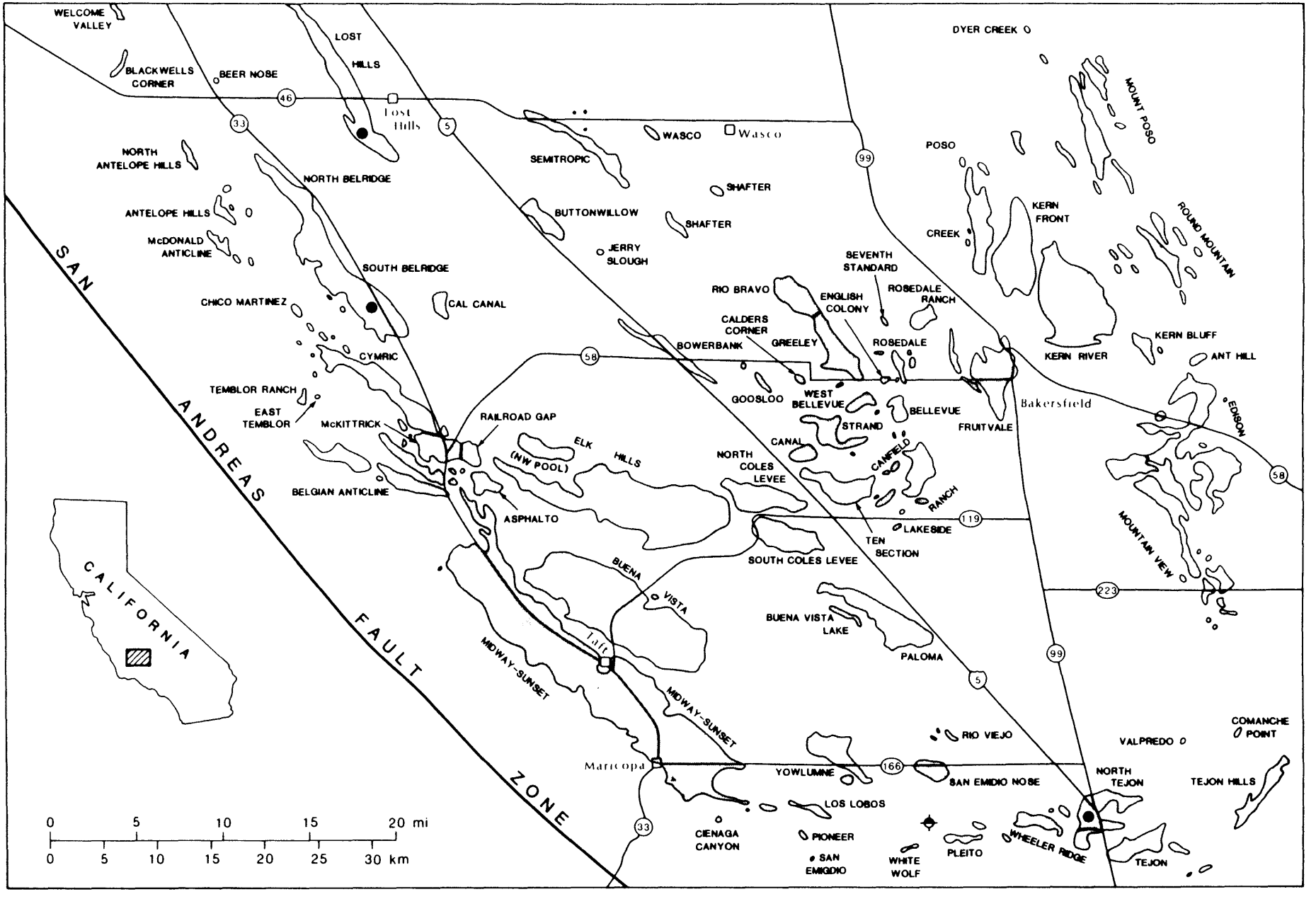


Figure 3. Index map of the southern San Joaquin Valley showing locations of major oil fields, including North Tejon, South Belridge and Lost Hills fields.

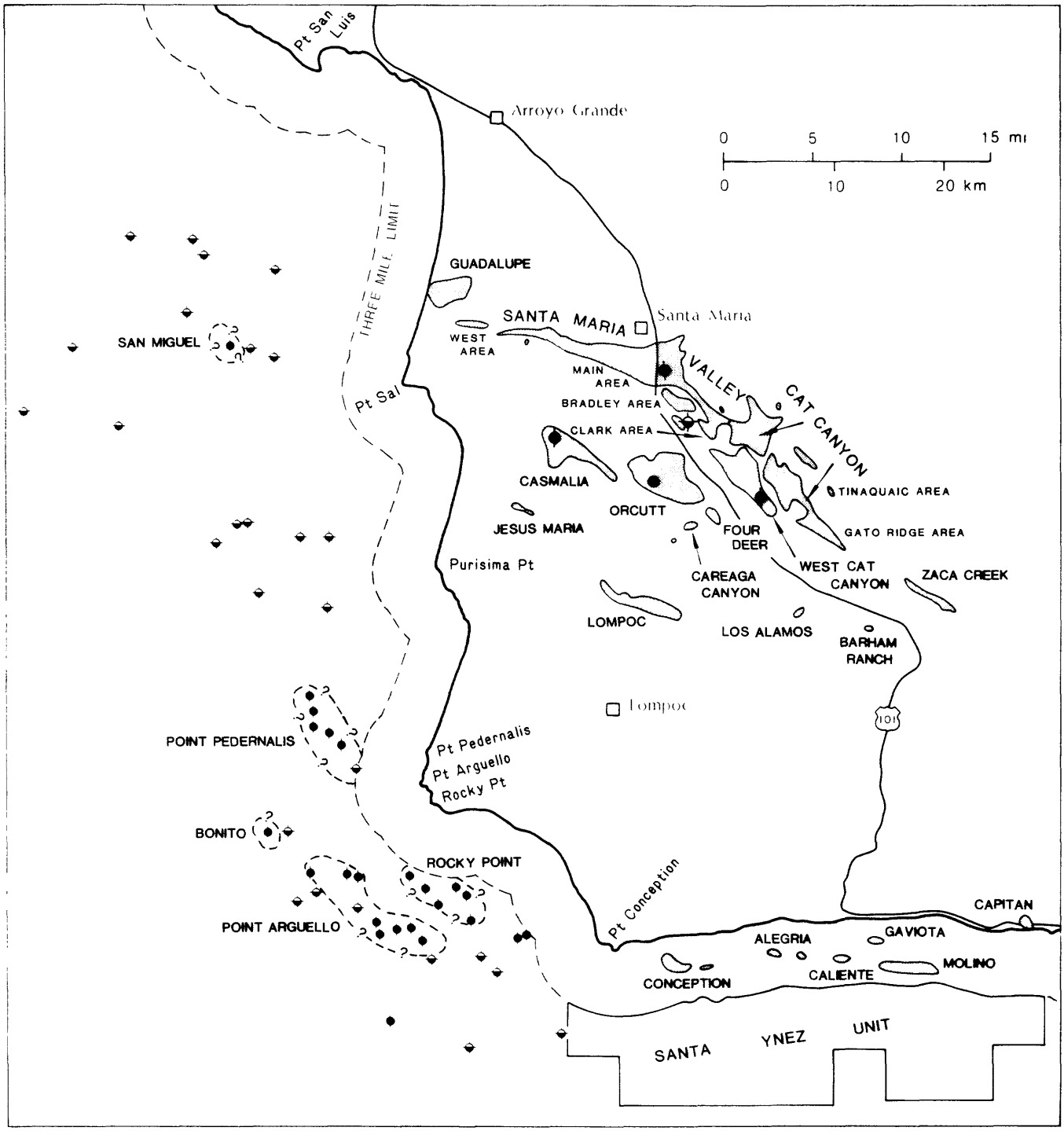


Figure 4. Index map of Santa Maria basin, adjacent offshore area, westernmost Tranverse Range Province, and northwest portion of Santa Barbara Channel. Onshore oil fields of Santa Maria basin, offshore exploratory drillholes and recently discovered fields north and west of Point Conception, and offshore fields of the northwestern Santa Barbara Channel are shown.

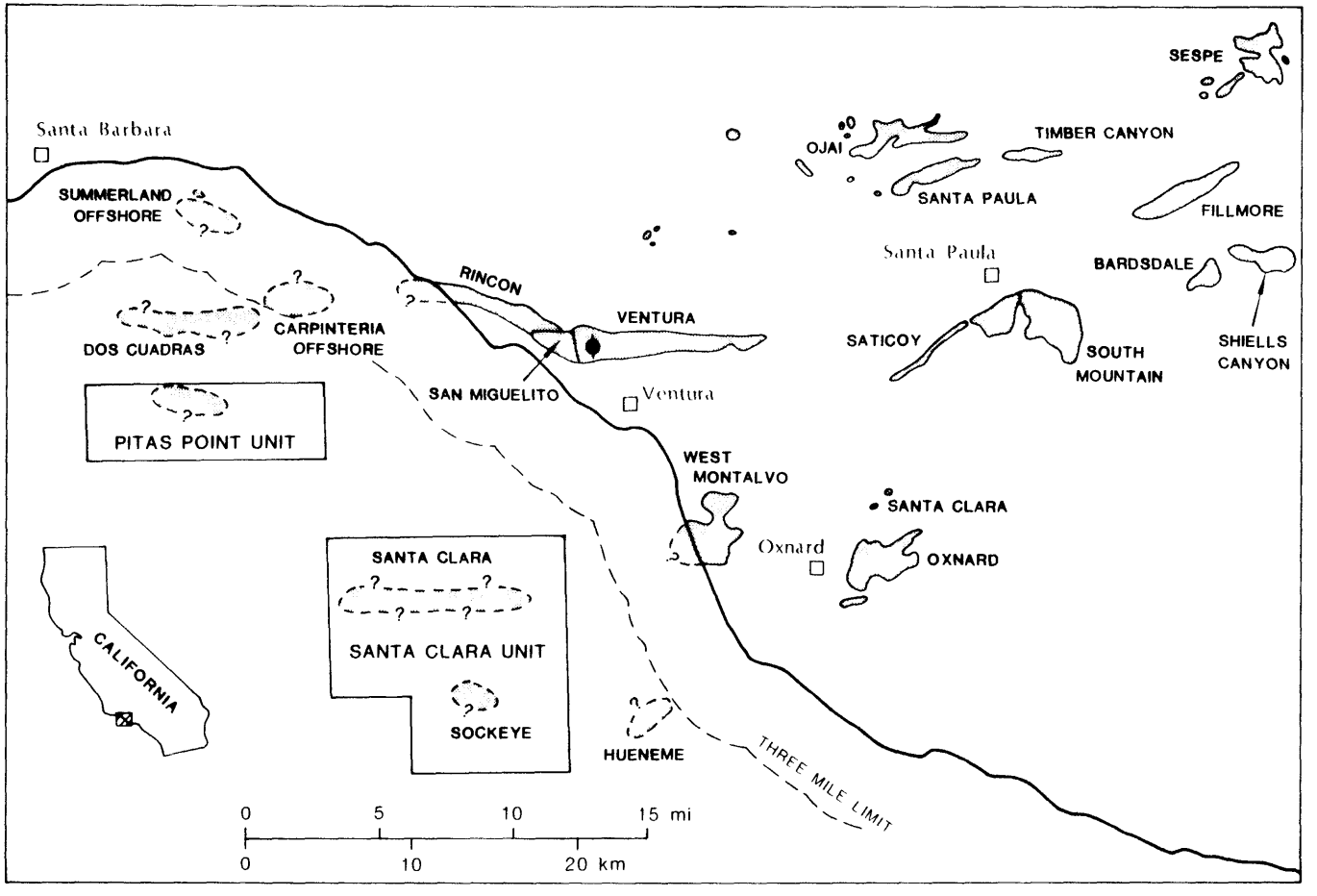


Figure 5. Index map of eastern Santa Barbara Channel and western Ventura Basin showing onshore oil fields (including Ventura oil field) and offshore oil fields and units.

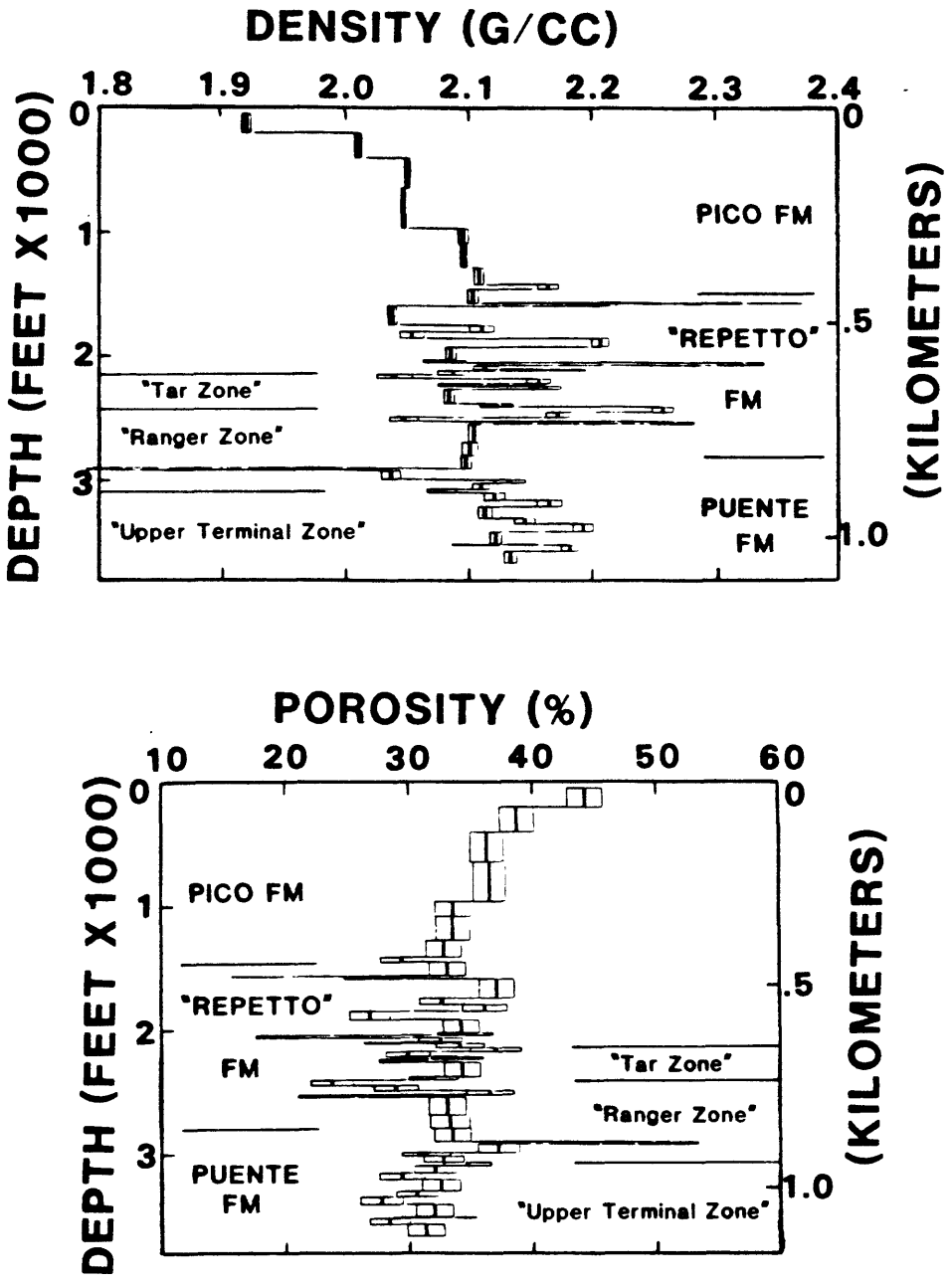


Figure 6. Interval density and porosity profiles calculated from borehole gravity survey in "Long Beach Unit" A860I.

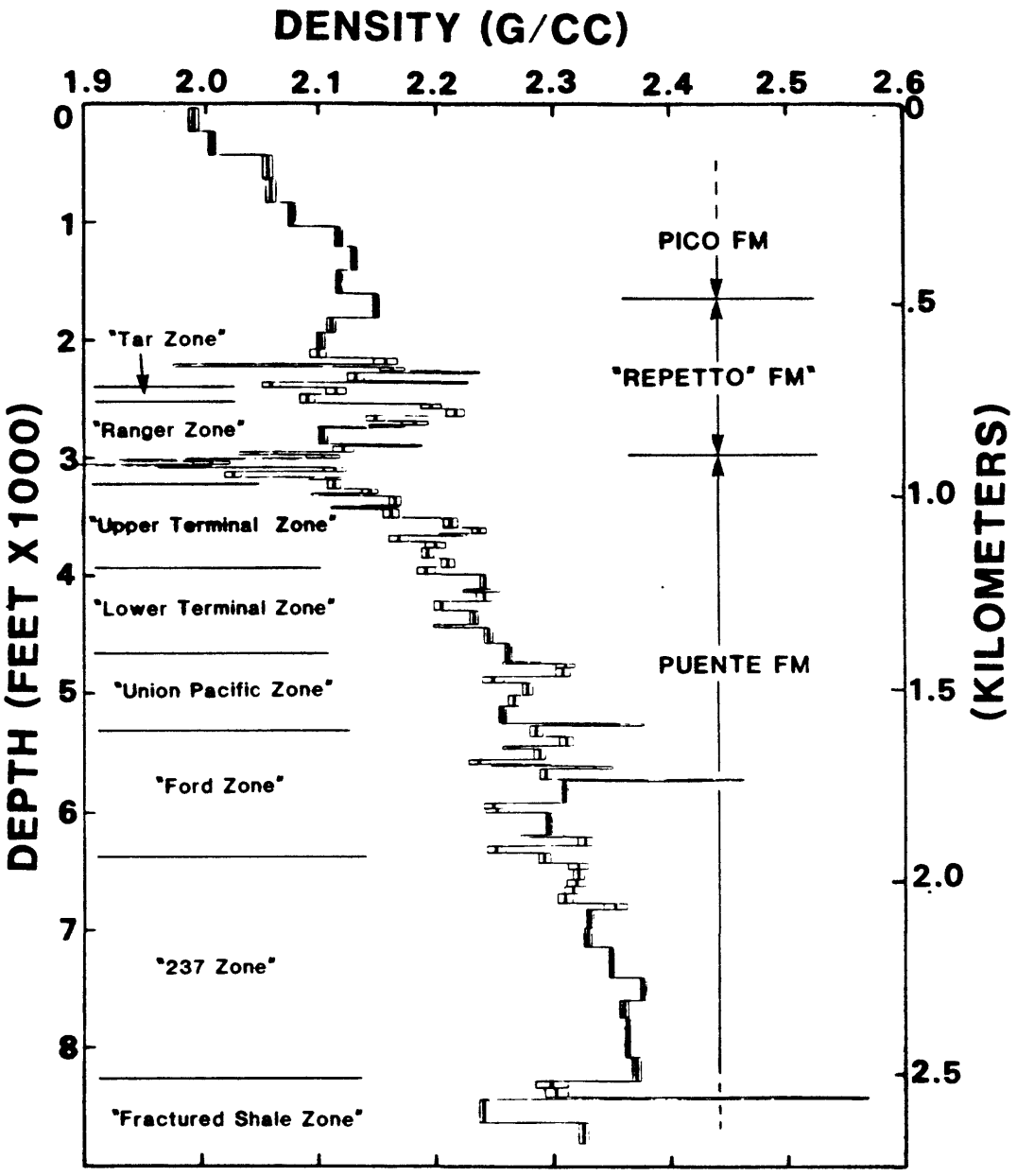


Figure 7. Interval density profile calculated from borehole gravity survey in "Long Beach Unit" D630.

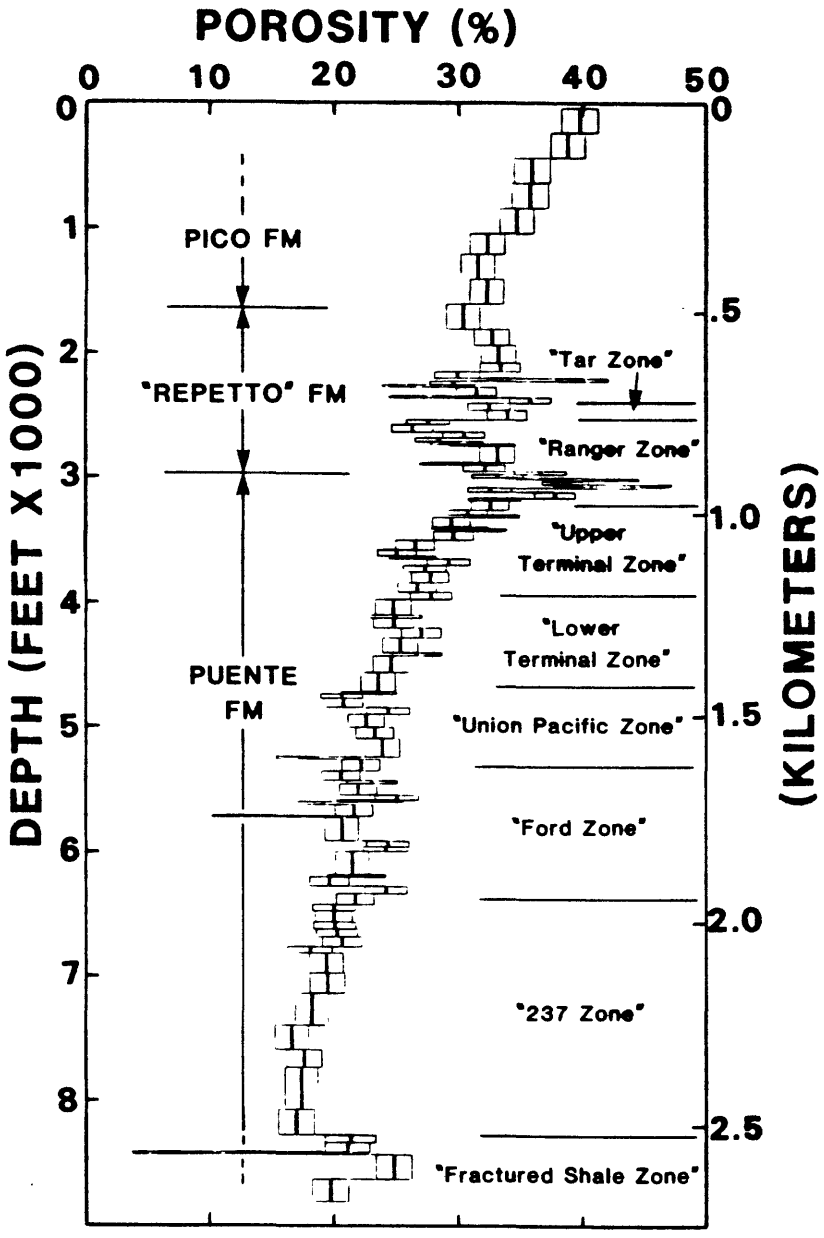


Figure 8. Interval porosity profile calculated from borehole gravity survey in "Long Beach Unit" D630.

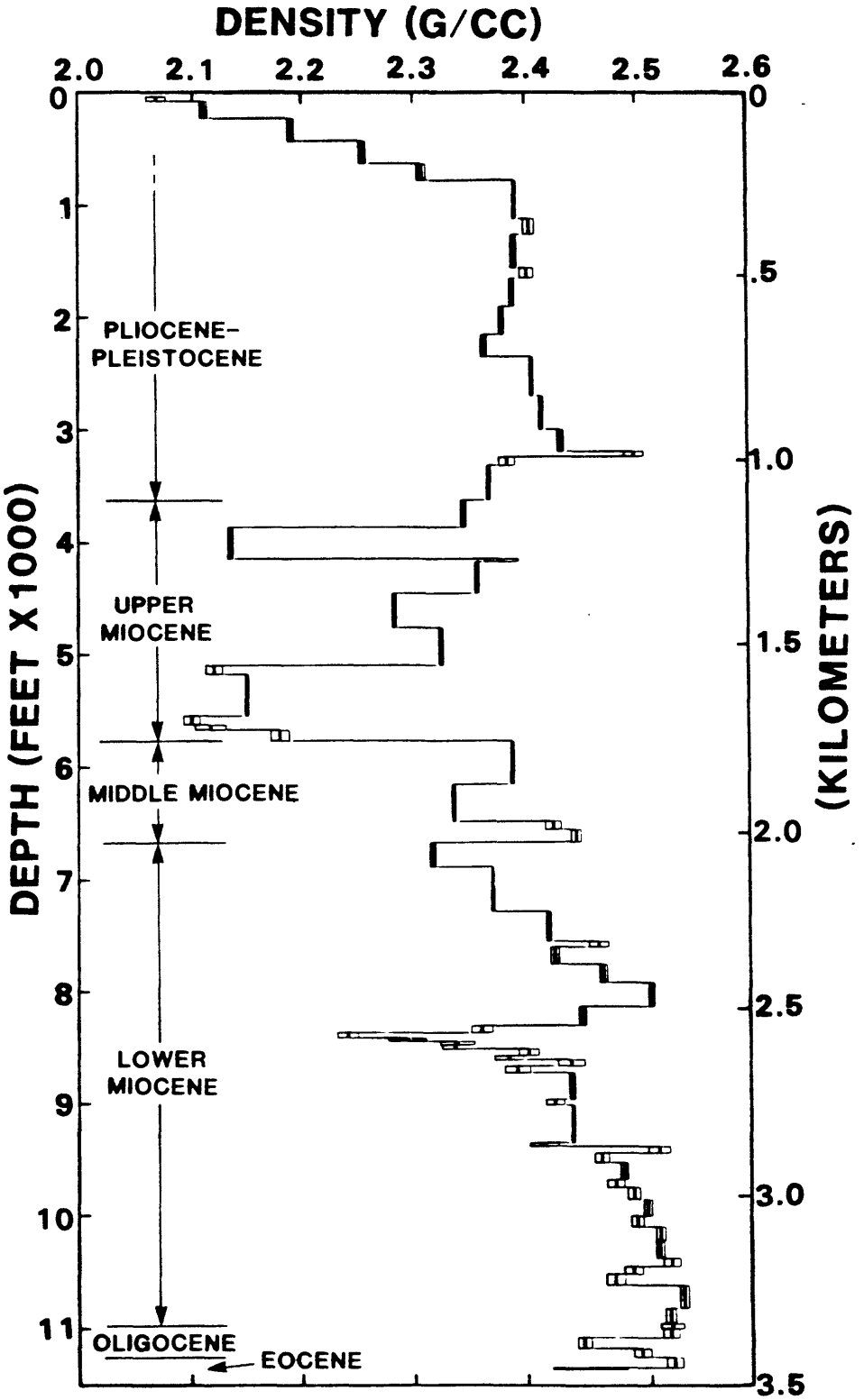


Figure 9. Interval density profile calculated from borehole gravity survey in "KCL-L" 45-25.

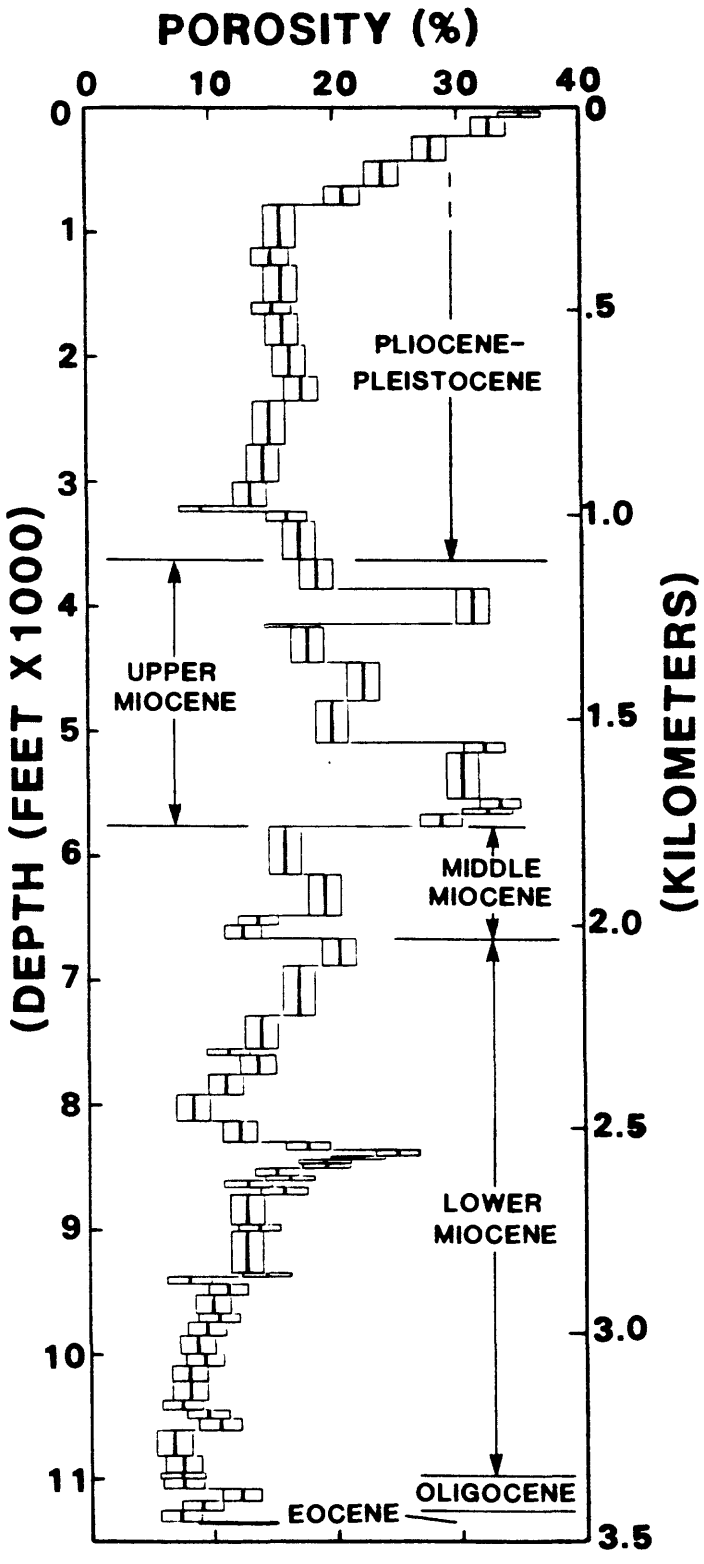


Figure 10. Interval porosity profile calculated from borehole gravity survey in "KCL-L" 45-25.

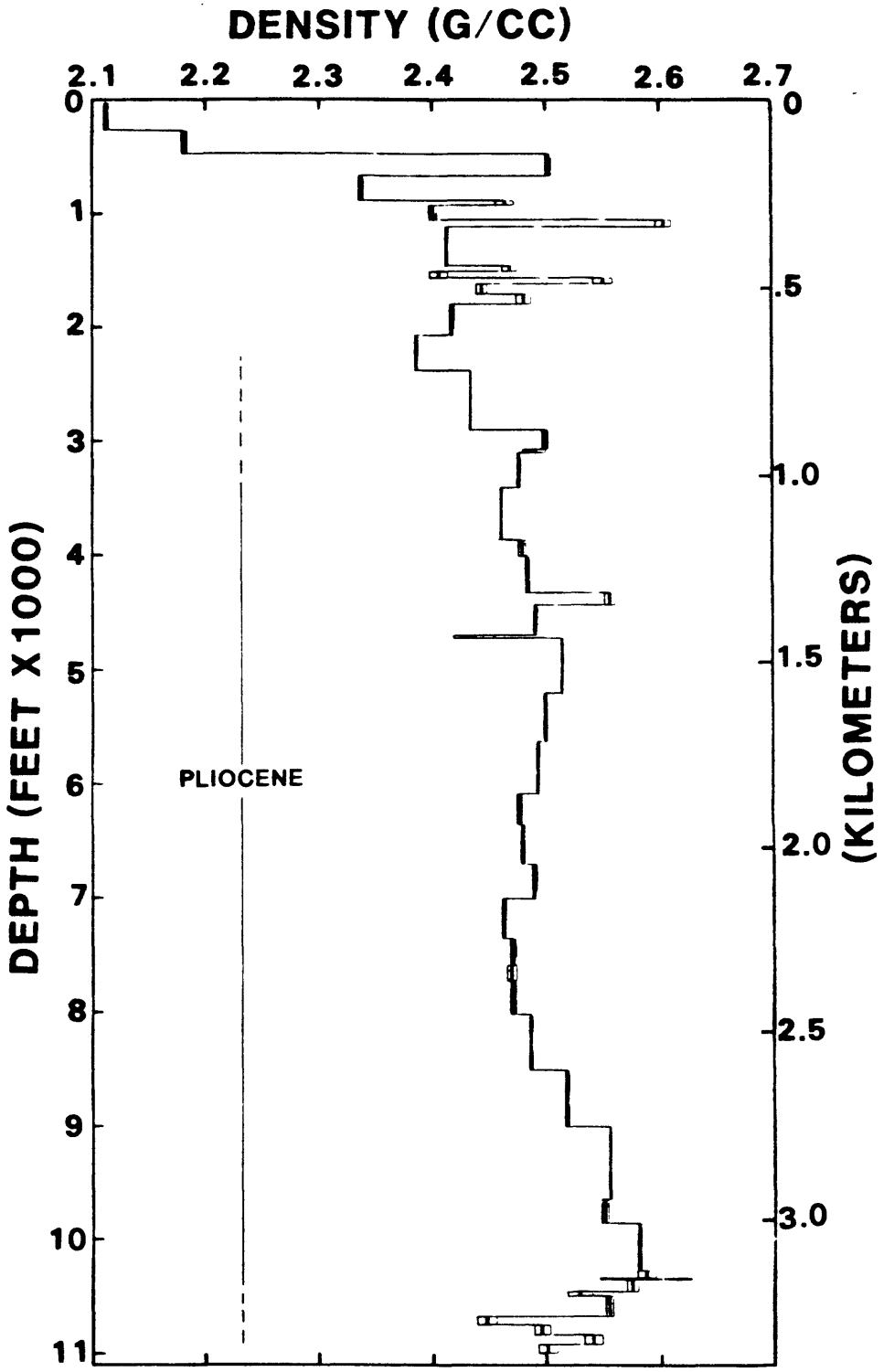


Figure 11. Interval density profile calculated from borehole gravity survey in "White Wolf Deep" 26x-28.

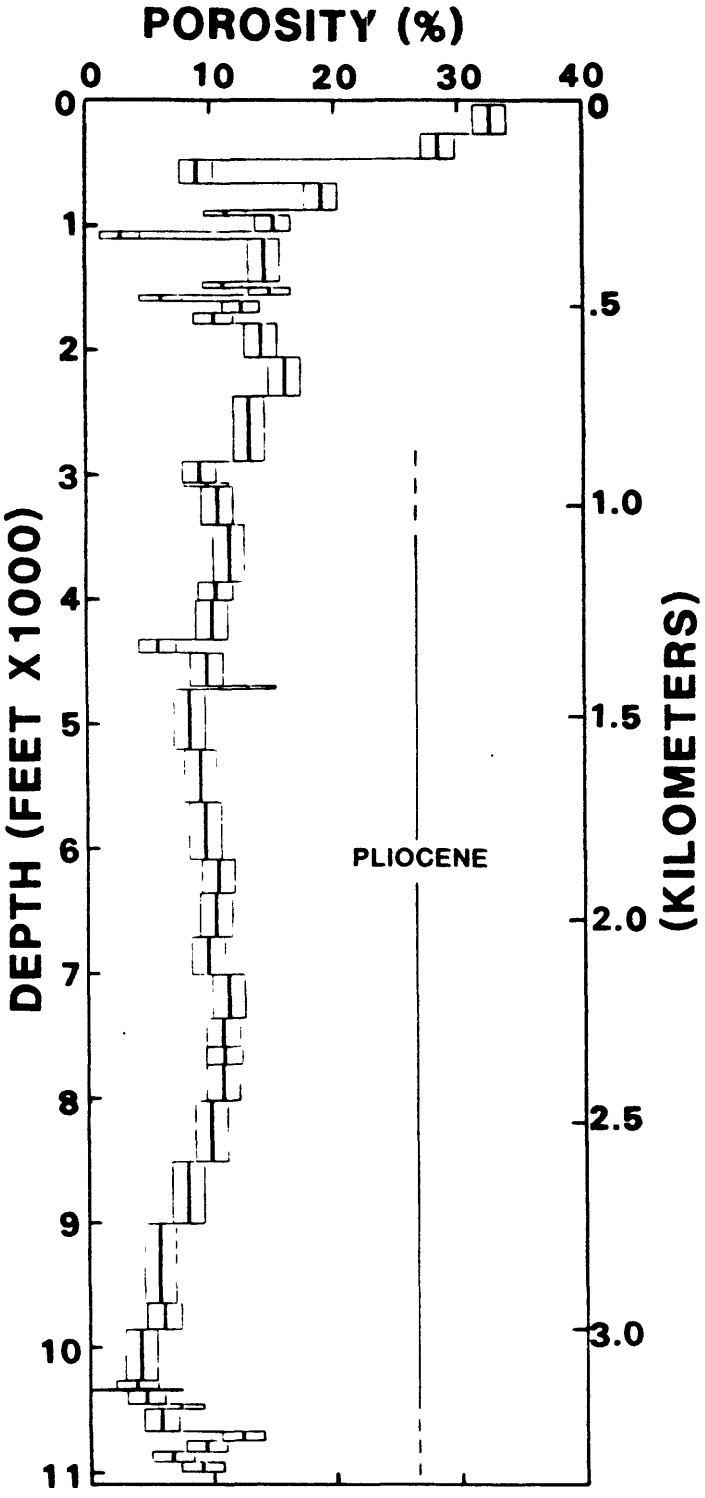


Figure 12. Interval porosity profile calculated from borehole gravity survey in "White Wolf Deep" 26x28.

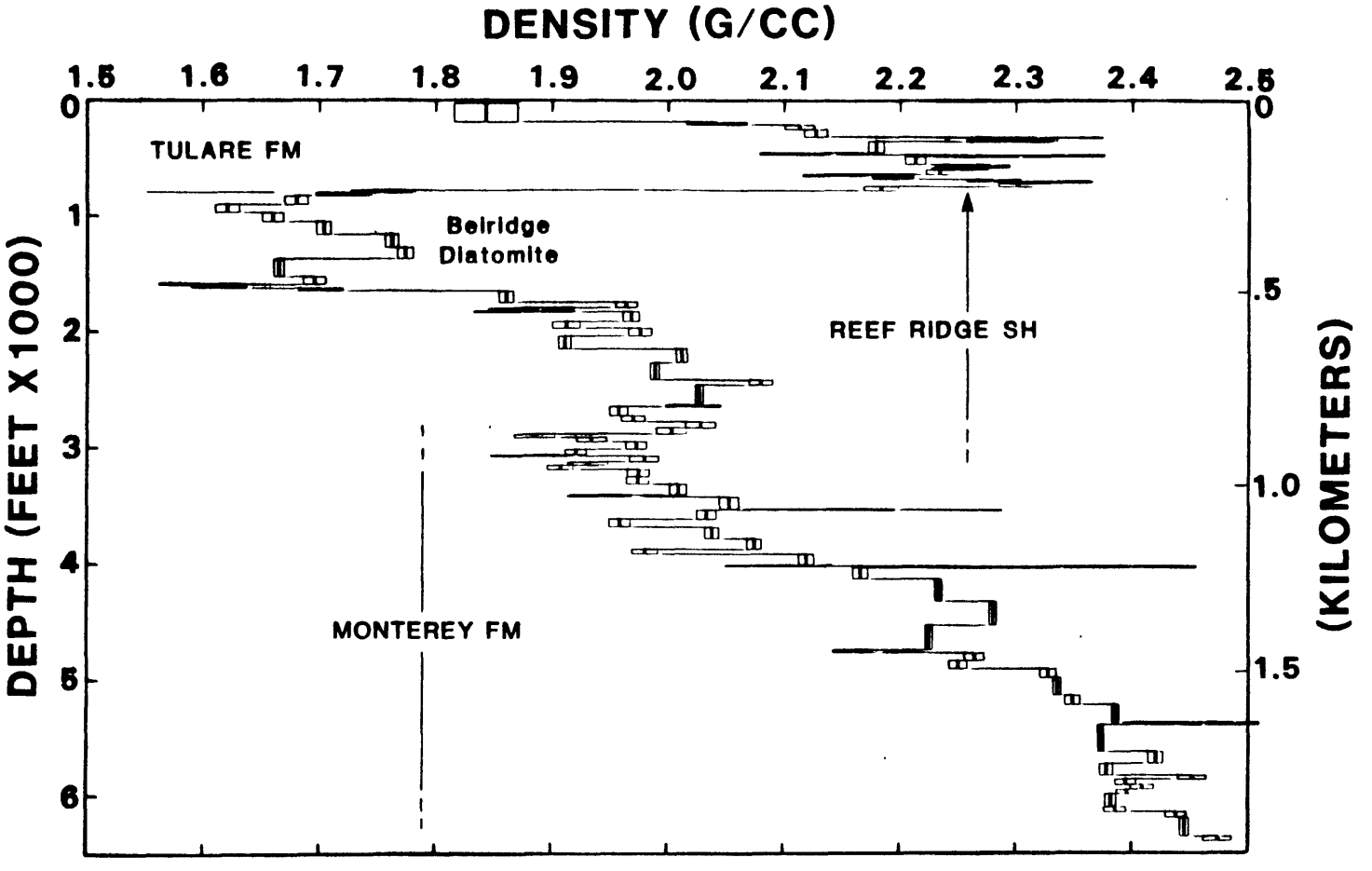


Figure 13. Interval density profile calculated from borehole gravity survey in "South Belridge" 548E-34.

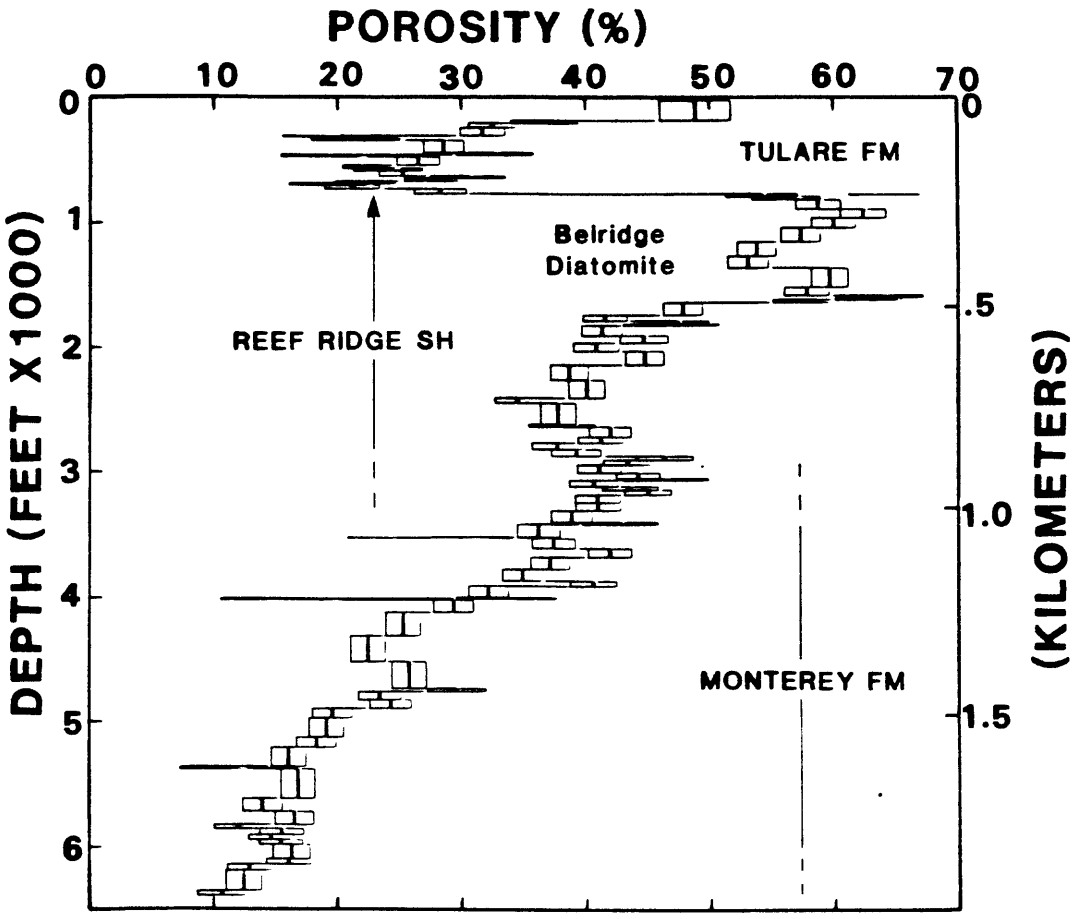


Figure 14. Interval porosity profile calculated from borehole gravity survey in "South Belridge" 548E-34

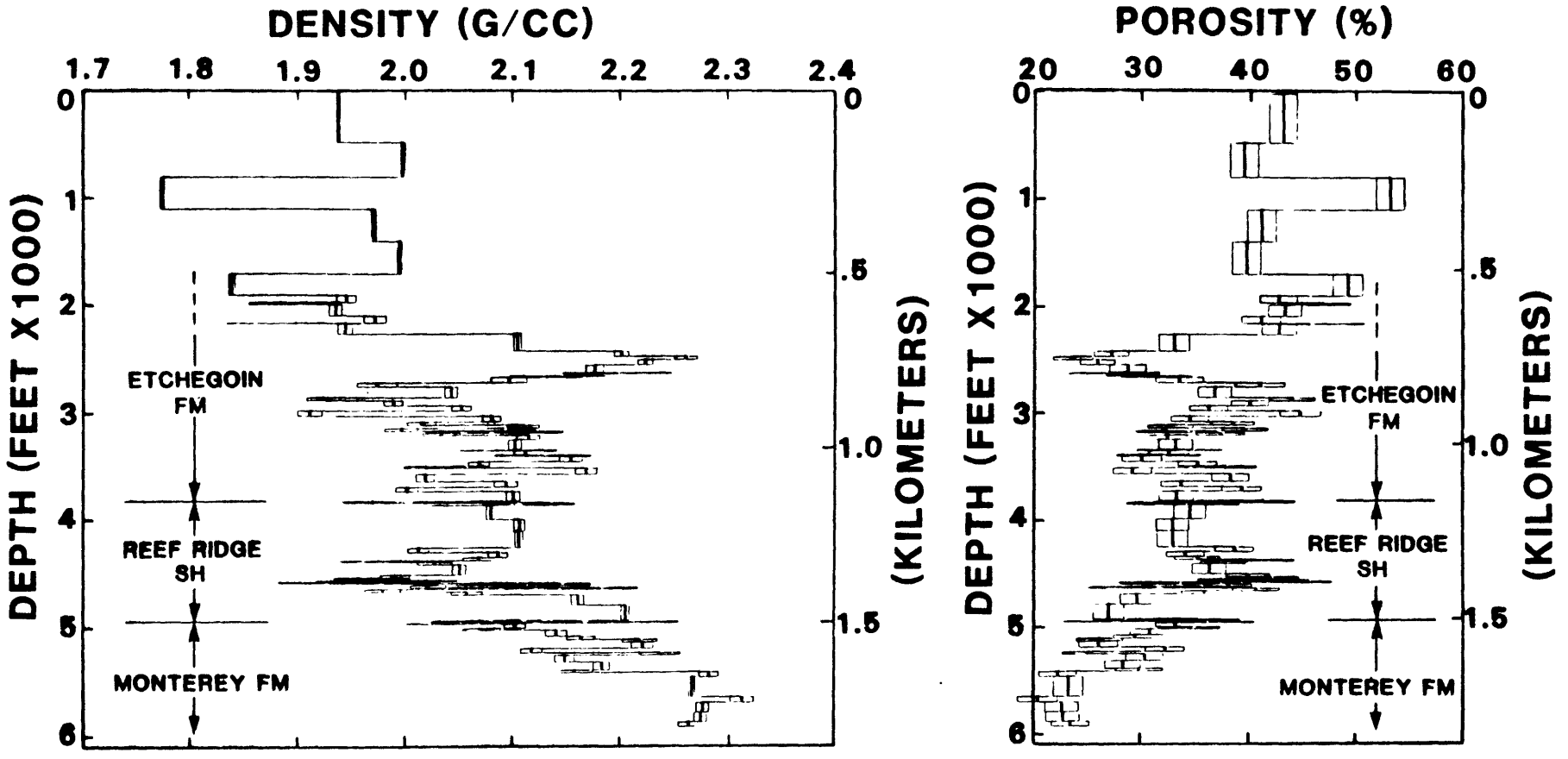


Figure 15. Interval density and porosity profiles calculated from borehole gravity survey in "Monte Cristo" 164.

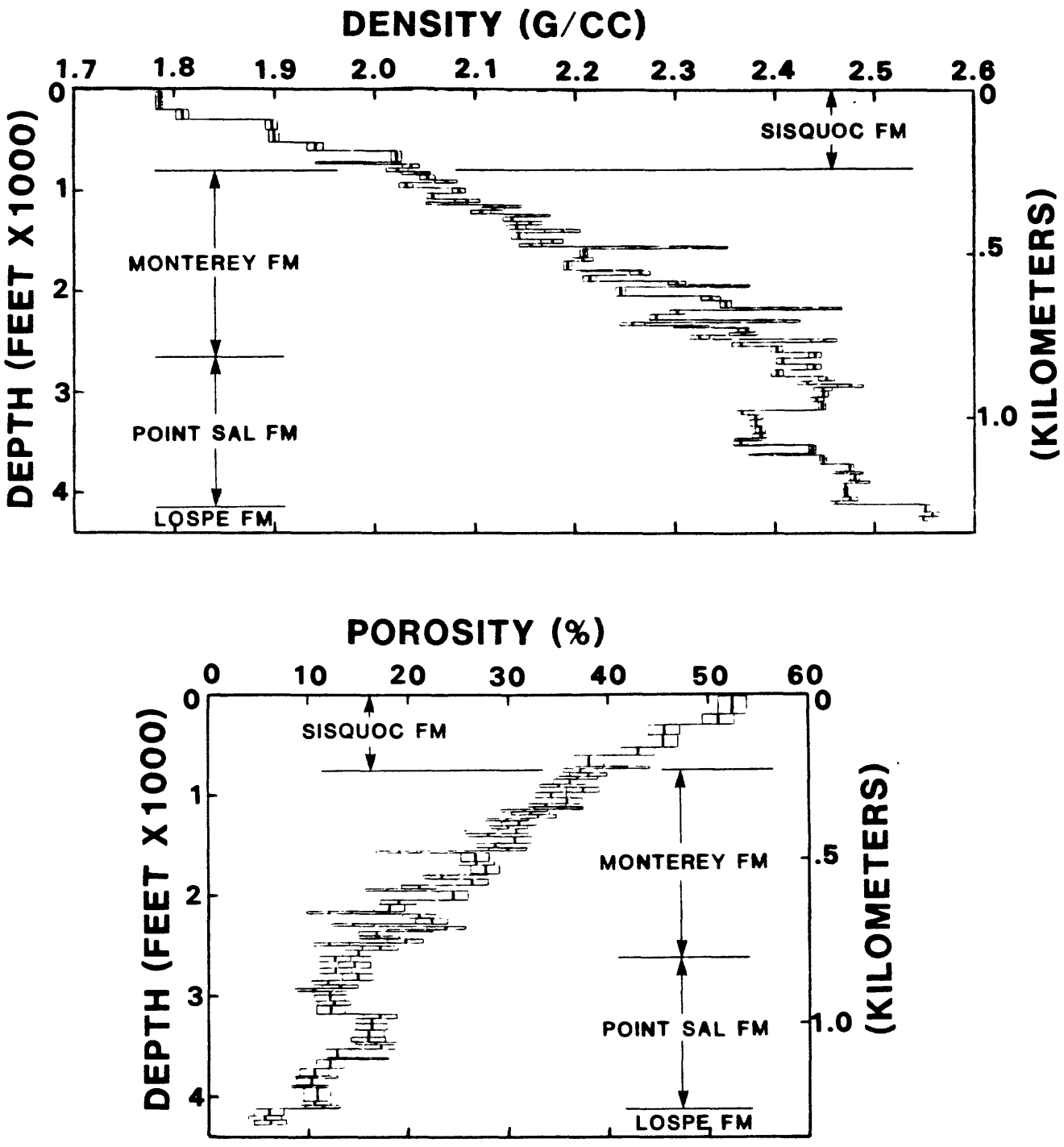


Figure 16. Interval density and porosity profiles calculated from borehole gravity survey in "Arellanes" 2.

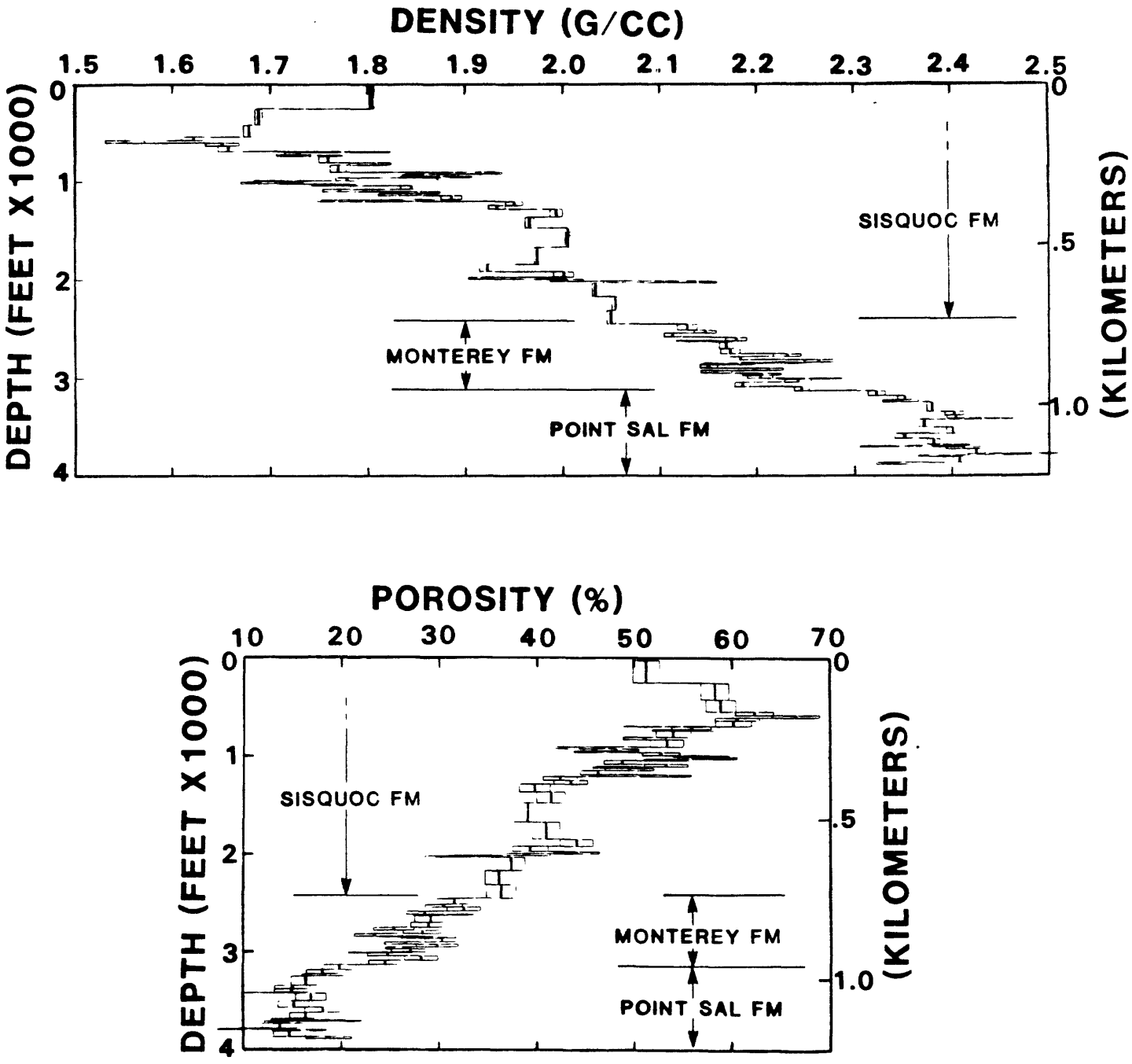


Figure 17. Interval density and porosity profiles calculated from borehole gravity survey in "Newlove" 108.

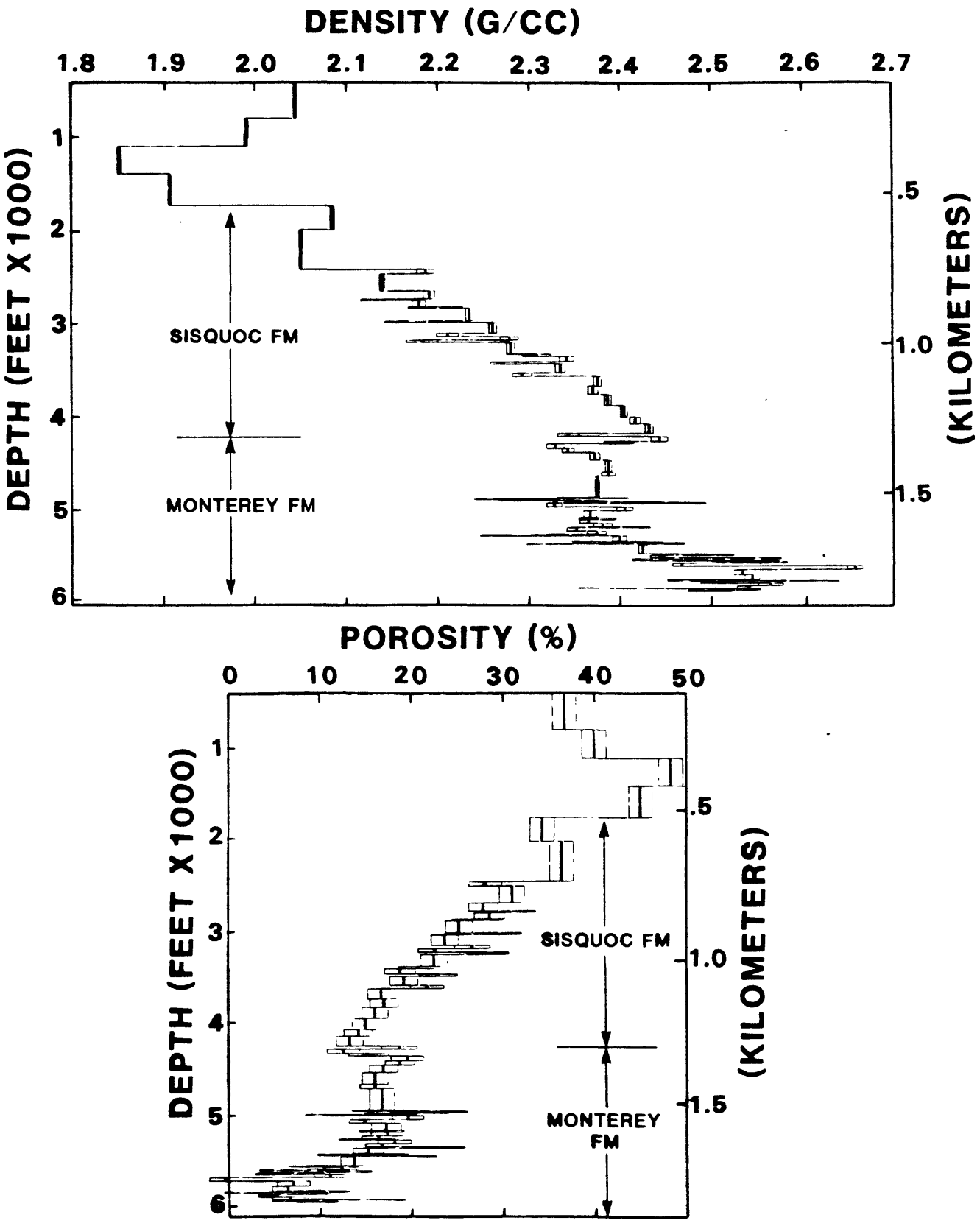


Figure 18. Interval density and porosity profiles calculated from borehole gravity survey in "Union Bell Fee" 156.

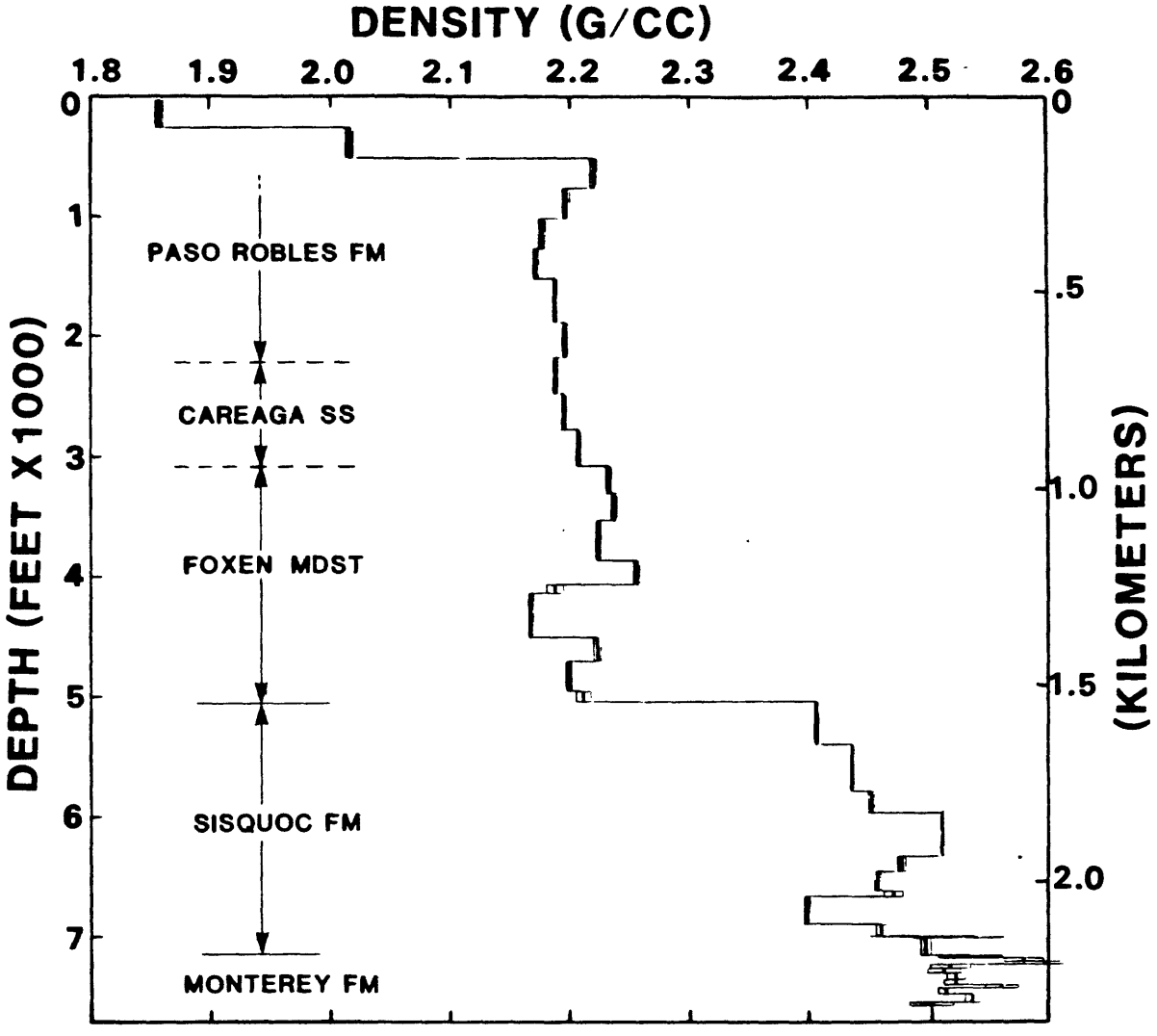


Figure 19. Interval density profile calculated from borehole gravity survey in "Morrison" 23-7.

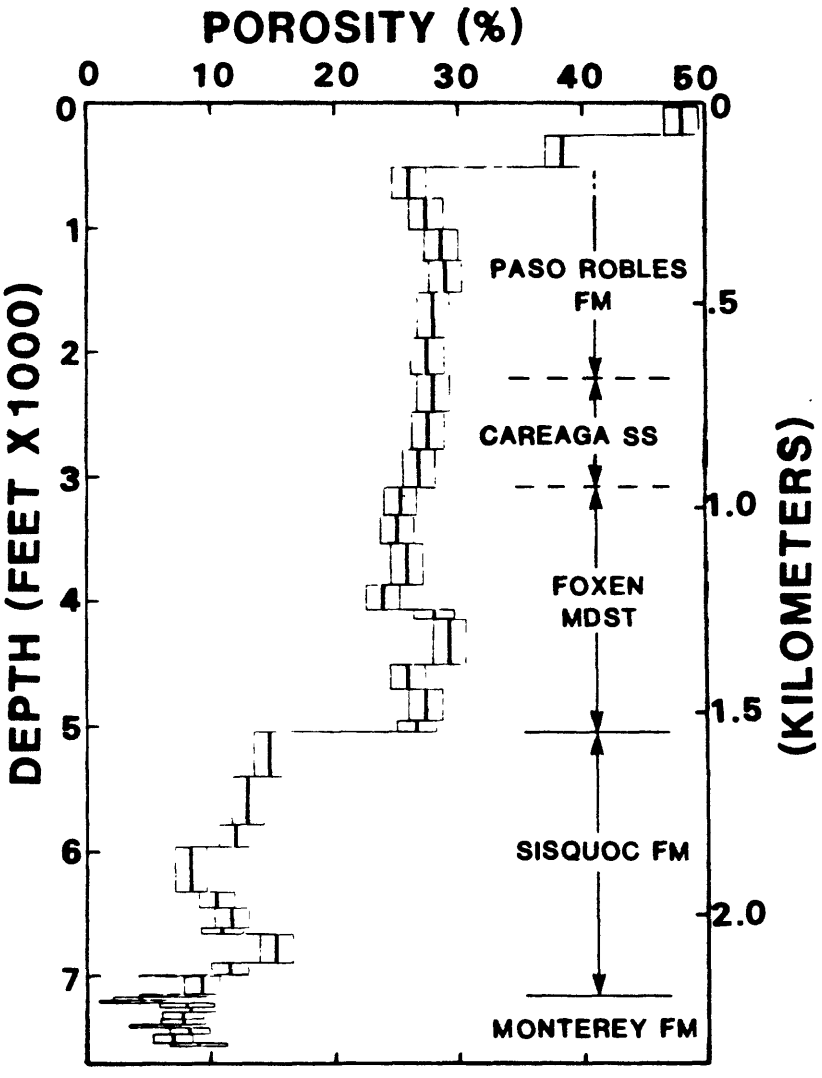


Figure 20. Interval porosity profile calculated from borehole gravity survey in "Morrison" 23-7.

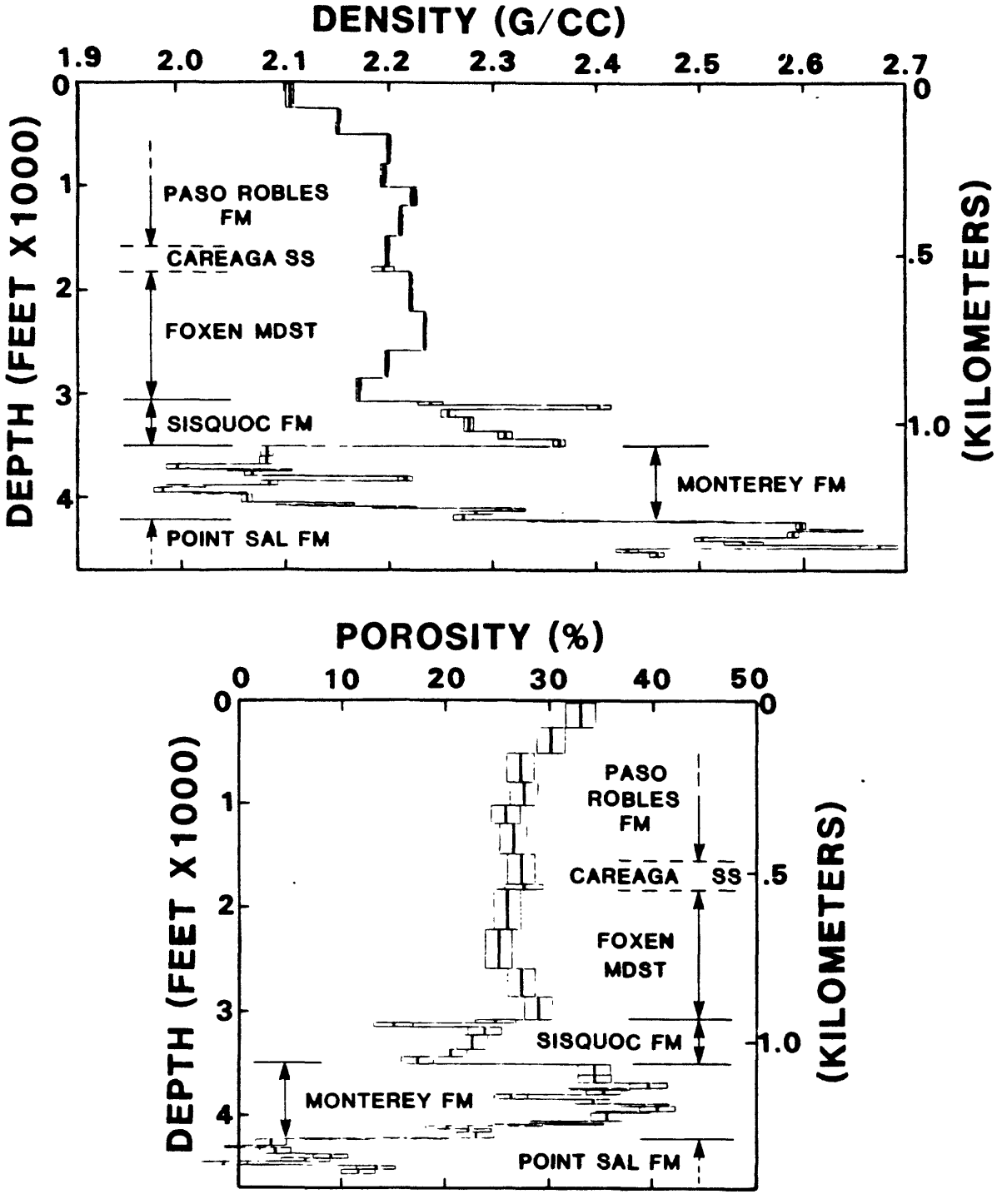


Figure 21. Interval density and porosity profiles calculated from borehole gravity survey in "Rosenblum," 6.

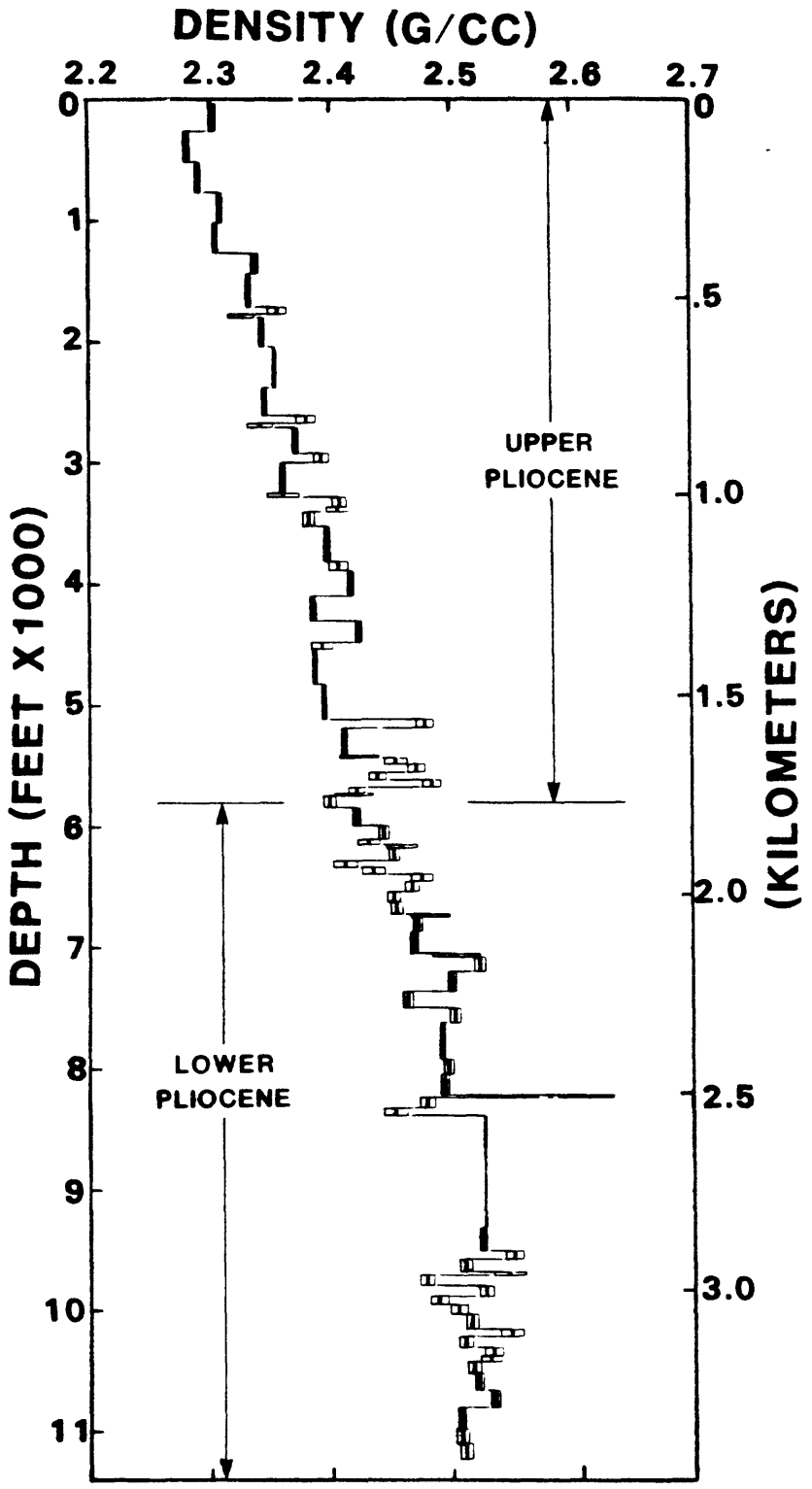


Figure 22. Interval density profile calculated from borehole gravity survey in "Taylor" 635.

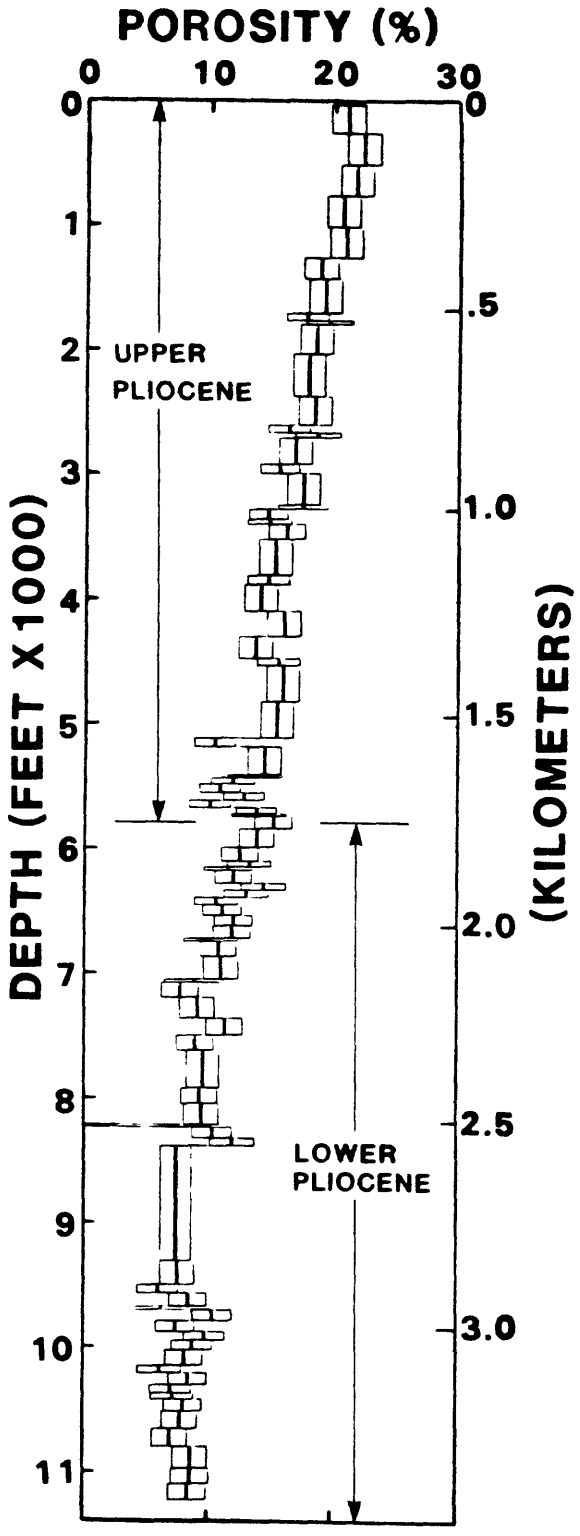


Figure 23. Interval porosity profile calculated from borehole gravity survey in "Taylor" 635.

Table 1. Operator, lease, number, location, date completed and total drilled depth of twelve wells in which borehole gravity surveys were made.

WELL OPERATOR	LEASE & WELL NUMBER	LOCATION	DATE WELL COMPLETED	TOTAL DEPTH DRILLED(FEET)
THUMS Long Beach Company	"Long Beach Unit" A860I	N 4 025 112', E 4 233 048', California coordinate system, zone 7, Grissom Island, Wilmington oil field, Los Angeles County, CA	November 1980	3,759
THUMS Long Beach Company	"Long Beach Unit" D630	N 4 018 564', E 4 238 903', California coordinate system, zone 7, Freeman Island, Wilmington oil field, Los Angeles County, CA	October 1968	9,048
Atlantic Richfield Company (originally Richfield Oil Co.)	"KCL-L" 45-25	approx. 1450' S from N line & 1140' E from W line, sec. 25, T. 11 N., R. 20 W.(S.B.B.& M.), North Tejon oil field, Kern County, CA	May 1961	11,621
Tenneco Oil Company	"White Wolf Deep" 26X-28	1565' N & 900' E from SW corner, sec. 28, T. 11 N., R. 21 E.(S.B.B.& M.), Los Padres oil field, Kern County, CA	November 1979	14,031
Shell California Production, Inc. (originally Kernridge Oil Co. 548E-34)	"South Belridge" 848E	409' N & 2040' E from SW corner, sec. 34, T. 28 S., R. 21 E.(M.D.B.& M.), South Belridge oil field, Kern County, CA	April 1980	8,750
Chevron USA, Inc.	"Monte Cristo" 164	2260' S & 1630' W from NE corner, sec. 16, T. 27 S., R. 21 E.(M.D.B.& M.), Lost Hills oil field, Kern County, CA	February 1981	6,348
Union Oil Company of California (originally Bell-Casmite Oil Co.)	"Arellanes" 2	approx. 2700' from W line & 2580' from S line, sec. 13, T. 9 N., R. 35 W.(S.B.B.& M.), Casmalia oil field, Santa Barbara County, CA	March 1946	5,950
Union Oil Company of California	"Newlove" 108	820' N & 5446' E from SW corner of Newlove lease, sec. 36, T. 9 N., R. 34 W.(S.B.B.& M.), Orcutt oil field, Santa Barbara County, CA	August 1980	3,975
Union Oil Company of California (originally Humble Oil & Refining Co.)	"Bell" 156 ("Union Bell Fee" 156)	approx. 70' from E line & 1390' from S line, sec. 35, T. 9 N., R. 33 W.(S.B.B.& M.), West Cat Canyon oil field, Santa Barbara County, CA	July 1971	6,000
Chevron USA, Inc.	"Morrison" 23-7	1850' E & 750' S from NW corner, sec. 7, T. 9 N., R. 33 W.(S.B.B.& M.), Santa Maria oil field, Santa Barbara County, CA	September 1979	8,426
Union Oil Company of California (originally Hancock-Bush Oil Co.)	"Rosenblum" 6	approx. 3690' from E line & 3750' from S line, sec. 25, T. 10 N., R. 34 W.(S.B.B.& M.), Santa Maria oil field, Santa Barbara County, CA	June 1944	4,674
Shell California Production, Inc. (originally Shell Oil Co.)	"Taylor" 635	approx. 1090' from E line & 2110' from N line, sec. 30, T. 3 N., R. 23 W.(S.B.B.& M.), Ventura oil field, Ventura County, CA	January 1969	13,450

Table 2. Investigative radial distances selected to encompass 90% of the effects for gamma-gamma, neutron, and acoustical type logs, and borehole gravity survey with corresponding formation volumes over a 10-foot (3.05 m) vertical interval. Borehole radius is assumed to be 6 in (16.2 cm) and gamma-gamma, neutron, and acoustical logs are assumed to investigate one-half of the circular annulus around the borehole. Conventional 5.25 in core is included for comparison. Investigative radii of gamma-gamma, neutron, and acoustical logs, chosen very liberally, are from Sherman and Locke (1975), Antkiw (1976), Jageler (1976) and Baker (1981).

Logging Method	Radial Investigated Distance for 90% Effect in (cm)	Formation Volume Investigated ft^3 (m^3)
Conventional 5.25 in (13 cm) core	2.6 (6.6)	1.5 (.04)
Gamma-gamma log (FDC)	8 (20)	17 (0.5)
Neutron log	14 (36)	40 (1.1)
Sonic log	18 (46)	59 (1.7)
Borehole gravity survey	50 ft (15 m)	78,532 (2,224)

Table 3. Basic data from borehole gravity survey in "Long Beach Unit" A860I (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: THUMS LONG BEACH COMPANY LONG BEACH UNIT A860I
LOCATION: 7-5S-12W GRISSOM ISLAND WILMINGTON OIL FIELD LOS ANGELES COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	-1.1	45.6	.637	.000	.002	6.950	.008	154.40	.15	.04501	.094071	1.919	.004	2.65	.02	1.00	.02	44.3	1.4	1
2	-155.5	200.0	.557	6.950	.003	8.538	.008	200.00	.15	.04269	.094073	2.010	.003	2.65	.02	1.00	.02	38.8	1.4	2
3	-355.5	400.0	.460	15.488	.002	10.000	.008	240.00	.15	.04167	.094075	2.051	.002	2.65	.02	1.00	.02	36.3	1.4	3
4	-595.5	640.0	.386	25.488	.003	13.364	.008	320.00	.15	.04176	.094079	2.047	.002	2.65	.02	1.00	.02	36.5	1.3	4
5	-915.5	960.0	.325	38.852	.002	4.863	.007	120.00	.15	.04053	.094083	2.096	.004	2.65	.02	1.00	.02	33.6	1.5	5
6	-1035.5	1080.0	.306	43.715	.002	7.900	.008	195.00	.15	.04051	.094084	2.096	.003	2.65	.02	1.00	.02	33.6	1.4	6
7	-1230.5	1275.0	.277	51.615	.003	5.427	.008	135.00	.15	.04020	.094087	2.108	.004	2.65	.02	1.00	.02	32.8	1.5	7
8	-1365.5	1410.0	.257	57.042	.002	1.537	.007	39.65	.05	.03876	.094089	2.165	.009	2.65	.02	1.00	.02	29.4	1.7	8
9	-1405.1	1449.7	.252	58.579	.002	4.470	.007	110.85	.15	.04032	.094089	2.104	.005	2.65	.02	1.00	.02	33.1	1.5	9
10	-1516.0	1560.5	.236	63.049	.002	.243	.007	7.00	.05	.03472	.094091	2.323	.049	2.65	.02	1.00	.02	19.8	4.2	10
11	-1523.0	1567.5	.235	63.292	.002	.662	.007	17.50	.05	.03703	.094091	2.201	.020	2.65	.02	1.00	.02	27.2	2.4	11
12	-1540.5	1585.0	.232	63.954	.002	6.553	.008	156.00	.15	.04201	.094091	2.038	.004	2.65	.02	1.00	.02	37.1	1.4	12
13	-1696.5	1741.0	.209	70.507	.003	2.168	.008	54.00	.15	.04015	.094093	2.111	.010	2.65	.02	1.00	.02	32.7	1.8	13
14	-1750.5	1795.0	.201	72.575	.002	2.122	.007	51.00	.15	.04161	.094094	2.054	.010	2.65	.02	1.00	.02	36.1	1.8	14
15	-1801.5	1846.0	.193	74.797	.002	2.640	.007	70.05	.15	.03769	.094095	2.207	.007	2.65	.02	1.00	.02	26.8	1.6	15
16	-1871.5	1916.1	.182	77.437	.002	4.404	.006	107.95	.15	.04480	.094096	2.085	.004	2.65	.02	1.00	.02	34.2	1.5	16
17	-1979.5	2024.0	.165	81.841	.001	.818	.007	19.99	.05	.04092	.094097	2.081	.018	2.65	.02	1.00	.02	34.5	2.3	17
18	-1999.5	2044.0	.162	82.659	.003	.697	.008	20.04	.05	.03478	.094097	2.321	.019	2.65	.02	1.00	.02	19.9	2.4	18
19	-2019.5	2064.0	.159	83.356	.002	1.427	.007	35.60	.05	.04009	.094098	2.113	.010	2.65	.02	1.00	.02	32.5	1.8	19
20	-2055.1	2099.6	.153	84.783	.002	.388	.007	9.98	.05	.03887	.094098	2.161	.035	2.65	.02	1.00	.02	29.7	3.3	20
21	-2065.1	2109.6	.152	85.171	.002	1.361	.009	33.40	.05	.04075	.094098	2.087	.013	2.65	.02	1.00	.02	34.1	2.0	21
22	-2098.5	2143.0	.146	86.532	.004	1.343	.010	32.00	.05	.04197	.094099	2.040	.015	2.65	.02	1.00	.02	37.0	2.1	22
23	-2130.5	2175.0	.141	87.875	.003	1.520	.008	39.00	.05	.03897	.094099	2.157	.010	2.65	.02	1.00	.02	29.9	1.8	23
24	-2169.5	2214.0	.135	89.395	.002	.834	.006	20.50	.05	.04068	.094100	2.090	.015	2.65	.02	1.00	.02	33.9	2.1	24
25	-2190.0	2234.5	.132	90.229	.001	.952	.006	24.52	.05	.03882	.094100	2.163	.013	2.65	.02	1.00	.02	29.5	2.0	25
26	-2214.5	2259.0	.128	91.181	.002	4.777	.007	116.98	.15	.04084	.094100	2.084	.004	2.65	.02	1.00	.02	34.3	1.5	26
27	-2331.5	2376.0	.108	95.958	.002	1.034	.007	25.95	.05	.03985	.094102	2.123	.014	2.65	.02	1.00	.02	31.9	2.0	27
28	-2357.4	2402.0	.104	96.992	.002	1.566	.008	43.02	.05	.03640	.094102	2.258	.009	2.65	.02	1.00	.02	23.8	1.8	28
29	-2400.5	2445.0	.097	98.558	.003	1.658	.009	42.98	.05	.03858	.094103	2.173	.010	2.65	.02	1.00	.02	28.9	1.8	29
30	-2443.4	2488.0	.089	100.216	.003	1.379	.008	33.00	.05	.04179	.094103	2.047	.012	2.65	.02	1.00	.02	36.5	1.9	30
31	-2476.4	2521.0	.084	101.595	.002	.688	.007	19.00	.05	.03621	.094104	2.265	.018	2.65	.02	1.00	.02	23.3	2.3	31
32	-2495.4	2540.0	.081	102.283	.002	5.888	.012	146.00	.15	.04033	.094104	2.104	.005	2.65	.02	1.00	.02	33.1	1.5	32
33	-2641.4	2686.0	.055	108.171	.007	4.365	.012	108.30	.15	.04042	.094106	2.101	.007	2.65	.02	1.00	.02	33.3	1.6	33
34	-2749.4	2794.0	.036	112.536	.002	4.252	.006	105.00	.15	.04049	.094107	2.098	.004	2.65	.02	1.00	.02	33.5	1.5	34
35	-2854.4	2899.0	.018	116.788	.001	.861	.007	18.00	.05	.04784	.094109	1.811	.020	2.65	.02	1.00	.02	50.9	2.4	35
36	-2872.4	2917.0	.014	117.649	.003	2.987	.008	71.02	.15	.04206	.094109	2.037	.008	2.65	.02	1.00	.02	37.2	1.7	36
37	-2943.5	2988.0	.002	120.636	.002	1.068	.007	26.98	.05	.03958	.094110	2.133	.013	2.65	.02	1.00	.02	31.3	2.0	37
38	-2970.4	3015.0	-.003	121.704	.002	1.970	.007	49.02	.05	.04019	.094110	2.110	.007	2.65	.02	1.00	.02	32.7	1.6	38
39	-3019.5	3064.0	-.012	123.674	.002	1.188	.007	28.98	.05	.04099	.094111	2.078	.012	2.65	.02	1.00	.02	34.7	2.0	39
40	-3048.4	3093.0	-.018	124.962	.002	2.356	.007	59.04	.15	.03990	.094111	2.121	.009	2.65	.02	1.00	.02	32.1	1.7	40
41	-3107.5	3152.0	-.028	127.218	.002	2.015	.008	51.98	.15	.03877	.094112	2.166	.010	2.65	.02	1.00	.02	29.4	1.8	41
42	-3159.5	3204.0	-.038	129.233	.003	3.729	.008	92.98	.15	.04011	.094113	2.113	.006	2.65	.02	1.00	.02	32.5	1.6	42
43	-3252.4	3297.0	-.055	132.962	.002	1.768	.008	45.00	.05	.03929	.094114	2.145	.009	2.65	.02	1.00	.02	33.6	1.7	43
44	-3297.4	3342.0	-.064	134.730	.003	2.437	.008	64.00	.15	.03808	.094115	2.193	.008	2.65	.02	1.00	.02	27.7	1.7	44
45	-3361.4	3406.0	-.076	137.167	.002	3.989	.007	100.00	.15	.03999	.094116	2.122	.005	2.65	.02	1.00	.02	32.0	1.5	45
46	-3461.4	3506.0	-.095	141.156	.002	.399	.007	10.00	.05	.03990	.094117	2.121	.035	2.65	.02	1.00	.02	32.0	3.3	46
47	-3471.4	3516.0	-.097	141.555	.002	1.841	.007	48.00	.05	.03835	.094117	2.182	.007	2.65	.02	1.00	.02	28.4	1.7	47
48	-3519.4	3564.0	-.106	143.396	.002	3.761	.007	95.00	.15	.03959	.094118	2.134	.005	2.65	.02	1.00	.02	31.3	1.5	48
49	-3614.4	3659.0	-.124	147.157	.002															

Table 4. Basic data from borehole gravity survey in "Long Beach Unit" D630 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: THUMS LONG BEACH COMPANY LONG BEACH UNIT 0630
LOCATION: 17-5S-12W FREEMAN ISLAND WILMINGTON OIL FIELD LOS ANGELES COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	.0	32.7	.664	.000	.010	8.621	.016	200.00	.15	.04310	.094071	1.994	.004	2.65	.02	1.00	.02	39.7	1.5	1
2	-199.9	232.7	.438	8.621	.003	8.541	.009	200.00	.15	.04270	.094073	2.010	.003	2.65	.02	1.00	.02	38.8	1.4	2
3	-400.0	432.7	.286	17.162	.003	8.299	.016	200.00	.15	.04150	.094076	2.057	.004	2.65	.02	1.00	.02	35.9	1.5	3
4	-600.0	632.7	.187	25.461	.010	8.286	.017	200.00	.15	.04143	.094079	2.060	.005	2.65	.02	1.00	.02	35.8	1.5	4
5	-800.0	832.7	.115	33.747	.004	8.195	.010	200.00	.15	.04097	.094081	2.078	.003	2.65	.02	1.00	.02	34.7	1.4	5
6	-999.9	1032.7	.059	41.942	.003	6.687	.009	167.30	.15	.03997	.094084	2.117	.004	2.65	.02	1.00	.02	32.3	1.4	6
7	-1167.3	1200.0	.019	48.629	.003	7.927	.008	200.00	.15	.03964	.094086	2.131	.003	2.65	.02	1.00	.02	31.5	1.4	7
8	-1367.3	1400.0	-.024	56.556	.002	7.988	.008	199.90	.15	.03996	.094089	2.118	.003	2.65	.02	1.00	.02	32.2	1.4	8
9	-1567.2	1599.9	-.064	64.544	.003	7.914	.008	202.10	.15	.03916	.094092	2.149	.003	2.65	.02	1.00	.02	30.3	1.4	9
10	-1769.3	1802.0	-.101	72.458	.002	5.138	.007	128.00	.15	.04014	.094094	2.111	.004	2.65	.02	1.00	.02	32.7	1.5	10
11	-1897.3	1930.0	-.125	77.596	.002	5.732	.007	142.00	.15	.04037	.094096	2.102	.004	2.65	.02	1.00	.02	33.2	1.4	11
12	-2039.3	2072.0	-.150	83.328	.002	2.911	.007	72.00	.15	.04043	.094098	2.100	.007	2.65	.02	1.00	.02	33.3	1.6	12
13	-2111.3	2144.0	-.163	86.239	.002	2.030	.008	52.10	.15	.03896	.094099	2.157	.010	2.65	.02	1.00	.02	29.9	1.8	13
14	-2163.4	2196.1	-.172	88.269	.003	1.120	.007	25.90	.05	.04324	.094100	1.990	.014	2.65	.02	1.00	.02	40.0	2.1	14
15	-2189.3	2222.0	-.176	89.389	.001	1.087	.006	28.00	.05	.03882	.094100	2.163	.011	2.65	.02	1.00	.02	29.5	1.9	15
16	-2217.3	2250.0	-.181	90.476	.002	.710	.007	19.00	.05	.03737	.094100	2.220	.018	2.65	.02	1.00	.02	26.1	2.3	16
17	-2236.3	2269.0	-.185	91.186	.002	2.813	.007	71.00	.15	.03962	.094101	2.132	.007	2.65	.02	1.00	.02	31.4	1.6	17
18	-2307.3	2340.0	-.197	93.999	.002	.529	.007	14.00	.05	.03779	.094102	2.203	.025	2.65	.02	1.00	.02	27.1	2.7	18
19	-2321.3	2354.0	-.199	94.528	.002	1.824	.007	44.00	.05	.04146	.094102	2.060	.008	2.65	.02	1.00	.02	35.8	1.7	19
20	-2365.3	2398.0	-.207	96.352	.002	2.323	.007	58.00	.15	.04005	.094102	2.115	.009	2.65	.02	1.00	.02	32.4	1.7	20
21	-2423.3	2456.0	-.217	98.675	.002	3.091	.007	76.00	.15	.04067	.094103	2.091	.007	2.65	.02	1.00	.02	33.9	1.6	21
22	-2499.3	2532.0	-.230	101.766	.002	1.463	.007	38.53	.05	.03797	.094104	2.196	.009	2.65	.02	1.00	.02	27.5	1.8	22
23	-2537.8	2570.5	-.237	103.229	.002	2.339	.007	62.47	.15	.03744	.094105	2.217	.008	2.65	.02	1.00	.02	26.2	1.7	23
24	-2600.3	2633.0	-.248	105.568	.002	1.842	.008	47.00	.05	.03919	.094106	2.149	.008	2.65	.02	1.00	.02	30.4	1.7	24
25	-2647.3	2680.0	-.256	107.410	.003	1.150	.007	30.00	.05	.03833	.094106	2.182	.012	2.65	.02	1.00	.02	28.3	1.9	25
26	-2677.3	2710.0	-.261	108.560	.001	.779	.006	20.00	.05	.03895	.094107	2.158	.016	2.65	.02	1.00	.02	29.8	2.2	26
27	-2697.3	2730.0	-.265	109.339	.002	.518	.006	13.00	.05	.03984	.094107	2.123	.024	2.65	.02	1.00	.02	31.9	2.7	27
28	-2710.3	2743.0	-.267	109.857	.001	5.449	.007	135.10	.15	.04033	.094107	2.104	.004	2.65	.02	1.00	.02	33.1	1.4	28
29	-2845.4	2878.1	-.290	115.306	.003	.654	.007	16.90	.05	.03870	.094109	2.168	.021	2.65	.02	1.00	.02	29.2	2.5	29
30	-2862.3	2895.0	-.293	115.960	.001	2.035	.006	51.00	.15	.03990	.094109	2.121	.009	2.65	.02	1.00	.02	32.1	1.8	30
31	-2913.3	2946.0	-.302	117.995	.002	1.003	.008	24.00	.05	.04179	.094110	2.047	.016	2.65	.02	1.00	.02	36.5	2.2	31
32	-2937.3	2970.0	-.306	118.998	.003	1.182	.009	29.30	.05	.04034	.094110	2.104	.015	2.65	.02	1.00	.02	33.1	2.1	32
33	-2966.6	2999.3	-.311	120.180	.003	.366	.009	8.70	.05	.04207	.094110	2.036	.050	2.65	.02	1.00	.02	37.2	4.2	33
34	-2975.3	3008.0	-.313	120.546	.003	.662	.008	15.00	.05	.04413	.094111	1.955	.027	2.65	.02	1.00	.02	42.1	2.8	34
35	-2990.3	3023.0	-.315	121.208	.002	1.155	.009	27.00	.05	.04278	.094111	2.009	.016	2.65	.02	1.00	.02	38.9	2.2	35
36	-3017.3	3050.0	-.320	122.363	.004	.539	.008	12.00	.05	.04492	.094111	1.925	.033	2.65	.02	1.00	.02	44.0	3.2	36
37	-3029.3	3062.0	-.322	122.902	.001	.607	.006	14.00	.05	.04336	.094111	1.986	.023	2.65	.02	1.00	.02	40.2	2.6	37
38	-3043.3	3076.0	-.325	123.509	.002	1.403	.007	35.00	.05	.04009	.094111	2.114	.010	2.65	.02	1.00	.02	32.5	1.8	38
39	-3078.3	3111.0	-.331	124.912	.002	2.073	.007	49.00	.05	.04231	.094112	2.027	.007	2.65	.02	1.00	.02	37.8	1.7	39
40	-3127.3	3160.0	-.339	126.985	.002	.805	.006	20.00	.05	.04025	.094113	2.107	.016	2.65	.02	1.00	.02	32.9	2.2	40
41	-3147.3	3180.0	-.343	127.790	.001	2.967	.005	74.00	.15	.04009	.094113	2.114	.006	2.65	.02	1.00	.02	32.5	1.6	41
42	-3221.3	3254.0	-.355	130.757	.001	1.498	.005	38.10	.05	.03932	.094114	2.144	.007	2.65	.02	1.00	.02	30.7	1.6	42
43	-3259.4	3292.1	-.362	132.255	.001	.801	.005	19.90	.05	.04025	.094114	2.107	.014	2.65	.02	1.00	.02	32.9	2.0	43
44	-3279.3	3312.0	-.365	133.056	.001	3.063	.005	79.00	.15	.03877	.094115	2.165	.005	2.65	.02	1.00	.02	29.4	1.5	44
45	-3358.3	3391.0	-.379	136.119	.001	.586	.005	15.00	.05	.03907	.094116	2.154	.018	2.65	.02	1.00	.02	30.1	2.3	45
46	-3373.3	3406.0	-.382	136.705	.001	.675	.006	17.00	.05	.03971	.094116	2.129	.018	2.65	.02	1.00	.02	31.6	2.3	46

Table 4. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: THUMS LONG BEACH COMPANY LONG BEACH UNIT D630
LOCATION: 17-5S-12W FREEMAN ISLAND WILMINGTON OIL FIELD LOS ANGELES COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-3390.3	3423.0	-.385	137.380	.002	2.798	.007	72.00	.15	.03886	.094116	2.162	.007	2.65	.02	1.00	.02	29.6	1.6	47
48	-3462.3	3495.0	-.397	140.178	.002	2.967	.007	79.00	.15	.03756	.094117	2.213	.006	2.65	.02	1.00	.02	26.5	1.6	48
49	-3541.3	3574.0	-.411	143.145	.002	1.810	.006	49.00	.05	.03694	.094118	2.237	.006	2.65	.02	1.00	.02	25.0	1.6	49
50	-3590.3	3623.0	-.420	144.955	.001	.825	.005	22.00	.05	.03750	.094119	2.215	.012	2.65	.02	1.00	.02	26.3	2.0	50
51	-3612.3	3645.0	-.423	145.780	.001	2.020	.006	52.20	.15	.03870	.094119	2.169	.009	2.65	.02	1.00	.02	29.2	1.7	51
52	-3664.4	3697.2	-.433	147.800	.002	1.925	.006	50.80	.15	.03789	.094120	2.200	.009	2.65	.02	1.00	.02	27.3	1.8	52
53	-3715.3	3748.0	-.442	149.725	.001	3.316	.006	87.10	.15	.03807	.094120	2.193	.005	2.65	.02	1.00	.02	27.7	1.5	53
54	-3802.4	3835.1	-.457	153.241	.002	2.856	.006	75.90	.15	.03763	.094122	2.210	.006	2.65	.02	1.00	.02	26.6	1.6	54
55	-3878.3	3911.0	-.470	155.897	.001	2.248	.006	59.00	.15	.03810	.094123	2.192	.008	2.65	.02	1.00	.02	27.8	1.7	55
56	-3937.3	3970.0	-.480	158.145	.002	4.603	.008	125.00	.15	.03682	.094123	2.242	.004	2.65	.02	1.00	.02	24.7	1.5	56
57	-4062.3	4095.0	-.503	162.749	.003	.959	.009	26.00	.05	.03689	.094125	2.240	.016	2.65	.02	1.00	.02	24.9	2.2	57
58	-4088.3	4121.0	-.507	163.707	.003	2.910	.009	79.00	.15	.03684	.094125	2.242	.007	2.65	.02	1.00	.02	24.8	1.6	58
59	-4167.3	4200.0	-.521	166.617	.003	2.984	.008	79.00	.15	.03777	.094127	2.205	.007	2.65	.02	1.00	.02	27.0	1.6	59
60	-4246.3	4279.0	-.535	169.601	.002	4.448	.006	120.00	.15	.03707	.094128	2.233	.004	2.65	.02	1.00	.02	25.3	1.4	60
61	-4366.3	4399.0	-.556	174.049	.001	.979	.007	26.02	.05	.03763	.094129	2.211	.013	2.65	.02	1.00	.02	26.6	2.0	61
62	-4392.3	4425.0	-.561	175.028	.003	4.958	.008	134.90	.15	.03675	.094130	2.245	.004	2.65	.02	1.00	.02	24.5	1.4	62
63	-4527.2	4559.9	-.585	179.986	.002	5.640	.007	155.28	.15	.03632	.094131	2.262	.003	2.65	.02	1.00	.02	23.5	1.4	63
64	-4682.5	4715.2	-.613	185.626	.002	.614	.006	17.05	.05	.03601	.094133	2.274	.018	2.65	.02	1.00	.02	22.8	2.3	64
65	-4699.5	4732.3	-.616	186.240	.001	1.263	.006	36.00	.05	.03508	.094134	2.310	.008	2.65	.02	1.00	.02	20.6	1.7	65
66	-4735.5	4768.3	-.622	187.503	.002	2.600	.007	74.00	.15	.03513	.094134	2.308	.006	2.65	.02	1.00	.02	20.7	1.6	66
67	-4809.5	4842.3	-.635	190.103	.002	1.943	.007	53.00	.15	.03666	.094135	2.249	.009	2.65	.02	1.00	.02	24.3	1.8	67
68	-4862.5	4895.3	-.645	192.046	.002	3.771	.007	105.00	.15	.03591	.094136	2.278	.005	2.65	.02	1.00	.02	22.5	1.5	68
69	-4967.5	5000.3	-.664	195.817	.002	3.262	.007	90.10	.15	.03620	.094137	2.267	.005	2.65	.02	1.00	.02	23.2	1.5	69
70	-5057.6	5090.4	-.680	199.079	.002	5.502	.007	150.90	.15	.03646	.094138	2.257	.003	2.65	.02	1.00	.02	23.8	1.4	70
71	-5208.5	5241.3	-.707	204.581	.002	.577	.008	17.00	.05	.03394	.094140	2.355	.022	2.65	.02	1.00	.02	17.9	2.6	71
72	-5225.5	5258.3	-.711	205.158	.003	3.291	.008	92.10	.15	.03573	.094141	2.285	.006	2.65	.02	1.00	.02	22.1	1.6	72
73	-5317.6	5350.4	-.727	208.449	.002	2.732	.007	77.90	.15	.03507	.094142	2.311	.006	2.65	.02	1.00	.02	20.5	1.6	73
74	-5395.5	5428.3	-.741	211.181	.002	.907	.007	25.10	.05	.03613	.094143	2.270	.014	2.65	.02	1.00	.02	23.0	2.0	74
75	-5420.6	5453.4	-.746	212.088	.002	3.277	.007	91.90	.15	.03566	.094143	2.288	.005	2.65	.02	1.00	.02	21.9	1.5	75
76	-5512.5	5545.3	-.763	215.365	.002	1.368	.007	37.00	.05	.03697	.094145	2.237	.009	2.65	.02	1.00	.02	25.0	1.8	76
77	-5549.5	5582.3	-.769	216.733	.002	.541	.008	15.00	.05	.03607	.094145	2.272	.026	2.65	.02	1.00	.02	22.9	2.0	77
78	-5564.5	5597.3	-.772	217.274	.003	.829	.008	24.05	.05	.03447	.094145	2.335	.016	2.65	.02	1.00	.02	19.1	2.2	78
79	-5588.5	5621.3	-.776	218.103	.002	3.151	.007	88.70	.15	.03552	.094146	2.294	.005	2.65	.02	1.00	.02	21.6	1.5	79
80	-5677.3	5710.0	-.793	221.254	.002	.383	.007	12.00	.05	.03192	.094147	2.435	.028	2.65	.02	1.00	.02	13.0	2.9	80
81	-5689.3	5722.0	-.795	221.637	.002	6.565	.007	187.00	.15	.03511	.094147	2.310	.003	2.65	.02	1.00	.02	20.6	1.4	81
82	-5876.3	5909.0	-.829	228.202	.002	1.650	.008	45.00	.05	.03667	.094149	2.249	.009	2.65	.02	1.00	.02	24.3	1.7	82
83	-5921.3	5954.0	-.837	229.852	.003	1.354	.008	37.00	.05	.03660	.094150	2.252	.010	2.65	.02	1.00	.02	24.1	1.8	83
84	-5958.3	5991.0	-.844	231.206	.002	6.703	.007	189.00	.15	.03547	.094150	2.296	.003	2.65	.02	1.00	.02	21.4	1.4	84
85	-6147.3	6180.0	-.879	237.909	.002	.641	.007	18.00	.05	.03561	.094153	2.290	.019	2.65	.02	1.00	.02	21.8	2.4	85
86	-6165.3	6198.0	-.882	238.550	.002	2.499	.007	72.05	.15	.03468	.094153	2.327	.007	2.65	.02	1.00	.02	19.6	1.6	86
87	-6237.3	6270.0	-.896	241.049	.002	2.195	.007	59.95	.15	.03661	.094154	2.251	.008	2.65	.02	1.00	.02	24.2	1.7	87
88	-6297.3	6330.0	-.907	243.244	.002	3.201	.007	90.00	.15	.03557	.094155	2.292	.005	2.65	.02	1.00	.02	21.7	1.5	88
89	-6387.3	6420.0	-.923	246.445	.002	1.742	.006	50.00	.15	.03484	.094156	2.321	.009	2.65	.02	1.00	.02	19.9	1.7	89
90	-6437.3	6470.0	-.933	248.187	.001	3.135	.006	90.00	.15	.03483	.094157	2.321	.005	2.65	.02	1.00	.02	19.9	1.5	90
91	-6527.3	6560.0	-.949	251.322	.002	1.988	.007	57.10	.15	.03488	.094158	2.319	.008	2.65	.02	1.00	.02	20.0	1.7	91
92	-6584.3	6617.0	-.960	253.310	.002	2.202	.007	63.00	.15	.03495	.094159	2.317	.008	2.65	.02	1.00	.02	20.2	1.7	92

Table 4. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: THUMS LONG BEACH COMPANY LONG BEACH UNIT 0630
LOCATION: 17-5S-12W FREEMAN ISLAND WILMINGTON OIL FIELD LOS ANGELES COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
93	-6647.3	6680.0	-.971	255.512	.002	2.810	.038	80.00	.15	.03513	.094160	2.310	.006	2.65	.02	1.00	.02	20.6	1.6	93
94	-6727.3	6760.0	-.986	258.322	.003	1.702	.038	50.00	.15	.03404	.094161	2.352	.010	2.65	.02	1.00	.02	18.0	1.8	94
95	-6777.3	6810.0	-.996	260.024	.002	5.534	.027	160.00	.15	.03459	.094161	2.331	.003	2.65	.02	1.00	.02	19.3	1.4	95
96	-6937.3	6970.0	-1.025	265.558	.002	5.645	.029	163.00	.15	.03463	.094164	2.329	.003	2.65	.02	1.00	.02	19.4	1.4	96
97	-7100.3	7133.0	-1.056	271.203	.004	8.837	.039	259.00	.15	.03412	.094166	2.349	.002	2.65	.02	1.00	.02	18.2	1.3	97
98	-7359.3	7392.0	-1.104	280.040	.002	6.588	.008	197.00	.15	.03344	.094169	2.376	.003	2.65	.02	1.00	.02	16.6	1.4	98
99	-7556.3	7589.0	-1.141	286.628	.003	4.842	.029	143.00	.15	.03386	.094172	2.360	.004	2.65	.02	1.00	.02	17.6	1.4	99
100	-7699.3	7732.0	-1.168	291.470	.003	11.417	.012	338.00	.15	.03378	.094174	2.363	.002	2.65	.02	1.00	.02	17.4	1.3	100
101	-8037.3	8070.0	-1.232	302.887	.006	6.821	.015	203.00	.15	.03360	.094178	2.370	.004	2.65	.02	1.00	.02	17.0	1.4	101
102	-8240.3	8273.0	-1.270	309.708	.006	2.020	.015	57.00	.15	.03544	.094181	2.298	.014	2.65	.02	1.00	.02	21.3	2.1	102
103	-8297.3	8330.0	-1.281	311.728	.006	2.827	.015	80.00	.15	.03534	.094182	2.302	.010	2.65	.02	1.00	.02	21.1	1.8	103
104	-8377.3	8410.0	-1.296	314.555	.006	.473	.015	16.00	.05	.02956	.094183	2.529	.040	2.65	.02	1.00	.02	7.4	3.7	104
105	-8393.3	8426.0	-1.299	315.028	.006	7.379	.015	199.90	.15	.03691	.094183	2.241	.004	2.65	.02	1.00	.02	24.8	1.5	105
106	-8593.2	8625.9	-1.337	322.407	.006	6.253	.015	179.90	.15	.03476	.094186	2.325	.004	2.65	.02	1.00	.02	19.7	1.5	106
107	-8773.8	8805.8	-1.371	328.660	.006															

Table 5. Basic data from borehole gravity survey in "KCL-L" 45-25 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: ATLANTIC RICHFIELD CO. KCL-L 45-25
LOCATION: 25-11N-20W NORTH TEJON OIL FIELD KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	852.4	34.8	2.974	.000	.002	1.621	.007	39.40	.05	.04114	.094056	2.070	.009	2.65	.02	1.00	.02	35.1	1.8	1
2	813.0	74.2	3.145	1.621	.002	6.090	.007	152.00	.15	.04007	.094057	2.113	.003	2.65	.02	1.00	.02	32.6	1.4	2
3	661.0	226.2	3.719	7.711	.002	7.616	.008	200.10	.15	.03806	.094059	2.191	.003	2.65	.02	1.00	.02	27.8	1.4	3
4	460.9	426.3	4.303	15.327	.003	7.285	.010	200.00	.15	.03643	.094062	2.255	.003	2.65	.02	1.00	.02	23.9	1.4	4
5	260.9	626.3	4.792	22.612	.004	5.267	.010	150.10	.15	.03509	.094064	2.307	.004	2.65	.02	1.00	.02	20.8	1.5	5
6	110.8	776.4	5.121	27.879	.003	11.275	.009	342.10	.15	.03296	.094066	2.391	.002	2.65	.02	1.00	.02	15.7	1.3	6
7	-231.3	1118.5	5.777	39.154	.003	4.638	.014	142.10	.15	.03264	.094071	2.404	.005	2.65	.02	1.00	.02	14.9	1.5	7
8	-373.4	1260.6	6.020	43.792	.008	9.766	.015	296.00	.15	.03299	.094073	2.390	.003	2.65	.02	1.00	.02	15.8	1.4	8
9	-669.4	1556.6	6.481	53.558	.004	3.008	.010	92.00	.15	.03270	.094077	2.402	.006	2.65	.02	1.00	.02	15.1	1.6	9
10	-761.4	1648.6	6.614	56.566	.003	8.320	.009	252.10	.15	.03303	.094078	2.388	.002	2.65	.02	1.00	.02	15.9	1.3	10
11	-1013.5	1900.7	6.957	64.894	.003	8.324	.009	250.10	.15	.03328	.094081	2.379	.002	2.65	.02	1.00	.02	16.4	1.3	11
12	-1263.6	2150.8	7.272	73.218	.003	6.634	.009	196.90	.15	.03369	.094085	2.363	.003	2.65	.02	1.00	.02	17.4	1.4	12
13	-1460.5	2347.7	7.505	79.852	.003	11.381	.009	349.10	.15	.03260	.094087	2.406	.002	2.65	.02	1.00	.02	14.8	1.3	13
14	-1809.6	2696.8	7.892	91.233	.003	9.752	.009	301.10	.15	.03239	.094092	2.414	.002	2.65	.02	1.00	.02	14.3	1.3	14
15	-2110.7	2997.9	8.205	100.985	.003	6.105	.009	191.10	.15	.03195	.094096	2.432	.003	2.65	.02	1.00	.02	13.2	1.4	15
16	-2301.8	3189.0	8.395	107.090	.003	1.392	.009	46.00	.05	.03026	.094099	2.498	.009	2.65	.02	1.00	.02	9.2	1.8	16
17	-2347.8	3235.0	8.440	108.482	.003	2.456	.009	74.00	.15	.03319	.094099	2.383	.007	2.65	.02	1.00	.02	16.2	1.7	17
18	-2421.8	3309.0	8.511	110.938	.003	10.254	.009	345.10	.15	.03361	.094100	2.367	.002	2.65	.02	1.00	.02	17.2	1.3	18
19	-2726.9	3614.1	8.798	121.192	.003	8.205	.010	240.00	.15	.03419	.094104	2.344	.002	2.65	.02	1.00	.02	18.5	1.4	19
20	-2966.9	3854.1	9.016	129.397	.004	11.146	.010	282.10	.15	.03951	.094108	2.136	.002	2.65	.02	1.00	.02	31.1	1.3	20
21	-3249.0	4136.2	9.265	140.543	.003	.893	.009	26.80	.05	.03332	.094111	2.379	.016	2.65	.02	1.00	.02	16.4	2.2	21
22	-3275.8	4163.0	9.289	141.436	.003	9.526	.009	281.10	.15	.03389	.094112	2.356	.002	2.65	.02	1.00	.02	17.8	1.3	22
23	-3556.9	4444.1	9.529	150.962	.003	11.020	.009	348.00	.15	.03578	.094116	2.283	.002	2.65	.02	1.00	.02	22.3	1.3	23
24	-3864.9	4752.1	9.786	161.982	.003	11.710	.010	337.30	.15	.03472	.094120	2.324	.002	2.65	.02	1.00	.02	19.7	1.3	24
25	-4202.2	5089.4	10.060	173.692	.004	3.189	.010	79.90	.15	.03991	.094124	2.121	.008	2.65	.02	1.00	.02	32.1	1.7	25
26	-4282.1	5169.3	10.124	176.881	.003	14.531	.009	371.10	.15	.03916	.094125	2.151	.002	2.65	.02	1.00	.02	30.3	1.3	26
27	-4653.2	5540.4	10.417	191.412	.003	3.190	.009	78.90	.15	.04043	.094130	2.101	.007	2.65	.02	1.00	.02	33.3	1.7	27
28	-4732.1	5619.3	10.478	194.602	.003	1.764	.014	44.10	.05	.04000	.094131	2.118	.014	2.65	.02	1.00	.02	32.2	2.1	28
29	-4776.2	5663.4	10.512	196.366	.008	3.688	.015	96.00	.15	.03842	.094132	2.180	.008	2.65	.02	1.00	.02	28.5	1.7	29
30	-4872.2	5759.4	10.586	200.054	.004	12.687	.010	383.10	.15	.03312	.094133	2.387	.002	2.65	.02	1.00	.02	15.9	1.3	30
31	-5255.3	6142.5	10.877	212.741	.003	11.375	.009	330.10	.15	.03446	.094138	2.335	.002	2.65	.02	1.00	.02	19.1	1.3	31
32	-5585.4	6472.6	11.123	224.116	.003	2.386	.009	74.10	.15	.03220	.094143	2.424	.007	2.65	.02	1.00	.02	13.7	1.7	32
33	-5659.5	6546.7	11.178	226.502	.003	3.583	.009	113.10	.15	.03168	.094144	2.444	.005	2.65	.02	1.00	.02	12.5	1.5	33
34	-5772.6	6659.8	11.261	230.085	.003	7.604	.009	217.60	.15	.03494	.094145	2.316	.003	2.65	.02	1.00	.02	20.2	1.4	34
35	-5990.2	6877.4	11.419	237.689	.003	13.438	.009	400.10	.15	.03359	.094148	2.370	.001	2.65	.02	1.00	.02	17.0	1.3	35
36	-6390.3	7277.5	11.706	251.127	.003	8.664	.009	268.10	.15	.03232	.094154	2.420	.002	2.65	.02	1.00	.02	14.0	1.3	36
37	-6658.4	7545.6	11.896	259.791	.003	1.559	.010	50.00	.05	.03118	.094157	2.464	.009	2.65	.02	1.00	.02	11.3	1.8	37
38	-6708.4	7595.6	11.931	261.350	.004	4.928	.011	153.10	.15	.03219	.094158	2.425	.004	2.65	.02	1.00	.02	13.7	1.5	38
39	-6861.5	7748.7	12.038	266.278	.004	5.129	.010	165.00	.15	.03109	.094160	2.468	.003	2.65	.02	1.00	.02	11.0	1.4	39
40	-7026.5	7913.7	12.152	271.407	.003	6.358	.009	212.10	.15	.02998	.094162	2.511	.002	2.65	.02	1.00	.02	8.4	1.4	40
41	-7238.6	8125.8	12.298	277.765	.003	5.342	.009	168.00	.15	.03156	.094165	2.450	.003	2.65	.02	1.00	.02	12.1	1.4	41
42	-7406.6	8293.8	12.412	283.107	.003	2.066	.010	61.00	.15	.03387	.094167	2.359	.010	2.65	.02	1.00	.02	17.6	1.8	42
43	-7467.6	8354.8	12.453	285.133	.004	1.809	.010	49.00	.05	.03692	.094168	2.240	.009	2.65	.02	1.00	.02	24.8	1.8	43
44	-7516.6	8403.8	12.486	286.942	.003	.985	.010	27.70	.05	.03556	.094169	2.293	.017	2.65	.02	1.00	.02	21.6	2.2	44
45	-7544.3	8431.5	12.505	287.927	.004	1.102	.011	32.00	.05	.03444	.094169	2.337	.016	2.65	.02	1.00	.02	19.0	2.2	45
46	-7576.3	8463.5	12.527	289.029	.004	1.314	.010	38.10	.05	.03449	.094169	2.335	.012	2.65	.02	1.00	.02	19.1	1.9	46

Table 5. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: ATLANTIC RICHFIELD CO. KCL-L 45-25
LOCATION: 25-11N-20W NORTH TEJON OIL FIELD KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-7614.4	8501.6	12.552	293.343	.003															
						1.936	.009	59.00	.15	.03281	.094170	2.401	.009	2.65	.02	1.00	.02	15.1	1.8	47
48	-7673.4	8560.6	12.592	292.279	.003															
						1.264	.011	38.00	.05	.03326	.094171	2.383	.013	2.65	.02	1.00	.02	16.2	2.0	48
49	-7711.4	8598.6	12.617	293.543	.005															
						1.719	.012	54.00	.15	.03183	.094171	2.439	.012	2.65	.02	1.00	.02	12.8	1.9	49
50	-7765.4	8652.6	12.653	295.262	.004															
						2.017	.013	61.00	.15	.03306	.094172	2.391	.012	2.65	.02	1.00	.02	15.7	1.9	50
51	-7826.4	8713.6	12.694	297.279	.006															
						7.639	.012	240.10	.15	.03182	.094173	2.440	.003	2.65	.02	1.00	.02	12.7	1.4	51
52	-8066.5	8953.7	12.853	304.918	.003															
						1.611	.009	50.00	.05	.03222	.094176	2.424	.008	2.65	.02	1.00	.02	13.7	1.7	52
53	-8116.5	9003.7	12.886	306.529	.003															
						10.752	.009	338.10	.15	.03180	.094177	2.441	.002	2.65	.02	1.00	.02	12.7	1.3	53
54	-8454.6	9341.8	13.107	317.281	.003															
						1.039	.009	32.00	.05	.03247	.094181	2.415	.013	2.65	.02	1.00	.02	14.3	2.0	54
55	-8486.6	9373.8	13.128	318.320	.003															
						1.701	.010	57.00	.15	.02984	.094182	2.517	.010	2.65	.02	1.00	.02	8.0	1.8	55
56	-8543.6	9430.8	13.164	320.021	.004															
						2.742	.010	88.00	.15	.03116	.094182	2.466	.007	2.65	.02	1.00	.02	11.2	1.6	56
57	-8631.6	9518.8	13.221	322.763	.003															
						4.600	.009	150.10	.15	.03065	.094184	2.486	.004	2.65	.02	1.00	.02	9.9	1.4	57
58	-8781.7	9668.9	13.317	327.363	.003															
						2.190	.010	71.00	.15	.03085	.094186	2.478	.008	2.65	.02	1.00	.02	10.4	1.7	58
59	-8852.7	9739.9	13.363	329.553	.004															
						3.287	.011	108.00	.15	.03044	.094187	2.494	.006	2.65	.02	1.00	.02	9.4	1.6	59
60	-8960.7	9847.9	13.431	332.840	.004															
						4.400	.010	146.10	.15	.03012	.094188	2.507	.004	2.65	.02	1.00	.02	8.7	1.4	60
61	-9106.8	9994.0	13.524	337.240	.003															
						2.914	.009	96.00	.15	.03035	.094190	2.498	.006	2.65	.02	1.00	.02	9.2	1.5	61
62	-9202.8	10090.0	13.584	340.154	.003															
						3.729	.009	125.00	.15	.02983	.094191	2.518	.004	2.65	.02	1.00	.02	8.0	1.5	62
63	-9327.8	10215.0	13.662	343.883	.003															
						4.600	.010	154.10	.15	.02985	.094193	2.518	.004	2.65	.02	1.00	.02	8.0	1.4	63
64	-9481.9	10369.1	13.758	348.483	.004															
						2.219	.010	75.00	.15	.02959	.094195	2.528	.008	2.65	.02	1.00	.02	7.4	1.7	64
65	-9556.9	10444.1	13.804	350.702	.003															
						2.068	.010	67.90	.15	.03046	.094196	2.494	.008	2.65	.02	1.00	.02	9.5	1.7	65
66	-9624.8	10512.0	13.846	352.770	.004															
						2.994	.017	97.30	.15	.03087	.094197	2.478	.009	2.65	.02	1.00	.02	10.4	1.7	66
67	-9721.8	10609.0	13.906	355.764	.010															
						5.982	.017	204.10	.15	.02931	.094198	2.539	.004	2.65	.02	1.00	.02	6.7	1.5	67
68	-9925.9	10813.1	14.030	361.746	.004															
						3.940	.011	133.00	.15	.02962	.094201	2.527	.005	2.65	.02	1.00	.02	7.5	1.5	68
69	-10058.9	10946.1	14.111	365.686	.004															
						1.361	.011	46.00	.05	.02959	.094203	2.528	.011	2.65	.02	1.00	.02	7.4	1.9	69
70	-10104.9	10992.1	14.139	367.047	.004															
						2.426	.011	81.90	.15	.02962	.094203	2.527	.007	2.65	.02	1.00	.02	7.5	1.7	70
71	-10186.8	11074.0	14.188	369.473	.004															
						3.065	.011	97.00	.15	.03160	.094204	2.450	.006	2.65	.02	1.00	.02	12.1	1.6	71
72	-10283.8	11171.0	14.246	372.538	.004															
						2.364	.011	78.10	.15	.03027	.094206	2.502	.008	2.65	.02	1.00	.02	9.0	1.7	72
73	-10361.9	11249.1	14.293	374.902	.004															
						2.747	.013	93.00	.15	.02954	.094207	2.530	.007	2.65	.02	1.00	.02	7.3	1.7	73
74	-10454.9	11342.1	14.348	377.649	.006															
						.535	.013	17.00	.05	.03147	.094208	2.455	.034	2.65	.02	1.00	.02	11.8	3.2	74
75	-10471.9	11359.1	14.358	378.184	.004															

Table 6. Basic data from borehole gravity survey in "White Wolf Deep" 26x-28 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: TENNECO OIL CO WHITE WOLF DEEP 26X-28
LOCATION: 28-11N-21W WILDCAT KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	928.4	34.6	3.602	.000	.003	9.492	.008	237.00	.15	.04005	.094055	2.113	.002	2.65	.02	1.00	.02	32.5	1.4	1
2	691.4	271.6	4.698	9.492	.002	7.736	.008	202.00	.15	.03830	.094059	2.182	.003	2.65	.02	1.00	.02	28.4	1.4	2
3	489.4	473.6	5.286	17.228	.003	5.716	.008	190.00	.15	.03008	.094061	2.503	.003	2.65	.02	1.00	.02	8.9	1.4	3
4	299.4	663.6	5.706	22.944	.002	7.414	.007	216.00	.15	.03432	.094064	2.337	.002	2.65	.02	1.00	.02	18.9	1.3	4
5	83.4	879.6	6.107	30.358	.002	1.243	.007	40.00	.05	.03107	.094067	2.465	.008	2.65	.02	1.00	.02	11.2	1.7	5
6	43.4	919.6	6.175	31.601	.002	4.251	.007	130.00	.15	.03270	.094067	2.401	.004	2.65	.02	1.00	.02	15.1	1.4	6
7	-86.6	1049.6	6.389	35.852	.002	1.651	.007	60.00	.15	.02752	.094069	2.604	.007	2.65	.02	1.00	.02	2.8	1.7	7
8	-146.6	1109.6	6.484	37.503	.002	11.110	.007	343.00	.15	.03239	.094070	2.413	.001	2.65	.02	1.00	.02	14.3	1.3	8
9	-489.6	1452.6	6.988	48.613	.002	1.518	.007	49.00	.05	.03098	.094074	2.469	.007	2.65	.02	1.00	.02	11.0	1.6	9
10	-538.6	1501.6	7.056	50.131	.002	1.857	.007	57.00	.15	.03258	.094075	2.406	.008	2.65	.02	1.00	.02	14.8	1.7	10
11	-595.6	1558.6	7.134	51.988	.002	1.473	.007	51.00	.15	.02888	.094076	2.551	.009	2.65	.02	1.00	.02	6.0	1.7	11
12	-646.6	1609.6	7.202	53.461	.002	2.908	.007	92.00	.15	.03161	.094077	2.444	.005	2.65	.02	1.00	.02	12.5	1.5	12
13	-738.6	1701.6	7.324	56.369	.002	2.668	.010	87.00	.15	.03067	.094078	2.481	.007	2.65	.02	1.00	.02	10.2	1.6	13
14	-825.6	1788.6	7.436	59.037	.005	8.812	.010	273.00	.15	.03228	.094079	2.418	.002	2.65	.02	1.00	.02	14.1	1.3	14
15	-1098.6	2061.6	7.775	67.849	.002	10.332	.007	312.20	.15	.03309	.094083	2.386	.001	2.65	.02	1.00	.02	16.0	1.3	15
16	-1410.8	2373.8	8.139	78.181	.002	16.608	.007	521.00	.15	.03188	.094087	2.434	.001	2.65	.02	1.00	.02	13.1	1.3	16
17	-1931.8	2894.8	8.703	94.789	.002	5.073	.007	168.00	.15	.03020	.094094	2.500	.003	2.65	.02	1.00	.02	9.1	1.4	17
18	-2099.8	3062.8	8.876	99.862	.002	.974	.007	32.00	.05	.03044	.094096	2.491	.010	2.65	.02	1.00	.02	9.7	1.8	18
19	-2131.8	3094.8	8.908	100.836	.002	9.394	.007	305.00	.15	.03080	.094096	2.477	.001	2.65	.02	1.00	.02	10.5	1.3	19
20	-2436.8	3399.8	9.210	110.230	.002	14.261	.007	457.10	.15	.03120	.094101	2.461	.001	2.65	.02	1.00	.02	11.4	1.3	20
21	-2893.9	3856.9	9.643	124.491	.002	4.433	.008	144.20	.15	.03074	.094107	2.479	.003	2.65	.02	1.00	.02	10.3	1.4	21
22	-3038.1	4001.1	9.775	128.924	.003	9.736	.009	318.00	.15	.03062	.094109	2.484	.002	2.65	.02	1.00	.02	10.0	1.3	22
23	-3356.1	4319.1	10.061	138.660	.003	3.025	.009	105.10	.15	.02878	.094113	2.556	.005	2.65	.02	1.00	.02	5.7	1.5	23
24	-3461.2	4424.2	10.154	141.685	.003	8.126	.010	266.90	.15	.03045	.094114	2.491	.002	2.65	.02	1.00	.02	9.6	1.3	24
25	-3728.1	4691.1	10.386	149.811	.004	.796	.010	25.00	.05	.03184	.094118	2.437	.018	2.65	.02	1.00	.02	12.9	2.3	25
26	-3753.1	4716.1	10.407	150.607	.003	14.481	.009	485.00	.15	.02986	.094118	2.514	.001	2.65	.02	1.00	.02	8.2	1.3	26
27	-4238.1	5201.1	10.816	165.088	.003	12.813	.010	423.80	.15	.03023	.094125	2.500	.001	2.65	.02	1.00	.02	9.1	1.3	27
28	-4661.9	5624.9	11.163	177.901	.004	13.874	.011	456.20	.15	.03041	.094130	2.493	.001	2.65	.02	1.00	.02	9.5	1.3	28
29	-5118.1	6081.1	11.527	191.775	.004	8.327	.011	270.00	.15	.03084	.094136	2.477	.002	2.65	.02	1.00	.02	10.5	1.3	29
30	-5388.1	6351.1	11.737	200.102	.004	10.770	.011	350.00	.15	.03077	.094140	2.479	.002	2.65	.02	1.00	.02	10.3	1.3	30
31	-5738.1	6701.1	12.005	210.872	.004	9.152	.012	300.00	.15	.03051	.094145	2.490	.002	2.65	.02	1.00	.02	9.7	1.3	31
32	-6038.1	7001.1	12.230	220.024	.005	10.923	.012	350.10	.15	.03120	.094149	2.463	.002	2.65	.02	1.00	.02	11.3	1.3	32
33	-6388.2	7351.2	12.488	230.947	.004	7.128	.010	229.90	.15	.03100	.094154	2.471	.002	2.65	.02	1.00	.02	10.9	1.4	33
34	-6618.1	7581.1	12.654	238.075	.003	4.346	.011	140.00	.15	.03104	.094157	2.469	.004	2.65	.02	1.00	.02	10.9	1.5	34
35	-6758.1	7721.1	12.755	242.421	.005	9.084	.012	293.00	.15	.03100	.094158	2.471	.002	2.65	.02	1.00	.02	10.8	1.3	35
36	-7051.1	8014.1	12.961	251.505	.004	14.897	.014	486.70	.15	.03061	.094162	2.487	.001	2.65	.02	1.00	.02	9.9	1.3	36
37	-7537.8	8500.8	13.296	266.402	.007	14.906	.015	500.00	.15	.02981	.094169	2.518	.002	2.65	.02	1.00	.02	8.0	1.3	37
38	-8037.8	9000.8	13.630	281.308	.005	18.470	.012	640.00	.15	.02886	.094176	2.556	.001	2.65	.02	1.00	.02	5.7	1.3	38
39	-8677.8	9640.8	14.040	299.778	.004	6.092	.013	210.10	.15	.02900	.094184	2.551	.003	2.65	.02	1.00	.02	6.0	1.4	39
40	-8887.9	9850.9	14.171	305.870	.006	11.623	.012	411.90	.15	.02822	.094187	2.581	.002	2.65	.02	1.00	.02	4.2	1.3	40
41	-9299.8	10262.8	14.421	317.493	.003	1.909	.010	68.00	.15	.02807	.094193	2.587	.008	2.65	.02	1.00	.02	3.8	1.7	41
42	-9367.8	10330.8	14.461	319.402	.004	.337	.011	12.00	.05	.02808	.094193	2.507	.040	2.65	.02	1.00	.02	3.8	3.7	42
43	-9379.8	10342.8	14.469	319.739	.004	3.066	.010	108.00	.15	.02839	.094194	2.575	.005	2.65	.02	1.00	.02	4.6	1.5	43
44	-9487.8	10450.8	14.533	322.805	.003	1.212	.010	41.00	.05	.02956	.094195	2.529	.011	2.65	.02	1.00	.02	7.3	1.9	44
45	-9528.8	10491.8	14.557	324.017	.004	5.094	.011	176.20	.15	.02891	.094196	2.554	.003	2.65	.02	1.00	.02	5.8	1.4	45
46	-9705.0	10668.0	14.660	329.111	.004	2.295	.011	72.50	.15	.03166	.094198	2.447	.008	2.65	.02	1.00	.02	12.3	1.7	46
47	-9777.5	10740.5	14.702	331.406	.004	2.692	.012	88.50	.15	.03042	.094199	2.496	.007	2.65	.02	1.00	.02	9.4	1.7	47
48	-9866.0	10829.0	14.753	334.098	.005	2.459	.013	84.00	.15	.02927	.094200	2.540	.008	2.65	.02	1.00	.02	6.6	1.7	48
49	-9950.0	10913.0	14.801	336.557	.005	2.302	.012	76.00	.15	.03029	.094201	2.501	.009	2.65	.02	1.00	.02	9.0	1.7	49
50	-10026.0	10989.0	14.844	338.859	.004															

Table 7. Basic data from borehole gravity survey in "South Belridge" 548E-34 (see p. 4 for explanation.

USGS BOREHOLE GRAVITY SURVEY: KERNRIDGE OIL CO SOUTH BELRIDGE 548E
LOCATION: 34-28S-21E SOUTH BELRIDGE OIL FIELD KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	579.3	19.7	.713	.000	.100	7.668	.128	163.35	.15	.04694	.094059	1.844	.028	2.65	.02	1.00	.02	48.9	2.9	1
2	416.0	183.1	.769	7.668	.005	.877	.012	20.95	.05	.04186	.094061	2.042	.026	2.65	.02	1.00	.02	36.8	2.8	2
3	395.0	204.0	.774	8.545	.004	1.562	.011	39.00	.05	.04005	.094062	2.113	.013	2.65	.02	1.00	.02	32.5	2.0	3
4	356.0	243.0	.782	10.107	.004	2.582	.011	65.05	.15	.03969	.094062	2.127	.010	2.65	.02	1.00	.02	31.7	1.8	4
5	291.0	308.0	.795	12.689	.004	.277	.010	7.95	.05	.03484	.094063	2.317	.058	2.65	.02	1.00	.02	20.2	4.7	5
6	283.0	316.0	.796	12.966	.003	.512	.011	14.50	.05	.03531	.094063	2.299	.034	2.65	.02	1.00	.02	21.3	3.3	6
7	268.5	330.5	.798	13.478	.005	.513	.013	14.50	.05	.03538	.094063	2.296	.040	2.65	.02	1.00	.02	21.4	3.6	7
8	254.0	345.0	.801	13.991	.005	3.798	.012	99.00	.15	.03836	.094064	2.179	.007	2.65	.02	1.00	.02	28.5	1.6	8
9	155.0	444.0	.815	17.789	.004	.642	.011	16.00	.05	.04012	.094065	2.111	.032	2.65	.02	1.00	.02	32.7	3.1	9
10	139.0	460.0	.818	18.431	.004	.481	.011	14.05	.05	.03424	.094065	2.341	.035	2.65	.02	1.00	.02	18.7	3.4	10
11	125.0	474.0	.820	18.912	.004	2.586	.010	68.95	.15	.03751	.094065	2.213	.009	2.65	.02	1.00	.02	26.5	1.7	11
12	56.0	543.0	.829	21.498	.003	.861	.009	24.00	.05	.03587	.094066	2.277	.018	2.65	.02	1.00	.02	22.6	2.3	12
13	32.0	567.0	.832	22.359	.003	.695	.011	19.05	.05	.03648	.094066	2.253	.026	2.65	.02	1.00	.02	24.1	2.8	13
14	13.0	586.0	.834	23.054	.005	1.588	.011	42.95	.05	.03697	.094067	2.234	.012	2.65	.02	1.00	.02	25.2	1.9	14
15	-30.0	629.0	.840	24.642	.003	.589	.009	15.00	.05	.03927	.094067	2.144	.029	2.65	.02	1.00	.02	30.7	2.9	15
16	-45.0	644.0	.842	25.231	.003	.913	.009	24.03	.05	.03800	.094068	2.194	.018	2.65	.02	1.00	.02	27.6	2.3	16
17	-69.0	668.0	.845	26.144	.003	.643	.009	17.97	.05	.03578	.094068	2.281	.023	2.65	.02	1.00	.02	22.4	2.6	17
18	-87.0	686.0	.847	26.787	.003	.414	.009	12.00	.05	.03450	.094068	2.331	.035	2.65	.02	1.00	.02	19.3	3.3	18
19	-99.0	698.0	.849	27.201	.003	1.128	.012	32.00	.05	.03525	.094068	2.301	.017	2.65	.02	1.00	.02	21.1	2.2	19
20	-131.0	730.0	.853	28.329	.006	1.473	.013	38.50	.05	.03826	.094069	2.184	.015	2.65	.02	1.00	.02	28.3	2.1	20
21	-169.5	768.5	.858	29.802	.004	1.058	.013	21.50	.05	.04921	.094069	1.755	.028	2.65	.02	1.00	.02	54.2	2.9	21
22	-191.0	790.0	.860	30.860	.006	1.251	.014	25.00	.05	.05004	.094069	1.723	.026	2.65	.02	1.00	.02	56.2	2.8	22
23	-216.0	815.0	.864	32.111	.005	3.834	.012	75.00	.15	.05112	.094070	1.681	.010	2.65	.02	1.00	.02	58.8	1.8	23
24	-291.0	890.0	.873	35.945	.004	3.685	.011	70.00	.15	.05264	.094071	1.621	.011	2.65	.02	1.00	.02	62.4	1.9	24
25	-361.0	960.0	.883	39.630	.004	4.028	.011	78.00	.15	.05164	.094072	1.660	.009	2.65	.02	1.00	.02	60.0	1.8	25
26	-439.0	1038.0	.893	43.658	.004	5.659	.011	112.00	.15	.05053	.094073	1.704	.006	2.65	.02	1.00	.02	57.3	1.6	26
27	-551.0	1150.0	.908	49.317	.004	5.590	.010	114.00	.15	.04903	.094074	1.762	.006	2.65	.02	1.00	.02	53.8	1.6	27
28	-665.0	1264.0	.924	54.907	.003	4.630	.010	95.00	.15	.04874	.094076	1.774	.007	2.65	.02	1.00	.02	53.1	1.6	28
29	-760.0	1359.0	.938	59.537	.004	7.933	.010	154.00	.15	.05151	.094077	1.665	.005	2.65	.02	1.00	.02	59.7	1.5	29
30	-914.0	1513.0	.960	67.470	.003	3.298	.009	65.00	.15	.05074	.094079	1.696	.010	2.65	.02	1.00	.02	57.8	1.8	30
31	-979.0	1578.0	.969	70.768	.003	.801	.009	15.00	.05	.05340	.094080	1.592	.030	2.65	.02	1.00	.02	64.1	3.1	31
32	-994.0	1593.0	.971	71.569	.003	1.004	.009	19.00	.05	.05284	.094080	1.613	.024	2.65	.02	1.00	.02	62.8	2.7	32
33	-1013.0	1612.0	.974	72.573	.003	1.164	.009	23.00	.05	.05061	.094081	1.701	.020	2.65	.02	1.00	.02	57.5	2.4	33
34	-1036.0	1635.0	.978	73.737	.003	4.606	.009	99.00	.15	.04653	.094081	1.861	.006	2.65	.02	1.00	.02	47.8	1.6	34
35	-1135.0	1734.0	.992	78.343	.003	2.150	.010	49.00	.05	.04388	.094082	1.964	.010	2.65	.02	1.00	.02	41.6	1.8	35
36	-1184.0	1783.0	.999	80.493	.004	1.113	.011	24.01	.05	.04636	.094083	1.867	.022	2.65	.02	1.00	.02	47.4	2.5	36
37	-1208.0	1807.0	1.003	81.606	.004	.507	.010	10.99	.05	.04613	.094083	1.876	.044	2.65	.02	1.00	.02	46.9	3.9	37
38	-1219.0	1818.0	1.005	82.113	.003	3.677	.009	84.00	.15	.04377	.094083	1.968	.007	2.65	.02	1.00	.02	41.3	1.7	38
39	-1303.0	1902.0	1.017	85.790	.003	2.573	.011	56.92	.15	.04520	.094084	1.913	.012	2.65	.02	1.00	.02	44.7	2.0	39
40	-1359.9	1958.9	1.026	88.363	.005	2.923	.011	67.08	.15	.04358	.094085	1.976	.010	2.65	.02	1.00	.02	40.8	1.8	40
41	-1427.0	2026.0	1.036	91.286	.003	4.976	.009	110.00	.15	.04524	.094086	1.911	.006	2.65	.02	1.00	.02	44.8	1.6	41
42	-1537.0	2136.0	1.053	96.262	.003	5.163	.009	121.01	.15	.04267	.094088	2.012	.005	2.65	.02	1.00	.02	38.7	1.5	42
43	-1658.0	2257.0	1.071	101.425	.003	6.402	.009	147.99	.15	.04326	.094089	1.989	.004	2.65	.02	1.00	.02	40.1	1.5	43
44	-1806.0	2405.0	1.094	107.827	.003	1.678	.009	41.00	.05	.04093	.094091	2.080	.011	2.65	.02	1.00	.02	34.5	1.9	44
45	-1847.0	2446.0	1.100	109.505	.003	7.231	.009	171.00	.15	.04229	.094092	2.027	.004	2.65	.02	1.00	.02	37.8	1.4	45
46	-2018.0	2617.0	1.127	116.736	.003	.764	.009	18.01	.05	.04242	.094094	2.022	.024	2.65	.02	1.00	.02	38.1	2.7	46

Table 7. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: KERNRIDGE OIL CO SOUTH BELRIDGE 548E
LOCATION: 34-28S-21E SOUTH BELRIDGE OIL FIELD KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-2036.0	2635.0	1.130	117.500	.003															
						3.568	.010	40.99	.15	.04405	.094094	1.958	.008	2.65	.02	1.00	.02	41.9	1.7	47
48	-2117.0	2716.0	1.142	121.068	.004															
						2.143	.011	49.00	.05	.04373	.094095	1.970	.011	2.65	.02	1.00	.02	41.2	1.9	48
49	-2166.0	2765.0	1.150	123.211	.004															
						2.155	.011	51.00	.15	.04226	.094096	2.028	.013	2.65	.02	1.00	.02	37.7	2.0	49
50	-2217.0	2816.0	1.158	125.366	.004															
						2.360	.012	55.01	.15	.04290	.094097	2.003	.013	2.65	.02	1.00	.02	39.2	2.0	50
51	-2272.0	2871.0	1.167	127.726	.005															
						1.423	.012	30.99	.05	.04592	.094097	1.885	.018	2.65	.02	1.00	.02	46.4	2.3	51
52	-2303.0	2902.0	1.171	129.149	.004															
						1.608	.010	36.00	.05	.04467	.094098	1.934	.013	2.65	.02	1.00	.02	43.4	2.0	52
53	-2339.0	2938.0	1.177	130.757	.003															
						2.839	.009	65.00	.15	.04368	.094098	1.973	.009	2.65	.02	1.00	.02	41.0	1.8	53
54	-2404.0	3003.0	1.187	133.596	.003															
						2.071	.009	46.01	.05	.04501	.094099	1.921	.010	2.65	.02	1.00	.02	44.2	1.8	54
55	-2450.0	3049.0	1.194	135.667	.003															
						.551	.009	11.99	.05	.04596	.094100	1.884	.037	2.65	.02	1.00	.02	46.4	3.4	55
56	-2462.0	3061.0	1.196	136.218	.003															
						2.175	.010	50.00	.15	.04350	.094100	1.980	.013	2.65	.02	1.00	.02	40.6	2.0	56
57	-2512.0	3111.0	1.204	138.393	.004															
						1.208	.010	27.00	.05	.04474	.094101	1.931	.018	2.65	.02	1.00	.02	43.6	2.3	57
58	-2539.0	3138.0	1.208	139.601	.003															
						1.746	.009	38.50	.05	.04535	.094101	1.907	.011	2.65	.02	1.00	.02	45.0	1.9	58
59	-2577.5	3176.5	1.214	141.347	.003															
						2.683	.009	61.50	.15	.04363	.094101	1.975	.010	2.65	.02	1.00	.02	40.9	1.8	59
60	-2639.0	3238.0	1.224	144.030	.003															
						2.838	.010	65.03	.15	.04364	.094102	1.974	.010	2.65	.02	1.00	.02	40.9	1.8	60
61	-2704.0	3303.0	1.234	146.868	.004															
						3.889	.011	90.97	.15	.04275	.094103	2.009	.007	2.65	.02	1.00	.02	38.8	1.7	61
62	-2795.0	3394.0	1.248	150.757	.004															
						.755	.011	17.00	.05	.04441	.094104	1.944	.030	2.65	.02	1.00	.02	42.8	3.1	62
63	-2812.0	3411.0	1.251	151.512	.004															
						4.413	.017	106.00	.15	.04163	.094105	2.053	.009	2.65	.02	1.00	.02	36.2	1.7	63
64	-2918.0	3517.0	1.268	155.925	.010															
						.304	.017	8.00	.05	.03800	.094106	2.195	.092	2.65	.02	1.00	.02	27.6	6.8	64
65	-2926.0	3525.0	1.269	156.229	.004															
						3.329	.011	79.00	.15	.04214	.094106	2.033	.009	2.65	.02	1.00	.02	37.4	1.7	65
66	-3005.0	3604.0	1.281	159.558	.004															
						3.040	.010	69.02	.15	.04405	.094107	1.959	.009	2.65	.02	1.00	.02	41.9	1.8	66
67	-3074.0	3673.0	1.292	162.598	.003															
						4.117	.009	97.98	.15	.04202	.094108	2.038	.006	2.65	.02	1.00	.02	37.1	1.6	67
68	-3172.0	3771.0	1.308	166.715	.003															
						3.739	.009	91.01	.15	.04108	.094109	2.075	.007	2.65	.02	1.00	.02	34.9	1.6	68
69	-3263.0	3862.0	1.322	170.454	.003															
						1.826	.010	41.99	.05	.04349	.094111	1.981	.011	2.65	.02	1.00	.02	40.6	1.9	69
70	-3305.0	3904.0	1.328	172.280	.004															
						3.714	.010	93.00	.15	.03994	.094111	2.120	.007	2.65	.02	1.00	.02	32.1	1.6	70
71	-3398.0	3997.0	1.343	175.994	.003															
						.446	.011	11.00	.05	.04054	.094112	2.096	.046	2.65	.02	1.00	.02	33.6	4.0	71
72	-3409.0	4008.0	1.345	176.440	.005															
						.328	.013	10.00	.05	.03280	.094113	2.399	.057	2.65	.02	1.00	.02	15.2	4.7	72
73	-3419.0	4018.0	1.346	176.768	.005															
						3.797	.011	98.00	.15	.03875	.094113	2.166	.007	2.65	.02	1.00	.02	29.3	1.6	73
74	-3517.0	4116.0	1.362	180.565	.003															
						7.110	.010	192.00	.15	.03703	.094114	2.233	.003	2.65	.02	1.00	.02	25.2	1.4	74
75	-3709.0	4308.0	1.391	187.675	.004															
						7.382	.012	206.00	.15	.03583	.094117	2.280	.003	2.65	.02	1.00	.02	22.4	1.4	75
76	-3915.0	4514.0	1.423	195.057	.005															
						8.081	.012	217.02	.15	.03724	.094119	2.226	.003	2.65	.02	1.00	.02	25.7	1.4	76
77	-4132.0	4731.0	1.457	203.138	.004															
						.932	.010	23.98	.05	.03887	.094122	2.162	.019	2.65	.02	1.00	.02	29.6	2.4	77
78	-4156.0	4755.0	1.461	204.270	.003															
						2.356	.009	65.00	.15	.03625	.094123	2.265	.009	2.65	.02	1.00	.02	23.4	1.7	78
79	-4221.0	4820.0	1.471	206.426	.003															
						2.618	.009	71.51	.15	.03661	.094123	2.250	.008	2.65	.02	1.00	.02	24.2	1.7	79
80	-4292.5	4891.5	1.482	209.044	.003															
						2.683	.009	77.49	.15	.03462	.094124	2.320	.007	2.65	.02	1.00	.02	19.5	1.6	80
81	-4370.0	4969.0	1.494	211.727	.003															
						5.370	.009	156.00	.15	.03442	.094125	2.336	.004	2.65	.02	1.00	.02	19.0	1.4	81
82	-4526.0	5125.0	1.517	217.097	.003															
						2.762	.009	81.05	.15	.03408	.094128	2.350	.007	2.65	.02	1.00	.02	18.2	1.6	82
83	-4607.0	5206.0	1.530	219.859	.003															
						5.168	.008	155.95	.15	.03314	.094129	2.386	.003	2.65	.02	1.00	.02	16.0	1.4	83
84	-4763.0	5362.0	1.554	225.027	.002															
						.550	.029	18.00	.05	.03056	.094131	2.487	.023	2.65	.02	1.00	.02	9.9	2.6	84
85	-4781.0	5380.0	1.556	225.577	.004															
						7.863	.011	235.01	.15	.03346	.094131	2.374	.003	2.65	.02	1.00	.02	16.7	1.4	85
86	-5016.0	5615.0	1.592	233.440	.004															
						3.290	.012	101.99	.15	.03226	.094134	2.421	.006	2.65	.02	1.00	.02	13.9	1.6	86
87	-5118.0	5717.0	1.607	236.730	.005															
						3.534	.011	106.00	.15	.03334	.094136	2.379	.006	2.65	.02	1.00	.02	16.4	1.6	87
88	-5224.0	5823.0	1.623	240.264	.003															
						1.038	.009	33.00	.05	.03146	.094137	2.453	.013	2.65	.02	1.00	.02	12.0	2.0	88
89	-5257.0	5856.0	1.628	241.302	.003															
						1.613	.010	49.00	.05	.03292	.094137	2.395	.009	2.65	.02	1.00	.02	15.4	1.8	89
90	-5306.0	5905.0	1.635	242.915	.004															
						1.302	.009	40.00	.05	.03255	.094138	2.410	.010	2.65	.02	1.00	.02	14.6	1.8	90
91	-5346.0	5945.0	1.641	244.217	.002															
						1.217	.007	37.00	.05	.03289	.094139	2.396	.009	2.65	.02	1.00	.02	15.4	1.8	91
92	-5383.0	5982.0	1.646	245.434	.002															
						3.790	.009	114.00	.15	.03325	.094139	2.383	.005	2.65	.02	1.00	.02	16.2	1.5	92
93	-5497.0	6096.0	1.663	249.224	.004															
						1.426	.009	43.01	.05	.03316	.094141	2.386	.010	2.65	.02	1.00	.02	16.0	1.8	93
94	-5540.0	6139.0	1.670	250.658	.002															
						1.559	.010	48.99	.05	.03182	.094141	2.438	.009	2.65	.02	1.00	.02	12.8	1.8	94
95	-5589.0	6188.0	1.677	252.209	.005															
						5.157	.012	163.01	.15	.03164	.094142	2.446	.004	2.65	.02	1.00	.02	12.4	1.5	95
96	-5752.0	6351.0	1.701	257.366	.004															
						1.205	.011	38.99	.05	.03091	.094144	2.474	.013	2.65	.02	1.00	.02	13.6	2.0	96
97	-5791.0	6390.0	1.706	258.571	.004															

Table 8. Basic data from borehole gravity survey in "Monte Cristo" 164 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: CHEVRON U.S.A. INC. MONTE CRISTO 164
LOCATION: 16-27S-21E LOST HILLS OIL FIELD KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	374.2	20.8	.520	.000	.003	20.446	.011	459.18	.15	.04453	.094062	1.938	.002	2.65	.02	1.00	.02	43.1	1.3	1
2	-85.0	480.0	.695	20.446	.005	13.761	.011	320.02	.15	.04300	.094068	1.998	.002	2.65	.02	1.00	.02	39.5	1.3	2
3	-405.0	800.0	.772	34.207	.003	14.623	.009	299.98	.15	.04875	.094072	1.773	.002	2.65	.02	1.00	.02	53.1	1.3	3
4	-705.0	1100.0	.833	48.830	.003	13.111	.010	299.99	.15	.04370	.094076	1.971	.002	2.65	.02	1.00	.02	41.2	1.3	4
5	-1005.0	1400.0	.886	61.941	.004	12.932	.010	300.03	.15	.04310	.094080	1.995	.002	2.65	.02	1.00	.02	39.7	1.3	5
6	-1305.0	1700.0	.933	74.873	.003	9.418	.009	199.98	.15	.04709	.094084	1.839	.003	2.65	.02	1.00	.02	49.2	1.4	6
7	-1505.0	1900.0	.962	84.291	.003	2.951	.009	66.50	.15	.04438	.094087	1.945	.009	2.65	.02	1.00	.02	42.7	1.8	7
8	-1571.5	1966.5	.971	87.242	.003	.876	.009	19.00	.05	.04610	.094088	1.877	.023	2.65	.02	1.00	.02	46.8	2.6	8
9	-1590.5	1985.5	.974	88.118	.003	4.731	.010	106.00	.15	.04463	.094088	1.935	.006	2.65	.02	1.00	.02	43.3	1.6	9
10	-1696.5	2091.5	.988	92.849	.004	2.840	.011	65.00	.15	.04369	.094089	1.972	.011	2.65	.02	1.00	.02	41.1	1.9	10
11	-1761.5	2156.5	.996	95.689	.004	.367	.011	8.05	.05	.04559	.094090	1.898	.065	2.65	.02	1.00	.02	45.6	5.1	11
12	-1769.6	2164.6	.997	96.056	.004	4.283	.011	96.45	.15	.04441	.094090	1.944	.007	2.65	.02	1.00	.02	42.8	1.6	12
13	-1866.0	2261.0	1.009	100.339	.004	6.388	.009	158.50	.15	.04030	.094092	2.105	.004	2.65	.02	1.00	.02	33.1	1.4	13
14	-2024.5	2419.5	1.029	106.727	.002	1.854	.007	49.00	.05	.03784	.094094	2.201	.007	2.65	.02	1.00	.02	27.2	1.6	14
15	-2073.5	2468.5	1.035	108.581	.002	1.129	.007	31.09	.05	.03631	.094094	2.261	.011	2.65	.02	1.00	.02	23.6	1.9	15
16	-2104.6	2499.6	1.038	109.710	.002	1.787	.007	47.94	.05	.03728	.094095	2.223	.007	2.65	.02	1.00	.02	25.9	1.7	16
17	-2152.5	2547.5	1.044	111.497	.002	2.770	.010	72.00	.15	.03847	.094095	2.176	.009	2.65	.02	1.00	.02	28.7	1.7	17
18	-2224.5	2619.5	1.052	114.267	.005	.379	.011	9.99	.05	.03794	.094096	2.197	.051	2.65	.02	1.00	.02	27.4	4.3	18
19	-2234.5	2629.5	1.054	114.646	.003	.795	.009	20.56	.05	.03867	.094097	2.169	.021	2.65	.02	1.00	.02	29.2	2.5	19
20	-2255.1	2650.1	1.056	115.441	.003	.492	.009	12.42	.05	.03961	.094097	2.132	.035	2.65	.02	1.00	.02	31.4	3.3	20
21	-2267.5	2662.5	1.057	115.933	.003	2.066	.016	51.00	.15	.04051	.094097	2.097	.017	2.65	.02	1.00	.02	33.5	2.2	21
22	-2318.5	2713.5	1.063	117.999	.010	1.659	.016	38.00	.05	.04366	.094098	1.974	.019	2.65	.02	1.00	.02	41.0	2.3	22
23	-2356.5	2751.5	1.067	119.658	.003	4.147	.009	99.00	.15	.04189	.094098	2.043	.006	2.65	.02	1.00	.02	36.8	1.6	23
24	-2455.5	2850.5	1.078	123.805	.003	1.258	.009	28.00	.05	.04493	.094100	1.924	.016	2.65	.02	1.00	.02	44.0	2.2	24
25	-2483.5	2878.5	1.081	125.063	.003	2.077	.009	48.00	.05	.04327	.094100	1.989	.009	2.65	.02	1.00	.02	40.1	1.8	25
26	-2531.5	2926.5	1.086	127.140	.003	1.918	.009	46.05	.05	.04165	.094101	2.052	.009	2.65	.02	1.00	.02	36.2	1.8	26
27	-2577.6	2972.6	1.091	129.058	.003	2.418	.009	53.43	.15	.04526	.094101	1.911	.012	2.65	.02	1.00	.02	44.8	1.9	27
28	-2631.0	3026.0	1.097	131.476	.003	1.986	.009	48.53	.05	.04092	.094102	2.081	.009	2.65	.02	1.00	.02	34.5	1.8	28
29	-2679.5	3074.5	1.102	133.462	.003	1.363	.009	31.99	.05	.04261	.094103	2.015	.014	2.65	.02	1.00	.02	38.5	2.0	29
30	-2711.5	3106.5	1.105	134.825	.003	1.138	.009	28.33	.05	.04017	.094103	2.110	.015	2.65	.02	1.00	.02	32.7	2.1	30
31	-2739.8	3134.8	1.108	135.963	.003	1.192	.009	27.67	.05	.04308	.094103	1.996	.016	2.65	.02	1.00	.02	39.6	2.2	31
32	-2767.5	3162.5	1.111	137.155	.003	.658	.009	16.50	.05	.03988	.094104	2.122	.026	2.65	.02	1.00	.02	32.0	2.8	32
33	-2784.0	3179.0	1.113	137.813	.003	1.032	.009	24.50	.05	.04212	.094104	2.034	.018	2.65	.02	1.00	.02	37.3	2.3	33
34	-2808.5	3203.5	1.115	138.845	.003	1.562	.009	39.00	.05	.04005	.094104	2.115	.011	2.65	.02	1.00	.02	32.4	1.9	34
35	-2847.5	3242.5	1.119	140.407	.003	3.796	.009	94.02	.15	.04037	.094105	2.102	.006	2.65	.02	1.00	.02	33.2	1.6	35
36	-2941.5	3336.5	1.129	144.203	.003	.385	.009	9.50	.05	.04053	.094106	2.096	.045	2.65	.02	1.00	.02	33.6	4.0	36
37	-2951.0	3346.0	1.130	144.588	.003	1.584	.009	39.48	.05	.04012	.094106	2.112	.011	2.65	.02	1.00	.02	32.6	1.9	37
38	-2990.5	3385.5	1.134	146.172	.003	.380	.009	9.57	.05	.03971	.094107	2.128	.045	2.65	.02	1.00	.02	31.6	3.9	38
39	-3000.1	3395.1	1.135	146.552	.003	2.087	.009	53.45	.15	.03905	.094107	2.154	.011	2.65	.02	1.00	.02	30.0	1.9	39
40	-3053.5	3448.5	1.140	148.639	.003	1.773	.009	43.00	.05	.04123	.094108	2.069	.010	2.65	.02	1.00	.02	35.2	1.8	40
41	-3096.5	3491.5	1.144	150.412	.003	.634	.009	14.99	.05	.04230	.094108	2.027	.029	2.65	.02	1.00	.02	37.7	3.0	41
42	-3111.5	3506.5	1.145	151.046	.003	2.224	.009	57.49	.15	.03868	.094108	2.169	.010	2.65	.02	1.00	.02	29.2	1.8	42
43	-3169.0	3564.0	1.151	153.270	.003	2.955	.009	69.50	.15	.04252	.094109	2.019	.009	2.65	.02	1.00	.02	38.3	1.7	43
44	-3238.5	3633.5	1.158	156.225	.003	2.125	.009	52.35	.15	.04059	.094110	2.094	.011	2.65	.02	1.00	.02	33.7	1.9	44
45	-3290.9	3685.9	1.163	158.350	.003	1.746	.009	40.65	.05	.04295	.094111	2.002	.011	2.65	.02	1.00	.02	39.3	1.9	45
46	-3331.5	3726.5	1.166	160.096	.003	3.619	.009	89.54	.15	.04042	.094111	2.101	.007	2.65	.02	1.00	.02	33.3	1.6	46

Table 8. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: CHEVRON U.S.A. INC. MONTE CRISTO 164
LOCATION: 16-27S-21E LOST HILLS OIL FIELD KERN COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-3421.0	3816.0	1.175	163.715	.003															
						.633	.009	14.46	.05	.04378	.094112	1.969	.030	2.65	.02	1.00	.02	41.2	3.0	47
48	-3435.5	3830.5	1.176	164.348	.003															
						.693	.009	17.51	.05	.03958	.094113	2.134	.025	2.65	.02	1.00	.02	31.3	2.7	48
49	-3453.0	3848.0	1.178	165.041	.003															
						.286	.009	7.01	.05	.04080	.094113	2.086	.062	2.65	.02	1.00	.02	34.2	4.9	49
50	-3460.0	3855.0	1.178	165.327	.003															
						5.404	.009	131.98	.15	.04095	.094113	2.080	.004	2.65	.02	1.00	.02	34.5	1.5	50
51	-3592.0	3987.0	1.190	170.731	.003															
						4.431	.009	110.02	.15	.04027	.094115	2.107	.005	2.65	.02	1.00	.02	32.9	1.5	51
52	-3702.0	4097.0	1.200	175.162	.003															
						6.122	.009	151.98	.15	.04028	.094116	2.106	.004	2.65	.02	1.00	.02	32.9	1.4	52
53	-3854.0	4249.0	1.213	181.284	.003															
						1.878	.009	44.00	.05	.04268	.094118	2.013	.010	2.65	.02	1.00	.02	38.6	1.8	53
54	-3898.0	4293.0	1.217	183.162	.003															
						1.876	.009	46.00	.05	.04078	.094119	2.087	.009	2.65	.02	1.00	.02	34.1	1.8	54
55	-3944.0	4339.0	1.221	185.038	.003															
						1.197	.009	29.02	.05	.04125	.094119	2.069	.015	2.65	.02	1.00	.02	35.2	2.1	55
56	-3973.0	4368.0	1.223	186.235	.003															
						.478	.009	10.98	.05	.04353	.094120	1.979	.040	2.65	.02	1.00	.02	40.6	3.6	56
57	-3984.0	4379.0	1.224	186.713	.003															
						1.121	.009	26.50	.05	.04230	.094120	2.027	.016	2.65	.02	1.00	.02	37.7	2.2	57
58	-4010.5	4405.5	1.227	187.834	.003															
						3.860	.009	92.54	.15	.04171	.094120	2.051	.006	2.65	.02	1.00	.02	36.3	1.6	58
59	-4103.0	4498.0	1.234	191.694	.003															
						1.382	.009	31.96	.05	.04324	.094122	1.991	.014	2.65	.02	1.00	.02	40.0	2.0	59
60	-4135.0	4530.0	1.237	193.076	.003															
						.839	.009	19.02	.05	.04411	.094122	1.957	.023	2.65	.02	1.00	.02	42.0	2.6	60
61	-4154.0	4549.0	1.239	193.915	.003															
						.430	.009	10.03	.05	.04287	.094122	2.005	.043	2.65	.02	1.00	.02	39.1	3.8	61
62	-4164.0	4559.0	1.239	194.345	.003															
						.416	.009	9.47	.05	.04393	.094122	1.964	.046	2.65	.02	1.00	.02	41.6	4.0	62
63	-4173.5	4568.5	1.240	194.761	.003															
						.448	.010	10.00	.05	.04480	.094123	1.930	.048	2.65	.02	1.00	.02	43.6	4.1	63
64	-4183.5	4578.5	1.241	195.209	.004															
						.648	.010	16.48	.05	.03932	.094123	2.144	.028	2.65	.02	1.00	.02	30.7	2.9	64
65	-4200.0	4595.0	1.242	195.857	.003															
						1.104	.009	26.00	.05	.04246	.094123	2.021	.017	2.65	.02	1.00	.02	38.1	2.2	65
66	-4226.0	4621.0	1.245	196.961	.003															
						.461	.009	12.01	.05	.03838	.094123	2.181	.036	2.65	.02	1.00	.02	28.4	3.4	66
67	-4238.0	4633.0	1.246	197.422	.003															
						1.132	.009	26.00	.05	.04354	.094123	1.979	.017	2.65	.02	1.00	.02	40.7	2.2	67
68	-4264.0	4659.0	1.248	198.554	.003															
						1.204	.009	28.99	.05	.04153	.094124	2.058	.015	2.65	.02	1.00	.02	35.9	2.1	68
69	-4293.0	4688.0	1.250	199.758	.003															
						3.774	.009	97.03	.15	.03890	.094124	2.161	.006	2.65	.02	1.00	.02	29.6	1.6	69
70	-4390.0	4785.0	1.258	203.532	.003															
						5.439	.009	143.99	.15	.03777	.094125	2.205	.004	2.65	.02	1.00	.02	27.0	1.5	70
71	-4534.0	4929.0	1.269	208.971	.003															
						.412	.009	9.98	.05	.04128	.094127	2.068	.043	2.65	.02	1.00	.02	35.3	3.8	71
72	-4544.0	4939.0	1.270	209.383	.003															
						.376	.009	10.00	.05	.03760	.094128	2.212	.043	2.65	.02	1.00	.02	26.6	3.8	72
73	-4554.0	4949.0	1.271	209.759	.003															
						.334	.009	8.03	.05	.04160	.094128	2.055	.054	2.65	.02	1.00	.02	36.0	4.5	73
74	-4562.0	4957.0	1.272	210.093	.003															
						1.696	.009	41.99	.05	.04039	.094128	2.103	.010	2.65	.02	1.00	.02	33.2	1.8	74
75	-4604.0	4999.0	1.275	211.789	.003															
						.634	.009	15.49	.05	.04093	.094128	2.081	.028	2.65	.02	1.00	.02	34.5	2.9	75
76	-4619.5	5014.5	1.276	212.423	.003															
						2.226	.009	56.49	.15	.03940	.094129	2.141	.010	2.65	.02	1.00	.02	30.8	1.8	76
77	-4676.0	5071.0	1.280	214.649	.003															
						1.243	.009	32.02	.05	.03882	.094129	2.164	.013	2.65	.02	1.00	.02	29.5	2.0	77
78	-4708.0	5103.0	1.283	215.892	.003															
						.973	.009	25.99	.05	.03744	.094130	2.218	.016	2.65	.02	1.00	.02	26.2	2.2	78
79	-4734.0	5129.0	1.285	216.865	.003															
						2.056	.009	55.01	.15	.03737	.094130	2.221	.010	2.65	.02	1.00	.02	26.0	1.8	79
80	-4789.0	5184.0	1.289	218.921	.003															
						1.680	.009	42.01	.05	.03999	.094131	2.118	.010	2.65	.02	1.00	.02	32.2	1.8	80
81	-4831.0	5226.0	1.292	220.601	.003															
						.812	.009	21.97	.05	.03696	.094131	2.237	.019	2.65	.02	1.00	.02	25.0	2.4	81
82	-4853.0	5248.0	1.294	221.413	.003															
						2.471	.009	63.02	.15	.03921	.094132	2.149	.009	2.65	.02	1.00	.02	30.4	1.8	82
83	-4916.0	5311.0	1.299	223.884	.003															
						2.798	.009	72.98	.15	.03834	.094133	2.183	.008	2.65	.02	1.00	.02	28.3	1.7	83
84	-4989.0	5384.0	1.304	226.682	.003															
						.986	.009	25.30	.05	.03897	.094133	2.158	.017	2.65	.02	1.00	.02	29.8	2.2	84
85	-5014.3	5409.3	1.306	227.668	.003															
						1.636	.009	45.71	.05	.03579	.094134	2.283	.009	2.65	.02	1.00	.02	22.3	1.8	85
86	-5060.0	5455.0	1.309	229.304	.003															
						6.806	.009	187.99	.15	.03620	.094134	2.267	.003	2.65	.02	1.00	.02	23.2	1.4	86
87	-5248.0	5643.0	1.323	236.110	.003															
						1.750	.009	50.00	.15	.03500	.094137	2.314	.011	2.65	.02	1.00	.02	20.4	1.9	87
88	-5298.0	5693.0	1.327	237.860	.003															
						3.307	.009	92.00	.15	.03595	.094138	2.277	.006	2.65	.02	1.00	.02	22.6	1.6	88
89	-5390.0	5785.0	1.333	241.167	.003															
						3.240	.009	90.02	.15	.03599	.094139	2.275	.006	2.65	.02	1.00	.02	22.7	1.6	89
90	-5480.0	5875.0	1.339	244.407	.003															
						1.596	.009	43.98	.05	.03629	.094140	2.264	.010	2.65	.02	1.00	.02	23.4	1.8	90
91	-5524.0	5919.0	1.342	246.003	.003															

Table 9. Basic data from borehole gravity survey in "Arellanes" 2 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: UNION OIL CO. OF CALIFORNIA ARELLANES 2
LOCATION: 13-9N-35W CASMALIA OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	528.6	16.9	1.833	.000	.002															
						8.867	.009	183.09	.15	.04843	.094061	1.785	.003	2.65	.02	1.00	.02	52.4	1.4	1
2	345.5	200.0	1.317	8.867	.004															
						4.786	.010	100.03	.15	.04785	.094064	1.800	.007	2.65	.02	1.00	.02	51.0	1.6	2
3	245.5	300.0	1.139	13.653	.003															
						4.556	.009	99.98	.15	.04557	.094065	1.897	.006	2.65	.02	1.00	.02	45.6	1.6	3
4	145.5	400.0	.997	18.209	.003															
						5.689	.010	125.00	.15	.04551	.094066	1.900	.005	2.65	.02	1.00	.02	45.5	1.5	4
5	20.5	525.0	.848	23.898	.004															
						3.558	.010	80.03	.15	.04446	.094068	1.941	.008	2.65	.02	1.00	.02	43.0	1.7	5
6	-59.5	605.0	.761	27.456	.003															
						4.620	.009	108.97	.15	.04240	.094069	2.022	.006	2.65	.02	1.00	.02	38.1	1.5	6
7	-168.5	714.0	.649	32.076	.003															
						.925	.008	21.03	.05	.04399	.094070	1.960	.019	2.65	.02	1.00	.02	41.8	2.4	7
8	-189.5	735.0	.629	33.201	.002															
						1.722	.007	40.97	.05	.04203	.094071	2.036	.009	2.65	.02	1.00	.02	37.2	1.7	8
9	-230.5	776.0	.589	34.723	.002															
						1.487	.008	35.09	.05	.04238	.094071	2.023	.011	2.65	.02	1.00	.02	38.0	1.9	9
10	-265.6	811.1	.555	36.210	.003															
						1.212	.009	28.92	.05	.04191	.094072	2.041	.015	2.65	.02	1.00	.02	36.9	2.1	10
11	-294.5	840.0	.527	37.422	.003															
						2.080	.008	49.99	.05	.04161	.094072	2.053	.008	2.65	.02	1.00	.02	36.2	1.7	11
12	-344.5	890.0	.480	39.502	.002															
						1.234	.007	30.00	.05	.04113	.094073	2.071	.012	2.65	.02	1.00	.02	35.1	1.9	12
13	-374.5	920.0	.452	40.736	.002															
						2.066	.007	49.00	.05	.04216	.094073	2.031	.007	2.65	.02	1.00	.02	37.5	1.7	13
14	-423.5	969.0	.407	42.802	.002															
						2.163	.007	53.00	.05	.04081	.094074	2.084	.007	2.65	.02	1.00	.02	34.3	1.6	14
15	-476.5	1022.0	.359	44.965	.002															
						2.489	.007	60.00	.05	.04148	.094075	2.058	.006	2.65	.02	1.00	.02	35.9	1.6	15
16	-536.5	1082.0	.306	47.454	.002															
						1.218	.008	30.00	.05	.04060	.094075	2.092	.013	2.65	.02	1.00	.02	33.8	2.0	16
17	-566.5	1112.0	.279	48.672	.003															
						.987	.011	24.00	.05	.04113	.094076	2.072	.021	2.65	.02	1.00	.02	35.0	2.5	17
18	-590.5	1136.0	.258	49.659	.005															
						.954	.010	24.04	.05	.03968	.094076	2.128	.020	2.65	.02	1.00	.02	31.6	2.4	18
19	-614.5	1160.0	.238	50.613	.002															
						1.157	.007	28.96	.05	.03995	.094076	2.118	.012	2.65	.02	1.00	.02	32.3	1.9	19
20	-643.5	1189.0	.213	51.770	.002															
						1.531	.008	38.03	.05	.04026	.094077	2.106	.010	2.65	.02	1.00	.02	33.0	1.8	20
21	-681.5	1227.0	.180	53.301	.003															
						.933	.009	23.97	.05	.03892	.094077	2.158	.018	2.65	.02	1.00	.02	29.8	2.3	21
22	-705.5	1251.0	.160	54.234	.003															
						1.815	.009	46.00	.05	.03946	.094078	2.137	.009	2.65	.02	1.00	.02	31.1	1.8	22
23	-751.5	1297.0	.121	56.049	.003															
						1.248	.009	32.00	.05	.03900	.094078	2.155	.013	2.65	.02	1.00	.02	30.0	2.0	23
24	-783.5	1329.0	.094	57.297	.003															
						1.849	.010	47.00	.05	.03934	.094079	2.142	.010	2.65	.02	1.00	.02	30.8	1.8	24
25	-830.5	1376.0	.055	59.146	.004															
						1.145	.012	30.00	.05	.03817	.094079	2.188	.018	2.65	.02	1.00	.02	28.0	2.3	25
26	-860.5	1406.0	.031	60.291	.005															
						2.711	.012	69.02	.05	.03928	.094080	2.144	.008	2.65	.02	1.00	.02	30.7	1.7	26
27	-929.5	1475.0	-.025	63.002	.004															
						1.576	.010	41.00	.05	.03844	.094081	2.177	.011	2.65	.02	1.00	.02	28.7	1.9	27
28	-970.5	1516.0	-.058	64.578	.003															
						1.287	.008	33.01	.05	.03899	.094081	2.156	.012	2.65	.02	1.00	.02	30.0	1.9	28
29	-1003.5	1549.0	-.084	65.865	.002															
						.653	.007	18.98	.05	.03440	.094082	2.335	.018	2.65	.02	1.00	.02	19.1	2.3	29
30	-1022.5	1568.0	-.099	66.518	.002															
						3.348	.007	88.99	.05	.03762	.094082	2.209	.004	2.65	.02	1.00	.02	26.7	1.4	30
31	-1111.5	1657.0	-.168	69.866	.002															
						1.318	.008	35.00	.05	.03766	.094083	2.208	.011	2.65	.02	1.00	.02	26.8	1.9	31
32	-1146.5	1692.0	-.195	71.184	.003															
						3.425	.008	90.02	.05	.03805	.094084	2.193	.004	2.65	.02	1.00	.02	27.7	1.5	32
33	-1236.5	1782.0	-.263	74.609	.002															
						.406	.007	11.00	.05	.03691	.094085	2.237	.031	2.65	.02	1.00	.02	25.0	3.1	33
34	-1247.5	1793.0	-.271	75.015	.002															
						1.447	.009	39.98	.05	.03619	.094085	2.265	.011	2.65	.02	1.00	.02	23.3	1.9	34
35	-1287.5	1833.0	-.301	76.462	.004															
						2.212	.009	59.01	.05	.03748	.094085	2.215	.007	2.65	.02	1.00	.02	26.4	1.6	35
36	-1346.5	1892.0	-.344	78.674	.002															
						1.304	.007	36.99	.05	.03525	.094086	2.302	.009	2.65	.02	1.00	.02	21.1	1.8	36
37	-1383.5	1929.0	-.371	79.978	.002															
						.712	.009	21.00	.05	.03390	.094087	2.355	.020	2.65	.02	1.00	.02	17.9	2.4	37
38	-1404.5	1950.0	-.386	80.690	.004															
						3.375	.010	92.00	.05	.03668	.094087	2.246	.005	2.65	.02	1.00	.02	24.5	1.5	38
39	-1496.5	2042.0	-.452	84.065	.003															
						1.444	.009	42.00	.05	.03438	.094088	2.336	.010	2.65	.02	1.00	.02	19.0	1.8	39
40	-1538.5	2084.0	-.482	85.509	.003															
						2.482	.009	73.00	.05	.03400	.094089	2.351	.006	2.65	.02	1.00	.02	18.1	1.6	40
41	-1611.5	2157.0	-.533	87.991	.003															
						.661	.008	21.00	.05	.03148	.094090	2.450	.018	2.65	.02	1.00	.02	12.1	2.3	41
42	-1632.5	2178.0	-.547	88.652	.002															
						1.551	.007	44.00	.05	.03525	.094090	2.302	.008	2.65	.02	1.00	.02	21.1	1.7	42
43	-1676.5	2222.0	-.577	90.203	.002															
						2.004	.008	56.00	.05	.03579	.094091	2.281	.007	2.65	.02	1.00	.02	22.3	1.6	43
44	-1732.5	2278.0	-.616	92.207	.003															
						.845	.009	26.00	.05	.03250	.094091	2.410	.016	2.65	.02	1.00	.02	14.6	2.2	44
45	-1758.5	2304.0	-.633	93.052	.003															
						1.092	.008	30.00	.05	.03640	.094092	2.257	.013	2.65	.02	1.00	.02	23.8	2.0	45
46	-1788.5	2334.0	-.653	94.144	.002															
						.736	.008	21.10	.05	.03488	.094092	2.317	.018	2.65	.02	1.00	.02	20.2	2.3	46

Table 9. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: UNION OIL CO. OF CALIFORNIA ARELLANES 2
LOCATION: 13-9W-35W CASMALIA OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-1809.6	2355.1	-.667	94.880	.003	1.537	.009	45.92	.05	.03347	.094092	2.372	.009	2.65	.02	1.00	.02	16.9	1.8	47
48	-1855.5	2401.0	-.698	96.417	.003	.939	.009	27.98	.05	.03356	.094093	2.369	.015	2.65	.02	1.00	.02	17.1	2.1	48
49	-1883.5	2429.0	-.716	97.356	.003	1.422	.009	41.00	.05	.03468	.094093	2.325	.010	2.65	.02	1.00	.02	19.7	1.8	49
50	-1924.5	2470.0	-.743	98.778	.003	.945	.009	30.00	.05	.03150	.094094	2.449	.014	2.65	.02	1.00	.02	12.2	2.0	50
51	-1954.5	2500.0	-.763	99.723	.003	1.446	.009	43.01	.05	.03362	.094094	2.366	.010	2.65	.02	1.00	.02	17.2	1.8	51
52	-1997.5	2543.0	-.791	101.169	.003	1.995	.008	60.99	.05	.03271	.094095	2.402	.006	2.65	.02	1.00	.02	15.0	1.6	52
53	-2058.5	2604.0	-.830	103.164	.002	1.772	.008	55.85	.05	.03173	.094096	2.440	.007	2.65	.02	1.00	.02	12.7	1.6	53
54	-2114.4	2659.9	-.865	104.936	.003	2.019	.009	62.03	.05	.03255	.094097	2.408	.007	2.65	.02	1.00	.02	14.7	1.6	54
55	-2176.4	2721.9	-.905	106.955	.003	1.777	.009	55.98	.05	.03174	.094097	2.440	.007	2.65	.02	1.00	.02	12.7	1.7	55
56	-2232.4	2777.9	-.940	108.732	.003	2.223	.009	67.99	.05	.03270	.094098	2.403	.006	2.65	.02	1.00	.02	15.0	1.6	56
57	-2300.4	2845.9	-.982	110.955	.003	1.382	.008	43.97	.05	.03143	.094099	2.452	.009	2.65	.02	1.00	.02	12.0	1.7	57
58	-2344.3	2889.8	-1.009	112.337	.002	1.152	.008	36.08	.05	.03193	.094100	2.433	.010	2.65	.02	1.00	.02	13.2	1.8	58
59	-2380.4	2925.9	-1.031	113.489	.003	.863	.008	28.00	.05	.03082	.094100	2.476	.013	2.65	.02	1.00	.02	10.6	2.0	59
60	-2408.4	2953.9	-1.048	114.352	.002	1.101	.007	34.93	.05	.03152	.094100	2.449	.010	2.65	.02	1.00	.02	12.2	1.8	60
61	-2443.3	2988.8	-1.069	115.453	.002	1.985	.007	62.98	.05	.03152	.094101	2.449	.005	2.65	.02	1.00	.02	12.2	1.5	61
62	-2506.3	3051.8	-1.107	117.438	.002	1.364	.007	43.04	.05	.03169	.094102	2.442	.008	2.65	.02	1.00	.02	12.6	1.7	62
63	-2549.4	3094.9	-1.132	118.802	.002	2.682	.007	85.00	.05	.03155	.094102	2.447	.004	2.65	.02	1.00	.02	12.3	1.5	63
64	-2634.4	3179.9	-1.183	121.484	.002	1.412	.007	42.00	.05	.03362	.094104	2.367	.008	2.65	.02	1.00	.02	17.2	1.7	64
65	-2676.4	3221.9	-1.207	122.896	.002	1.661	.008	49.93	.05	.03327	.094104	2.380	.008	2.65	.02	1.00	.02	16.3	1.7	65
66	-2726.3	3271.8	-1.237	124.557	.003	2.128	.008	63.98	.05	.03326	.094105	2.381	.006	2.65	.02	1.00	.02	16.3	1.6	66
67	-2790.3	3335.8	-1.274	126.685	.002	2.384	.008	71.94	.05	.03314	.094106	2.385	.005	2.65	.02	1.00	.02	16.0	1.5	67
68	-2862.2	3407.7	-1.315	129.069	.003	1.558	.009	47.04	.05	.03312	.094107	2.386	.009	2.65	.02	1.00	.02	16.0	1.7	68
69	-2909.2	3454.7	-1.342	130.627	.003	.873	.008	26.11	.05	.03344	.094107	2.374	.014	2.65	.02	1.00	.02	16.7	2.1	69
70	-2935.4	3480.9	-1.357	131.500	.002	1.504	.007	44.70	.05	.03365	.094108	2.366	.008	2.65	.02	1.00	.02	17.2	1.7	70
71	-2980.1	3525.6	-1.382	133.004	.002	2.744	.007	86.26	.05	.03181	.094108	2.438	.004	2.65	.02	1.00	.02	12.9	1.4	71
72	-3066.3	3611.8	-1.431	135.748	.002	.491	.007	14.94	.05	.03287	.094109	2.396	.023	2.65	.02	1.00	.02	15.4	2.6	72
73	-3081.3	3626.8	-1.439	136.239	.002	2.901	.007	92.00	.05	.03153	.094110	2.448	.004	2.65	.02	1.00	.02	12.2	1.4	73
74	-3173.3	3718.8	-1.490	139.140	.002	2.379	.007	77.10	.05	.03086	.094111	2.475	.004	2.65	.02	1.00	.02	10.6	1.5	74
75	-3250.4	3795.9	-1.533	141.519	.002	.619	.007	20.01	.05	.03093	.094112	2.472	.017	2.65	.02	1.00	.02	10.8	2.2	75
76	-3270.4	3815.9	-1.544	142.138	.002	2.120	.007	68.99	.05	.03073	.094112	2.480	.005	2.65	.02	1.00	.02	10.3	1.5	76
77	-3339.4	3884.9	-1.582	144.258	.002	.767	.007	25.00	.05	.03068	.094113	2.482	.013	2.65	.02	1.00	.02	10.2	2.0	77
78	-3364.4	3909.9	-1.595	145.025	.002	4.177	.007	134.86	.05	.03097	.094113	2.470	.002	2.65	.02	1.00	.02	10.9	1.4	78
79	-3499.2	4044.7	-1.668	149.202	.002	1.269	.007	41.14	.05	.03084	.094115	2.476	.008	2.65	.02	1.00	.02	10.6	1.7	79
80	-3540.4	4085.9	-1.698	150.471	.002	1.061	.007	34.00	.05	.03121	.094116	2.461	.010	2.65	.02	1.00	.02	11.4	1.8	80
81	-3574.4	4119.9	-1.709	151.532	.002	2.025	.008	70.00	.05	.02893	.094116	2.551	.005	2.65	.02	1.00	.02	6.0	1.5	81
82	-3644.4	4189.9	-1.746	153.557	.003	1.322	.008	45.97	.05	.02876	.094117	2.557	.008	2.65	.02	1.00	.02	5.6	1.7	82
83	-3690.3	4235.8	-1.770	154.879	.002	1.332	.007	45.95	.05	.02899	.094118	2.548	.007	2.65	.02	1.00	.02	6.2	1.6	83
84	-3736.3	4281.8	-1.795	156.211	.002															

Table 10. Basic data from borehole gravity survey in "Newlove" 108 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: UNION OIL CO. OF CALIFORNIA NEWLOVE 108
LOCATION: 36-9N-34W ORCUTT OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	669.4	19.5	1.694	.000	.002															
						10.984	.008	229.17	.15	.04793	.094059	1.805	.003	2.65	.02	1.00	.02	51.2	1.4	1
2	440.2	248.6	2.125	10.984	.003															
						8.649	.010	169.93	.15	.05090	.094062	1.689	.004	2.65	.02	1.00	.02	58.2	1.5	2
3	270.3	418.5	2.327	19.633	.004															
						6.213	.010	121.45	.15	.05116	.094065	1.679	.006	2.65	.02	1.00	.02	58.9	1.6	3
4	148.8	540.0	2.423	25.846	.003															
						1.894	.009	36.00	.05	.05261	.094066	1.622	.013	2.65	.02	1.00	.02	62.3	2.0	4
5	112.8	576.0	2.446	27.740	.003															
						1.414	.011	26.00	.05	.05439	.094067	1.553	.021	2.65	.02	1.00	.02	66.5	2.5	5
6	86.8	602.0	2.460	29.154	.005															
						1.452	.010	28.00	.05	.05186	.094067	1.652	.018	2.65	.02	1.00	.02	60.5	2.3	6
7	58.8	630.0	2.475	30.606	.002															
						2.999	.008	58.00	.15	.05171	.094068	1.657	.011	2.65	.02	1.00	.02	60.2	1.9	7
8	.8	688.2	2.501	33.605	.003															
						.390	.008	8.00	.05	.04875	.094068	1.773	.051	2.65	.02	1.00	.02	53.1	4.3	8
9	-7.2	696.2	2.504	33.995	.002															
						1.347	.007	27.00	.05	.04989	.094068	1.729	.014	2.65	.02	1.00	.02	55.8	2.0	9
10	-34.2	723.2	2.513	35.342	.002															
						.596	.008	12.02	.05	.04958	.094069	1.741	.034	2.65	.02	1.00	.02	55.1	3.3	10
11	-46.2	735.2	2.518	35.938	.003															
						3.289	.009	66.98	.15	.04910	.094069	1.759	.010	2.65	.02	1.00	.02	54.0	1.8	11
12	-113.2	802.2	2.536	39.227	.003															
						1.149	.008	24.00	.05	.04788	.094070	1.807	.017	2.65	.02	1.00	.02	51.1	2.2	12
13	-137.2	826.2	2.542	40.376	.002															
						3.711	.009	76.00	.15	.04883	.094070	1.770	.008	2.65	.02	1.00	.02	53.3	1.7	13
14	-213.2	902.2	2.554	44.087	.004															
						.857	.009	19.00	.05	.04511	.094071	1.916	.023	2.65	.02	1.00	.02	44.5	2.6	14
15	-232.2	921.2	2.556	44.944	.002															
						1.073	.009	23.00	.05	.04665	.094071	1.855	.019	2.65	.02	1.00	.02	48.2	2.4	15
16	-255.2	944.2	2.559	46.017	.004															
						.555	.009	12.00	.05	.04625	.094072	1.871	.037	2.65	.02	1.00	.02	47.2	3.4	16
17	-267.2	956.2	2.559	46.572	.002															
						1.458	.007	30.00	.05	.04860	.094072	1.779	.012	2.65	.02	1.00	.02	52.8	2.0	17
18	-297.2	986.2	2.561	48.030	.002															
						.755	.008	15.00	.05	.05033	.094072	1.711	.027	2.65	.02	1.00	.02	56.9	2.9	18
19	-312.2	1001.2	2.562	48.785	.003															
						1.120	.008	22.00	.05	.05091	.094072	1.689	.019	2.65	.02	1.00	.02	58.3	2.3	19
20	-334.2	1023.2	2.562	49.905	.002															
						.783	.007	16.00	.05	.04894	.094073	1.766	.023	2.65	.02	1.00	.02	53.6	2.6	20
21	-350.2	1039.2	2.562	50.688	.002															
						1.642	.008	35.00	.05	.04691	.094073	1.845	.012	2.65	.02	1.00	.02	48.8	1.9	21
22	-385.2	1074.2	2.561	52.330	.003															
						1.269	.009	26.00	.05	.04881	.094073	1.771	.017	2.65	.02	1.00	.02	53.3	2.3	22
23	-411.2	1100.2	2.560	53.599	.003															
						.842	.009	18.00	.05	.04678	.094074	1.851	.025	2.65	.02	1.00	.02	48.4	2.7	23
24	-429.2	1118.2	2.559	54.441	.003															
						1.039	.010	22.00	.05	.04723	.094074	1.833	.022	2.65	.02	1.00	.02	49.5	2.5	24
25	-451.2	1140.2	2.557	55.480	.004															
						1.995	.010	43.50	.05	.04586	.094074	1.886	.011	2.65	.02	1.00	.02	46.3	1.9	25
26	-494.7	1183.5	2.552	57.475	.003															
						.849	.008	17.40	.05	.04879	.094075	1.772	.023	2.65	.02	1.00	.02	53.2	2.6	26
27	-512.1	1200.9	2.550	58.324	.002															
						1.729	.007	39.10	.05	.04422	.094075	1.951	.009	2.65	.02	1.00	.02	42.4	1.8	27
28	-551.2	1240.0	2.545	60.053	.002															
						1.787	.007	40.00	.05	.04468	.094076	1.933	.009	2.65	.02	1.00	.02	43.5	1.8	28
29	-591.2	1280.0	2.538	61.840	.002															
						3.450	.007	80.00	.15	.04312	.094076	1.994	.007	2.65	.02	1.00	.02	39.8	1.6	29
30	-671.2	1360.0	2.522	65.290	.002															
						4.821	.007	110.00	.15	.04383	.094077	1.966	.005	2.65	.02	1.00	.02	41.4	1.5	30
31	-781.2	1470.0	2.494	70.111	.002															
						8.479	.008	198.00	.15	.04282	.094079	2.005	.003	2.65	.02	1.00	.02	39.1	1.4	31
32	-979.2	1668.0	2.431	78.590	.003															
						7.505	.009	172.05	.15	.04362	.094081	1.974	.004	2.65	.02	1.00	.02	40.9	1.4	32
33	-1151.2	1840.1	2.365	86.095	.003															
						3.374	.009	75.08	.15	.04494	.094084	1.923	.008	2.65	.02	1.00	.02	44.1	1.7	33
34	-1226.3	1915.1	2.334	89.469	.003															
						2.313	.008	53.87	.15	.04294	.094085	2.001	.010	2.65	.02	1.00	.02	39.3	1.0	34
35	-1280.2	1969.2	2.311	91.782	.002															
						.944	.008	21.00	.05	.04495	.094085	1.922	.019	2.65	.02	1.00	.02	44.1	2.4	35
36	-1301.2	1990.2	2.302	92.726	.003															
						.987	.008	23.03	.05	.04286	.094086	2.004	.017	2.65	.02	1.00	.02	39.1	2.3	36
37	-1324.2	2013.2	2.292	93.713	.002															
						.611	.007	15.48	.05	.03947	.094086	2.137	.023	2.65	.02	1.00	.02	31.1	2.6	37
38	-1339.7	2028.5	2.285	94.324	.002															
						5.790	.007	137.50	.15	.04211	.094086	2.034	.004	2.65	.02	1.00	.02	37.3	1.4	38
39	-1477.2	2166.2	2.221	100.114	.002															
						5.988	.008	143.99	.15	.04159	.094088	2.054	.004	2.65	.02	1.00	.02	36.1	1.4	39
40	-1621.2	2310.2	2.151	106.102	.003															
						5.805	.011	139.25	.15	.04169	.094090	2.050	.005	2.65	.02	1.00	.02	36.3	1.5	40
41	-1760.4	2449.3	2.081	111.907	.005															
						2.377	.010	59.89	.15	.03969	.094092	2.129	.010	2.65	.02	1.00	.02	31.6	1.8	41
42	-1820.3	2509.1	2.051	114.284	.002															
						1.175	.007	29.96	.05	.03922	.094093	2.147	.012	2.65	.02	1.00	.02	30.5	1.9	42
43	-1850.3	2539.1	2.035	115.459	.002															
						1.585	.007	39.55	.05	.04008	.094093	2.113	.009	2.65	.02	1.00	.02	32.5	1.8	43
44	-1889.8	2578.6	2.015	117.044	.002															
						1.324	.008	34.48	.05	.03840	.094094	2.179	.011	2.65	.02	1.00	.02	28.5	1.9	44
45	-1924.3	2613.1	1.997	118.368	.003															
						.491	.008	12.52	.05	.03922	.094094	2.147	.031	2.65	.02	1.00	.02	30.5	3.1	45
46	-1936.8	2625.6	1.990	118.859	.002															
						2.569	.007	66.45	.15	.03866	.094094	2.169	.008	2.65	.02	1.00	.02	29.2	1.7	46

Table 10. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: UNION OIL CO. OF CALIFORNIA NEWLOVE 108
LOCATION: 36-9N-34W ORCUTT OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-2003.3	2692.1	1.955	121.428	.002	2.005	.008	52.00	.15	.03856	.094095	2.173	.010	2.65	.02	1.00	.02	28.9	1.8	47
48	-2055.3	2744.1	1.927	123.433	.003	1.076	.009	29.03	.05	.03707	.094096	2.231	.015	2.65	.02	1.00	.02	25.4	2.1	48
49	-2084.3	2773.1	1.912	124.509	.003	1.301	.009	33.97	.05	.03830	.094096	2.183	.013	2.65	.02	1.00	.02	28.3	2.0	49
50	-2118.3	2807.1	1.893	125.810	.003	.906	.008	25.00	.05	.03624	.094097	2.264	.015	2.65	.02	1.00	.02	23.4	2.1	50
51	-2143.3	2832.1	1.880	126.716	.002	.374	.007	10.00	.05	.03740	.094097	2.219	.035	2.65	.02	1.00	.02	26.1	3.3	51
52	-2153.3	2842.1	1.875	127.090	.002	.503	.007	13.04	.05	.03857	.094097	2.172	.027	2.65	.02	1.00	.02	28.9	2.8	52
53	-2166.3	2855.1	1.868	127.593	.002	1.488	.007	38.02	.05	.03914	.094097	2.150	.009	2.65	.02	1.00	.02	30.3	1.8	53
54	-2204.3	2893.2	1.847	129.081	.002	.918	.008	24.44	.05	.03756	.094098	2.212	.016	2.65	.02	1.00	.02	26.5	2.2	54
55	-2228.8	2917.6	1.834	129.999	.003	1.033	.009	26.53	.05	.03894	.094098	2.158	.016	2.65	.02	1.00	.02	29.8	2.2	55
56	-2255.3	2944.1	1.819	131.032	.003	.792	.009	20.99	.05	.03773	.094099	2.205	.020	2.65	.02	1.00	.02	26.9	2.4	56
57	-2276.3	2965.1	1.808	131.824	.003	1.095	.008	28.98	.05	.03778	.094099	2.203	.013	2.65	.02	1.00	.02	27.1	2.0	57
58	-2305.3	2994.1	1.792	132.919	.002	.366	.008	10.00	.05	.03660	.094099	2.250	.038	2.65	.02	1.00	.02	24.3	3.5	58
59	-2315.3	3004.1	1.787	133.285	.003	1.105	.009	30.03	.05	.03680	.094099	2.242	.014	2.65	.02	1.00	.02	24.7	2.1	59
60	-2345.3	3034.1	1.770	134.390	.003	1.759	.008	46.00	.05	.03824	.094100	2.186	.008	2.65	.02	1.00	.02	28.1	1.7	60
61	-2391.3	3080.1	1.745	136.149	.002	1.614	.007	43.99	.05	.03669	.094100	2.246	.008	2.65	.02	1.00	.02	24.5	1.7	61
62	-2435.3	3124.1	1.721	137.763	.002	1.806	.007	52.00	.15	.03473	.094101	2.323	.009	2.65	.02	1.00	.02	19.8	1.8	62
63	-2487.3	3176.1	1.693	139.569	.002	1.495	.007	43.98	.05	.03399	.094102	2.352	.008	2.65	.02	1.00	.02	18.1	1.7	63
64	-2531.3	3220.1	1.668	141.064	.002	.682	.008	20.00	.05	.03410	.094102	2.348	.019	2.65	.02	1.00	.02	18.3	2.4	64
65	-2551.3	3240.1	1.657	141.746	.003	3.200	.009	96.15	.15	.03328	.094102	2.380	.006	2.65	.02	1.00	.02	16.4	1.6	65
66	-2647.4	3336.3	1.604	144.946	.003	1.178	.008	36.03	.05	.03269	.094104	2.403	.010	2.65	.02	1.00	.02	15.0	1.8	66
67	-2683.5	3372.3	1.584	146.124	.002	1.142	.007	34.97	.05	.03266	.094104	2.404	.010	2.65	.02	1.00	.02	14.9	1.8	67
68	-2718.4	3407.3	1.565	147.266	.002	.321	.007	10.03	.05	.03200	.094105	2.430	.034	2.65	.02	1.00	.02	13.3	3.2	68
69	-2728.5	3417.3	1.559	147.587	.002	2.578	.007	76.97	.15	.03349	.094105	2.372	.006	2.65	.02	1.00	.02	16.9	1.6	69
70	-2805.4	3494.3	1.517	150.165	.002	2.211	.007	67.52	.15	.03275	.094106	2.401	.007	2.65	.02	1.00	.02	15.1	1.6	70
71	-2873.0	3561.8	1.480	152.376	.002	1.718	.009	52.52	.15	.03401	.094107	2.352	.011	2.65	.02	1.00	.02	18.1	1.9	71
72	-2923.5	3612.3	1.452	154.094	.004	1.995	.009	59.99	.05	.03326	.094107	2.381	.007	2.65	.02	1.00	.02	16.3	1.6	72
73	-2983.5	3672.3	1.418	156.089	.002	.558	.007	17.01	.05	.03281	.094108	2.399	.020	2.65	.02	1.00	.02	15.2	2.4	73
74	-3000.5	3689.3	1.409	156.647	.002	.376	.008	10.96	.05	.03431	.094109	2.340	.035	2.65	.02	1.00	.02	18.8	3.3	74
75	-3011.4	3700.3	1.403	157.023	.003	.650	.008	20.02	.05	.03246	.094109	2.412	.019	2.65	.02	1.00	.02	14.4	2.4	75
76	-3031.5	3720.3	1.392	157.673	.002	1.671	.008	52.00	.15	.03214	.094109	2.425	.010	2.65	.02	1.00	.02	13.6	1.8	76
77	-3083.5	3772.3	1.363	159.344	.003	.399	.008	13.00	.05	.03069	.094110	2.481	.029	2.65	.02	1.00	.02	10.2	3.0	77
78	-3096.5	3785.3	1.356	159.743	.002	.429	.007	13.00	.05	.03300	.094110	2.391	.026	2.65	.02	1.00	.02	15.7	2.8	78
79	-3109.5	3798.3	1.349	160.172	.002	1.987	.007	61.02	.15	.03256	.094110	2.408	.008	2.65	.02	1.00	.02	14.7	1.7	79
80	-3170.5	3859.3	1.315	162.159	.002	.685	.008	19.98	.05	.03428	.094111	2.341	.019	2.65	.02	1.00	.02	18.7	2.4	80
81	-3190.5	3879.3	1.304	162.844	.003															

Table 11. Basic data from borehole gravity survey in "Union Bell Fee" 156 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: HUMBLE/UNION OIL CO OF CALIFORNIA UNION BELL FEE 156
LOCATION: 35-9N-33 W 33 WEST CAT CANYON OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	804.6	400.0	-.352	.200	.00															
						16.474	.009	394.00	.15	.04181	.094058	2.044	.002	2.65	.02	1.00	.02	36.7	1.3	1
2	410.6	794.0	-1.525	16.474	.003															
						13.212	.011	396.00	.15	.04318	.094063	1.991	.002	2.65	.02	1.00	.02	39.9	1.3	2
3	104.6	1100.0	-2.143	29.686	.005															
						14.017	.011	300.00	.15	.04672	.094067	1.852	.002	2.65	.02	1.00	.02	48.3	1.4	3
4	-195.4	1400.0	-2.649	43.703	.003															
						15.638	.008	345.00	.15	.04533	.094071	1.907	.002	2.65	.02	1.00	.02	45.0	1.3	4
5	-540.4	1745.0	-3.153	59.341	.002															
						10.646	.009	261.00	.15	.04079	.094076	2.085	.002	2.65	.02	1.00	.02	34.2	1.4	5
6	-801.4	2006.0	-3.493	69.987	.004															
						18.090	.012	434.00	.15	.04168	.094079	2.050	.002	2.65	.02	1.00	.02	36.4	1.3	6
7	-1235.4	2440.0	-3.995	88.077	.005															
						1.795	.010	47.00	.05	.03819	.094085	2.187	.010	2.65	.02	1.00	.02	28.1	1.8	7
8	-1282.4	2487.0	-4.046	89.872	.002															
						7.290	.008	185.00	.15	.03941	.094086	2.139	.003	2.65	.02	1.00	.02	30.9	1.4	8
9	-1467.4	2672.0	-4.236	97.162	.003															
						3.352	.009	88.00	.15	.03809	.094088	2.191	.007	2.65	.02	1.00	.02	27.8	1.6	9
10	-1555.4	2760.0	-4.324	100.514	.003															
						.551	.028	14.02	.05	.03930	.094089	2.144	.028	2.65	.02	1.00	.02	30.7	2.9	10
11	-1569.4	2774.0	-4.337	101.065	.002															
						2.762	.008	71.98	.15	.03837	.094089	2.180	.007	2.65	.02	1.00	.02	28.5	1.7	11
12	-1641.4	2846.0	-4.406	103.927	.003															
						.531	.029	14.00	.05	.03792	.094090	2.198	.030	2.65	.02	1.00	.02	27.4	3.1	12
13	-1655.4	2860.0	-4.420	104.458	.003															
						5.102	.009	138.00	.15	.03697	.094091	2.235	.004	2.65	.02	1.00	.02	25.2	1.5	13
14	-1793.4	2998.0	-4.548	109.460	.003															
						.659	.008	17.00	.05	.03876	.094092	2.165	.023	2.65	.02	1.00	.02	29.4	2.6	14
15	-1810.4	3015.0	-4.563	110.119	.002															
						4.288	.008	118.05	.15	.03632	.094093	2.260	.004	2.65	.02	1.00	.02	23.6	1.5	15
16	-1928.5	3133.1	-4.668	114.447	.003															
						1.276	.009	33.95	.05	.03759	.094094	2.211	.013	2.65	.02	1.00	.02	26.6	2.0	16
17	-1962.4	3167.0	-4.698	115.683	.003															
						1.470	.009	40.99	.05	.03586	.094095	2.278	.010	2.65	.02	1.00	.02	22.5	1.8	17
18	-2003.4	3208.0	-4.733	117.153	.003															
						.919	.009	24.00	.05	.03829	.094095	2.183	.018	2.65	.02	1.00	.02	28.3	2.3	18
19	-2027.4	3232.0	-4.754	118.072	.003															
						4.587	.009	128.02	.15	.03583	.094095	2.280	.004	2.65	.02	1.00	.02	22.4	1.5	19
20	-2155.4	3360.0	-4.860	122.659	.003															
						.843	.008	24.02	.05	.03509	.094097	2.309	.016	2.65	.02	1.00	.02	20.7	2.2	20
21	-2179.4	3384.0	-4.880	123.502	.002															
						2.020	.007	58.96	.15	.03426	.094098	2.341	.008	2.65	.02	1.00	.02	18.7	1.7	21
22	-2238.4	3443.0	-4.928	125.522	.002															
						.973	.008	27.00	.05	.03604	.094098	2.272	.014	2.65	.02	1.00	.02	22.9	2.1	22
23	-2265.4	3470.0	-4.949	126.495	.003															
						3.341	.009	97.01	.15	.03444	.094099	2.334	.006	2.65	.02	1.00	.02	19.1	1.6	23
24	-2362.4	3567.0	-5.026	129.836	.003															
						1.244	.008	35.03	.05	.03551	.094100	2.292	.011	2.65	.02	1.00	.02	21.7	1.9	24
25	-2397.4	3602.0	-5.053	131.280	.002															
						3.806	.008	113.97	.15	.03339	.094100	2.375	.004	2.65	.02	1.00	.02	16.7	1.5	25
26	-2511.4	3716.0	-5.139	134.886	.003															
						2.985	.008	89.03	.15	.03353	.094102	2.370	.006	2.65	.02	1.00	.02	17.0	1.6	26
27	-2600.4	3805.0	-5.204	137.871	.002															
						3.972	.007	119.97	.15	.03311	.094103	2.387	.004	2.65	.02	1.00	.02	16.0	1.4	27
28	-2720.4	3925.0	-5.290	141.843	.002															
						4.082	.007	125.00	.15	.03266	.094105	2.404	.004	2.65	.02	1.00	.02	14.9	1.4	28
29	-2845.4	4050.0	-5.377	145.925	.002															
						2.361	.007	73.00	.15	.03234	.094106	2.417	.006	2.65	.02	1.00	.02	14.1	1.6	29
30	-2918.4	4123.0	-5.427	148.286	.002															
						3.451	.008	108.03	.15	.03194	.094107	2.432	.005	2.65	.02	1.00	.02	13.2	1.5	30
31	-3026.4	4231.0	-5.498	151.737	.003															
						1.060	.008	30.97	.05	.03423	.094109	2.343	.012	2.65	.02	1.00	.02	18.6	2.0	31
32	-3057.4	4262.0	-5.518	152.797	.002															
						1.679	.008	53.03	.15	.03166	.094109	2.443	.009	2.65	.02	1.00	.02	12.5	1.8	32
33	-3110.4	4315.0	-5.552	154.476	.003															
						.819	.009	24.97	.05	.03280	.094110	2.399	.017	2.65	.02	1.00	.02	15.2	2.2	33
34	-3135.4	4340.0	-5.568	155.295	.003															
						1.799	.008	52.00	.15	.03460	.094110	2.329	.010	2.65	.02	1.00	.02	19.5	1.8	34
35	-3187.4	4392.0	-5.601	157.094	.002															
						1.678	.007	49.00	.05	.03424	.094111	2.342	.007	2.65	.02	1.00	.02	18.6	1.6	35
36	-3236.4	4441.0	-5.632	158.772	.002															
						2.647	.007	79.03	.15	.03349	.094112	2.372	.006	2.65	.02	1.00	.02	16.9	1.6	36
37	-3315.4	4520.0	-5.680	161.419	.002															
						4.304	.007	130.00	.15	.03311	.094113	2.387	.004	2.65	.02	1.00	.02	15.9	1.4	37
38	-3445.4	4650.0	-5.758	165.723	.002															
						1.423	.007	42.97	.05	.03312	.094115	2.387	.008	2.65	.02	1.00	.02	16.0	1.7	38
39	-3488.4	4693.0	-5.783	167.146	.002															
						7.923	.009	237.04	.15	.03343	.094115	2.375	.002	2.65	.02	1.00	.02	16.7	1.4	39
40	-3725.4	4930.0	-5.918	175.069	.004															
						.386	.010	11.50	.05	.03356	.094118	2.369	.040	2.65	.02	1.00	.02	17.0	3.6	40
41	-3736.9	4941.5	-5.924	175.455	.003															
						.319	.009	8.94	.05	.03568	.094118	2.287	.047	2.65	.02	1.00	.02	22.0	4.1	41
42	-3745.9	4950.5	-5.929	175.774	.003															
						.424	.009	12.03	.05	.03525	.094119	2.303	.035	2.65	.02	1.00	.02	21.0	3.3	42
43	-3757.9	4962.5	-5.936	176.198	.003															
						.526	.010	15.52	.05	.03389	.094119	2.357	.029	2.65	.02	1.00	.02	17.8	3.0	43
44	-3773.4	4978.0	-5.944	176.724	.004															
						.315	.010	9.99	.05	.03154	.094119	2.449	.045	2.65	.02	1.00	.02	12.2	4.0	44
45	-3783.4	4988.0	-5.950	177.039	.003															
						1.524	.008	43.99	.05	.03464	.094119	2.327	.009	2.65	.02	1.00	.02	19.6	1.7	45
46	-3827.4	5032.0	-5.974	178.563	.002															
						1.307	.008	40.02	.05	.03266	.094120	2.405	.009	2.65	.02	1.00	.02	14.9	1.8	46

Table 11. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: HUMBLE/UNION OIL CO OF CALIFORNIA UNION BELL FEE 156
LOCATION: 35-9N-33 W 33 WEST CAT CANYON OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-3867.4	5072.0	-5.995	179.870	.003	2.557	.009	76.01	.15	.03364	.094120	2.366	.007	2.65	.02	1.00	.02	17.2	1.7	47
48	-3943.4	5148.0	-6.036	182.427	.003	.668	.009	19.98	.05	.03343	.094121	2.375	.021	2.65	.02	1.00	.02	16.7	2.5	48
49	-3963.4	5168.0	-6.046	183.095	.003	1.415	.009	42.00	.05	.03369	.094121	2.364	.010	2.65	.02	1.00	.02	17.3	1.8	49
50	-4005.4	5210.0	-6.068	184.510	.003	1.165	.008	35.00	.05	.03329	.094122	2.380	.011	2.65	.02	1.00	.02	16.3	1.9	50
51	-4040.4	5245.0	-6.086	185.675	.002	.360	.008	10.97	.05	.03281	.094122	2.399	.034	2.65	.02	1.00	.02	15.2	3.3	51
52	-4051.4	5256.0	-6.092	186.035	.003	1.327	.009	39.00	.05	.03403	.094123	2.351	.011	2.65	.02	1.00	.02	18.1	1.9	52
53	-4090.4	5295.0	-6.112	187.362	.003	1.171	.008	35.00	.05	.03346	.094123	2.374	.011	2.65	.02	1.00	.02	16.7	1.9	53
54	-4125.4	5330.0	-6.129	188.533	.002	.467	.008	12.97	.05	.03601	.094124	2.274	.030	2.65	.02	1.00	.02	22.8	3.0	54
55	-4138.4	5343.0	-6.136	189.000	.003	2.055	.008	62.63	.15	.03281	.094124	2.399	.008	2.65	.02	1.00	.02	15.2	1.7	55
56	-4201.0	5405.6	-6.167	191.055	.002	.244	.008	7.42	.05	.03287	.094125	2.397	.051	2.65	.02	1.00	.02	15.4	4.3	56
57	-4208.4	5413.0	-6.171	191.299	.003	.491	.009	15.51	.05	.03166	.094125	2.444	.027	2.65	.02	1.00	.02	12.5	2.8	57
58	-4223.9	5428.5	-6.179	191.790	.003	.255	.008	7.47	.05	.03414	.094125	2.347	.051	2.65	.02	1.00	.02	18.4	4.3	58
59	-4231.4	5436.0	-6.182	192.045	.002	3.281	.008	102.02	.15	.03216	.094125	2.425	.005	2.65	.02	1.00	.02	13.7	1.5	59
60	-4333.4	5538.0	-6.232	195.326	.003	.394	.008	12.99	.05	.03033	.094126	2.496	.029	2.65	.02	1.00	.02	9.3	2.9	60
61	-4346.4	5551.0	-6.239	195.720	.002	.853	.008	26.99	.05	.03160	.094127	2.446	.014	2.65	.02	1.00	.02	12.3	2.1	61
62	-4373.4	5578.0	-6.252	196.573	.003	.364	.008	12.54	.05	.02904	.094127	2.547	.029	2.65	.02	1.00	.02	6.3	3.0	62
63	-4385.9	5590.5	-6.258	196.937	.002	.622	.009	19.48	.05	.03193	.094127	2.434	.021	2.65	.02	1.00	.02	13.1	2.5	63
64	-4405.4	5610.0	-6.267	197.559	.004	.351	.010	11.98	.05	.02929	.094127	2.537	.037	2.65	.02	1.00	.02	6.9	3.5	64
65	-4417.4	5622.0	-6.273	197.910	.003	.347	.008	12.01	.05	.02890	.094128	2.552	.031	2.65	.02	1.00	.02	5.9	3.1	65
66	-4429.4	5634.0	-6.278	198.257	.002	.994	.007	32.00	.05	.03106	.094128	2.468	.010	2.65	.02	1.00	.02	11.1	1.8	66
67	-4461.4	5666.0	-6.293	199.251	.002	1.101	.008	41.99	.05	.02622	.094128	2.657	.009	2.65	.02	1.00	.02	-.4	1.7	67
68	-4503.4	5708.0	-6.313	200.352	.003	1.527	.009	52.01	.15	.02936	.094129	2.534	.010	2.65	.02	1.00	.02	7.0	1.8	68
69	-4555.4	5760.0	-6.337	201.879	.003	1.629	.008	55.99	.15	.02909	.094129	2.545	.009	2.65	.02	1.00	.02	6.4	1.7	69
70	-4611.4	5816.0	-6.363	203.508	.002	.431	.008	14.00	.05	.03079	.094130	2.478	.027	2.65	.02	1.00	.02	10.4	2.8	70
71	-4625.4	5830.0	-6.369	203.939	.003	.198	.009	7.04	.05	.02813	.094130	2.582	.058	2.65	.02	1.00	.02	4.1	4.7	71
72	-4632.4	5837.0	-6.373	204.137	.003	.523	.009	17.47	.05	.02994	.094130	2.512	.024	2.65	.02	1.00	.02	8.4	2.6	72
73	-4649.9	5854.5	-6.380	204.660	.003	.742	.008	25.96	.05	.02858	.094131	2.565	.014	2.65	.02	1.00	.02	5.2	2.1	73
74	-4675.9	5880.5	-6.392	205.402	.002	.804	.008	27.54	.05	.02919	.094131	2.541	.013	2.65	.02	1.00	.02	6.6	2.0	74
75	-4703.4	5908.0	-6.405	206.206	.003	.197	.008	6.08	.05	.03242	.094131	2.415	.062	2.65	.02	1.00	.02	14.3	5.0	75
76	-4709.5	5914.1	-6.407	206.403	.002	.410	.007	13.92	.05	.02945	.094131	2.531	.024	2.65	.02	1.00	.02	7.2	2.7	76
77	-4723.4	5928.0	-6.414	206.813	.002	.394	.007	13.02	.05	.03026	.094132	2.499	.026	2.65	.02	1.00	.02	9.1	2.8	77
78	-4736.4	5941.0	-6.419	207.207	.002															

Table 12. Basic data borehole gravity survey in "Morrison" 23-7 (see p. 4 for explanation.

USGS BOREHOLE GRAVITY SURVEY: CHEVRON USA INC MORRISON 23-7
LOCATION: 7-9N-33W SANTA MARIA VALLEY OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	540.9	34.5	1.866	.324	.004	10.687	.012	229.40	.15	.04659	.094061	1.858	.003	2.65	.02	1.00	.02	48.0	1.4	1
2	311.5	259.9	1.883	10.687	.005	14.634	.014	250.40	.15	.04254	.094064	2.016	.003	2.65	.02	1.00	.02	38.4	1.4	2
3	61.5	509.9	1.831	21.321	.006	9.327	.014	254.40	.15	.03731	.094067	2.221	.003	2.65	.02	1.00	.02	26.0	1.4	3
4	-188.5	759.9	1.786	30.648	.005	9.474	.014	254.40	.15	.03790	.094071	2.198	.003	2.65	.02	1.00	.02	27.4	1.4	4
5	-438.5	1009.9	1.751	40.122	.006	9.603	.012	254.00	.15	.03841	.094074	2.178	.003	2.65	.02	1.00	.02	28.6	1.4	5
6	-688.5	1259.9	1.722	49.725	.003	9.869	.009	256.40	.15	.03855	.094077	2.173	.002	2.65	.02	1.00	.02	28.9	1.3	6
7	-944.5	1515.9	1.695	59.594	.003	13.961	.009	366.40	.15	.03814	.094081	2.189	.002	2.65	.02	1.00	.02	28.0	1.3	7
8	-1319.5	1891.9	1.659	73.555	.003	11.079	.009	292.00	.15	.03794	.094086	2.197	.002	2.65	.02	1.00	.02	27.5	1.3	8
9	-1602.5	2173.9	1.633	84.634	.003	11.368	.009	298.02	.15	.03815	.094090	2.189	.002	2.65	.02	1.00	.02	27.9	1.3	9
10	-1900.5	2471.9	1.606	96.402	.003	11.390	.009	299.98	.15	.03797	.094094	2.196	.002	2.65	.02	1.00	.02	27.5	1.3	10
11	-2200.5	2771.9	1.580	107.392	.003	11.357	.008	301.50	.15	.03767	.094098	2.208	.002	2.65	.02	1.00	.02	26.8	1.3	11
12	-2502.0	3073.4	1.555	118.749	.002	8.276	.007	223.50	.15	.03703	.094102	2.233	.002	2.65	.02	1.00	.02	25.3	1.3	12
13	-2725.5	3296.9	1.536	127.025	.002	8.454	.009	229.40	.15	.03692	.094105	2.238	.002	2.65	.02	1.00	.02	25.0	1.4	13
14	-2954.5	3525.9	1.517	135.479	.004	12.409	.010	333.10	.15	.03725	.094108	2.225	.002	2.65	.02	1.00	.02	25.8	1.3	14
15	-3287.6	3859.0	1.491	147.888	.003	7.285	.008	199.90	.15	.03644	.094112	2.256	.003	2.65	.02	1.00	.02	23.9	1.4	15
16	-3487.5	4058.9	1.475	155.173	.002	2.864	.008	75.40	.15	.03819	.094115	2.188	.007	2.65	.02	1.00	.02	28.2	1.6	16
17	-3562.5	4133.9	1.469	158.037	.003	14.244	.010	368.40	.15	.03871	.094116	2.168	.002	2.65	.02	1.00	.02	29.2	1.3	17
18	-3930.5	4501.9	1.440	172.281	.004	7.347	.011	197.00	.15	.03729	.094121	2.223	.003	2.65	.02	1.00	.02	25.9	1.4	18
19	-4127.5	4698.9	1.425	179.628	.004	9.437	.010	249.40	.15	.03790	.094123	2.200	.002	2.65	.02	1.00	.02	27.3	1.4	19
20	-4376.5	4947.9	1.406	189.065	.003	3.346	.009	89.30	.15	.03764	.094127	2.212	.006	2.65	.02	1.00	.02	26.6	1.6	20
21	-4465.5	5036.9	1.399	192.411	.003	11.672	.009	358.40	.15	.03260	.094128	2.407	.002	2.65	.02	1.00	.02	14.7	1.3	21
22	-4823.5	5394.9	1.372	206.083	.003	12.329	.009	387.30	.15	.03186	.094133	2.437	.001	2.65	.02	1.00	.02	12.9	1.3	22
23	-5214.5	5781.9	1.343	216.412	.003	5.599	.008	176.00	.15	.03145	.094138	2.453	.003	2.65	.02	1.00	.02	12.0	1.4	23
24	-5388.5	5953.9	1.330	222.011	.002	10.838	.007	362.00	.15	.02994	.094140	2.512	.001	2.65	.02	1.00	.02	8.4	1.3	24
25	-5750.5	6321.9	1.303	232.849	.002	3.852	.007	125.30	.15	.03082	.094145	2.478	.004	2.65	.02	1.00	.02	10.4	1.4	25
26	-5875.5	6446.9	1.294	236.701	.002	5.075	.007	162.40	.15	.03133	.094147	2.458	.003	2.65	.02	1.00	.02	11.6	1.4	26
27	-6037.5	6608.9	1.282	241.776	.002	1.581	.009	51.00	.05	.03100	.094149	2.471	.008	2.65	.02	1.00	.02	10.9	1.7	27
28	-6088.5	6659.9	1.278	243.357	.004	7.553	.009	234.40	.15	.03284	.094150	2.399	.002	2.65	.02	1.00	.02	15.2	1.4	28
29	-6318.5	6889.9	1.262	250.910	.002	2.974	.007	95.40	.15	.03126	.094153	2.461	.005	2.65	.02	1.00	.02	11.5	1.5	29
30	-6413.5	6984.9	1.255	253.884	.002	.213	.007	7.40	.05	.03043	.094154	2.493	.048	2.65	.02	1.00	.02	9.5	4.1	30
31	-6420.5	6991.9	1.254	254.093	.002	.296	.008	10.00	.05	.02960	.094154	2.526	.037	2.65	.02	1.00	.02	7.5	3.5	31
32	-6430.5	7001.9	1.253	254.389	.003	4.326	.011	142.70	.15	.03032	.094154	2.498	.004	2.65	.02	1.00	.02	9.2	1.5	32
33	-6573.2	7144.6	1.243	258.715	.005	.617	.013	21.40	.05	.02938	.094156	2.534	.027	2.65	.02	1.00	.02	7.8	2.8	33
34	-6594.2	7165.6	1.241	259.332	.005	.819	.011	29.00	.05	.02824	.094157	2.579	.017	2.65	.02	1.00	.02	4.3	2.2	34
35	-6623.2	7194.6	1.239	260.151	.003	.695	.010	25.30	.05	.02780	.094157	2.596	.018	2.65	.02	1.00	.02	3.3	2.3	35
36	-6648.2	7219.6	1.237	260.846	.004	.924	.012	31.00	.05	.02981	.094157	2.518	.017	2.65	.02	1.00	.02	8.0	2.2	36
37	-6679.2	7250.6	1.235	261.770	.005	1.138	.012	38.42	.05	.02993	.094158	2.513	.014	2.65	.02	1.00	.02	8.3	2.1	37
38	-6717.2	7288.6	1.232	262.996	.004	1.691	.010	56.98	.05	.02968	.094158	2.523	.008	2.65	.02	1.00	.02	7.7	1.7	38
39	-6774.2	7345.6	1.228	264.599	.003	1.217	.009	41.40	.05	.02968	.094159	2.523	.010	2.65	.02	1.00	.02	7.7	1.8	39
40	-6815.2	7386.6	1.225	265.815	.003	.747	.008	26.02	.05	.02871	.094160	2.561	.014	2.65	.02	1.00	.02	5.4	2.1	40
41	-6841.2	7412.6	1.223	266.563	.002	1.584	.008	52.99	.05	.02989	.094160	2.515	.007	2.65	.02	1.00	.02	8.2	1.6	41
42	-6894.2	7465.6	1.220	268.147	.003	1.995	.010	68.01	.05	.02933	.094161	2.536	.007	2.65	.02	1.00	.02	6.9	1.6	42
43	-6962.2	7533.6	1.215	270.142	.004	.845	.012	27.98	.05	.03020	.094161	2.503	.019	2.65	.02	1.00	.02	8.9	2.4	43
44	-6994.2	7561.6	1.213	270.987	.005															

Table 13. Basic data from borehole gravity survey in "Rosenblum" 6 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: UNION OIL CO. OF CALIFORNIA ROSENBLUM 6
LOCATION: 25-10N-34W SANTA MARIA VALLEY OIL FIELD SANTA BARBARA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	263.5	10.7	1.493	.300	.010															
						9.635	.019	239.30	.15	.04026	.094065	2.105	.004	2.65	.02	1.00	.02	33.0	1.5	1
2	24.2	250.0	1.520	9.635	.006															
						9.769	.011	250.00	.15	.03908	.094068	2.152	.003	2.65	.02	1.00	.02	30.2	1.4	2
3	-225.8	500.0	1.560	19.404	.002															
						10.707	.010	283.00	.15	.03783	.094071	2.200	.002	2.65	.02	1.00	.02	27.2	1.3	3
4	-508.8	783.0	1.605	30.111	.005															
						8.469	.011	223.00	.15	.03798	.094075	2.195	.003	2.65	.02	1.00	.02	27.6	1.4	4
5	-731.8	1006.0	1.639	38.580	.003															
						6.553	.009	176.00	.15	.03723	.094078	2.224	.003	2.65	.02	1.00	.02	25.8	1.4	5
6	-907.8	1182.0	1.665	45.133	.003															
						11.002	.010	293.00	.15	.03755	.094080	2.212	.002	2.65	.02	1.00	.02	26.6	1.3	6
7	-1200.8	1475.0	1.707	56.135	.004															
						11.063	.011	292.00	.15	.03789	.094084	2.199	.002	2.65	.02	1.00	.02	27.3	1.3	7
8	-1492.8	1767.0	1.747	67.198	.004															
						1.862	.012	49.00	.05	.03800	.094088	2.195	.011	2.65	.02	1.00	.02	27.6	1.9	8
9	-1541.8	1816.0	1.753	69.060	.005															
						14.330	.012	384.02	.15	.03732	.094089	2.221	.002	2.65	.02	1.00	.02	26.0	1.3	9
10	-1925.8	2220.0	1.803	83.390	.004															
						13.938	.010	377.02	.15	.03697	.094094	2.235	.002	2.65	.02	1.00	.02	25.1	1.3	10
11	-2302.8	2577.0	1.848	97.328	.003															
						10.161	.010	268.01	.15	.03791	.094099	2.198	.002	2.65	.02	1.00	.02	27.4	1.4	11
12	-2570.9	2845.1	1.879	107.489	.004															
						8.535	.010	221.03	.15	.03861	.094103	2.171	.003	2.65	.02	1.00	.02	29.0	1.4	12
13	-2791.9	3066.1	1.903	116.024	.003															
						1.250	.009	33.92	.05	.03685	.094106	2.240	.013	2.65	.02	1.00	.02	24.8	2.0	13
14	-2825.8	3100.0	1.907	117.274	.003															
						1.341	.011	41.00	.05	.03271	.094106	2.402	.012	2.65	.02	1.00	.02	15.0	1.9	14
15	-2866.8	3141.0	1.911	118.615	.005															
						2.731	.012	75.00	.05	.03641	.094107	2.257	.007	2.65	.02	1.00	.02	23.8	1.6	15
16	-2941.8	3216.0	1.919	121.346	.004															
						5.065	.012	141.05	.15	.03591	.094108	2.277	.005	2.65	.02	1.00	.02	22.6	1.5	16
17	-3082.9	3357.1	1.934	126.411	.005															
						2.449	.011	69.95	.05	.03501	.094109	2.312	.007	2.65	.02	1.00	.02	20.5	1.6	17
18	-3152.8	3427.0	1.941	128.860	.003															
						2.358	.009	70.00	.05	.03369	.094110	2.364	.006	2.65	.02	1.00	.02	17.3	1.6	18
19	-3222.8	3497.0	1.948	131.218	.003															
						4.171	.010	102.00	.15	.04089	.094111	2.082	.006	2.65	.02	1.00	.02	34.4	1.6	19
20	-3324.8	3599.0	1.958	135.389	.004															
						3.027	.011	74.00	.05	.04091	.094113	2.082	.007	2.65	.02	1.00	.02	34.4	1.6	20
21	-3398.8	3673.0	1.965	138.416	.004															
						2.241	.012	52.00	.05	.04310	.094114	1.996	.011	2.65	.02	1.00	.02	39.6	1.9	21
22	-3450.8	3725.0	1.970	140.657	.005															
						.616	.010	15.00	.05	.04107	.094114	2.076	.031	2.65	.02	1.00	.02	34.8	3.1	22
23	-3465.8	3740.0	1.972	141.273	.002															
						1.898	.007	46.00	.05	.04126	.094115	2.068	.008	2.65	.02	1.00	.02	35.3	1.7	23
24	-3511.8	3786.0	1.976	143.171	.002															
						1.724	.007	46.00	.05	.03748	.094115	2.216	.008	2.65	.02	1.00	.02	26.3	1.7	24
25	-3557.8	3832.0	1.980	144.895	.002															
						1.797	.008	44.00	.05	.04084	.094116	2.085	.009	2.65	.02	1.00	.02	34.3	1.8	25
26	-3601.8	3876.0	1.984	146.692	.003															
						.945	.009	22.02	.05	.04292	.094116	2.003	.020	2.65	.02	1.00	.02	39.2	2.4	26
27	-3623.8	3898.0	1.986	147.637	.003															
						2.172	.009	49.98	.05	.04346	.094117	1.982	.009	2.65	.02	1.00	.02	40.5	1.7	27
28	-3673.8	3948.0	1.991	149.809	.003															
						.631	.008	15.00	.05	.04206	.094117	2.037	.026	2.65	.02	1.00	.02	37.2	2.8	28
29	-3688.8	3963.0	1.992	150.440	.002															
						3.353	.009	81.00	.05	.04140	.094118	2.063	.005	2.65	.02	1.00	.02	35.6	1.5	29
30	-3769.8	4044.0	2.000	153.793	.004															
						.863	.009	22.00	.05	.03923	.094119	2.148	.019	2.65	.02	1.00	.02	30.4	2.4	30
31	-3791.8	4066.0	2.002	154.656	.002															
						.521	.007	13.00	.05	.04007	.094119	2.115	.027	2.65	.02	1.00	.02	32.4	2.9	31
32	-3804.8	4079.0	2.003	155.177	.002															
						.604	.007	16.00	.05	.03775	.094119	2.206	.022	2.65	.02	1.00	.02	26.9	2.5	32
33	-3820.8	4095.0	2.004	155.781	.002															
						1.012	.009	29.00	.05	.03490	.094119	2.317	.014	2.65	.02	1.00	.02	20.2	2.1	33
34	-3849.8	4124.0	2.007	156.793	.004															
						1.109	.012	31.02	.05	.03575	.094120	2.284	.017	2.65	.02	1.00	.02	22.2	2.3	34
35	-3880.8	4155.0	2.010	157.902	.005															
						1.984	.012	55.02	.05	.03606	.094120	2.272	.010	2.65	.02	1.00	.02	22.9	1.8	35
36	-3935.8	4210.0	2.015	159.886	.004															
						.436	.010	12.98	.05	.03359	.094121	2.368	.035	2.65	.02	1.00	.02	17.1	3.3	36
37	-3948.8	4223.0	2.016	160.322	.003															
						.303	.008	9.99	.05	.03033	.094121	2.496	.037	2.65	.02	1.00	.02	9.3	3.5	37
38	-3958.8	4233.0	2.017	160.625	.002															
						1.802	.007	65.01	.05	.02772	.094121	2.598	.005	2.65	.02	1.00	.02	3.1	1.5	38
39	-4023.8	4298.0	2.022	162.427	.002															
						.532	.007	20.00	.05	.02660	.094122	2.642	.016	2.65	.02	1.00	.02	.5	2.2	39
40	-4043.8	4318.0	2.024	162.959	.002															
						1.646	.007	58.99	.05	.02790	.094122	2.591	.006	2.65	.02	1.00	.02	3.6	1.5	40
41	-4102.8	4377.0	2.029	164.605	.002															
						1.236	.007	40.99	.05	.03015	.094123	2.503	.008	2.65	.02	1.00	.02	8.9	1.7	41
42	-4143.8	4418.0	2.032	165.841	.002															
						.967	.015	33.20	.05	.02913	.094124	2.543	.019	2.65	.02	1.00	.02	6.5	2.4	42
43	-4177.0	4451.2	2.035	166.808	.010															
						.923	.016	35.80	.05	.02578	.094124	2.674	.019	2.65	.02	1.00	.02	-1.5	2.4	43
44	-4212.8	4487.0	2.038	167.731	.003															
						1.057	.008	33.01	.05	.03202	.094125	2.430	.011	2.65	.02	1.00	.02	13.3	1.9	44
45	-4245.8	4520.0	2.041	168.788	.002															
						1.439	.007	46.00	.05	.03128	.094125	2.459	.007	2.65	.02	1.00	.02	11.6	1.7	45
46	-4291.8	4566.0	2.045	170.227	.002															

Table 14. Basic data from borehole gravity survey in "Taylor" 635 (see p. 4 for explanation).

USGS BOREHOLE GRAVITY SURVEY: SHELL OIL CO TAYLOR 635
LOCATION: 30-3N-23W VENTURA OIL FIELD VENTURA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	562.1	35.2	2.773	.000	.002															
						7.916	.010	225.00	.15	.03518	.094062	2.304	.003	2.65	.02	1.00	.02	21.0	1.4	1
2	337.1	260.2	-.601	7.916	.005															
						8.930	.010	249.95	.15	.03573	.094065	2.283	.002	2.65	.02	1.00	.02	22.3	1.4	2
3	87.2	510.1	-1.773	16.846	.002															
						8.873	.008	249.95	.15	.03550	.094068	2.292	.002	2.65	.02	1.00	.02	21.7	1.3	3
4	-162.8	760.1	-2.034	25.719	.003															
						8.759	.008	249.97	.15	.03504	.094072	2.310	.002	2.65	.02	1.00	.02	20.6	1.3	4
5	-412.8	1010.1	-1.962	34.478	.002															
						8.784	.007	249.93	.15	.03515	.094075	2.306	.002	2.65	.02	1.00	.02	20.9	1.3	5
6	-662.7	1260.8	-1.792	43.262	.002															
						5.728	.008	166.95	.15	.03431	.094078	2.339	.003	2.65	.02	1.00	.02	18.9	1.4	6
7	-829.7	1427.0	-1.669	48.990	.003															
						9.505	.008	275.91	.15	.03445	.094081	2.333	.002	2.65	.02	1.00	.02	19.2	1.3	7
8	-1105.6	1702.9	-1.484	58.495	.002															
						1.961	.007	57.94	.15	.03384	.094084	2.357	.008	2.65	.02	1.00	.02	17.6	1.7	8
9	-1163.5	1760.8	-1.449	60.456	.002															
						1.071	.007	30.95	.05	.03461	.094085	2.327	.011	2.65	.02	1.00	.02	19.6	1.9	9
10	-1194.4	1791.8	-1.431	61.527	.002															
						8.129	.007	237.90	.15	.03417	.094085	2.344	.002	2.65	.02	1.00	.02	18.5	1.3	10
11	-1432.3	2029.7	-1.309	69.656	.002															
						11.555	.007	340.75	.15	.03391	.094089	2.355	.001	2.65	.02	1.00	.02	17.9	1.3	11
12	-1773.1	2370.4	-1.180	81.211	.002															
						7.850	.007	230.02	.15	.03413	.094093	2.346	.002	2.65	.02	1.00	.02	18.4	1.3	12
13	-2003.1	2600.4	-1.119	89.261	.002															
						2.061	.008	61.98	.15	.03325	.094096	2.381	.008	2.65	.02	1.00	.02	16.3	1.7	13
14	-2065.1	2662.4	-1.106	91.122	.003															
						1.328	.009	38.80	.05	.03423	.094097	2.343	.011	2.65	.02	1.00	.02	18.6	1.9	14
15	-2103.9	2701.2	-1.098	92.450	.003															
						7.116	.008	212.60	.15	.03347	.094098	2.372	.002	2.65	.02	1.00	.02	16.8	1.4	15
16	-2316.5	2913.8	-1.064	99.566	.002															
						2.434	.007	73.90	.15	.03294	.094100	2.393	.006	2.65	.02	1.00	.02	15.6	1.6	16
17	-2390.4	2987.7	-1.055	102.200	.002															
						8.489	.009	251.50	.15	.03375	.094101	2.361	.002	2.65	.02	1.00	.02	17.5	1.3	17
18	-2641.9	3239.2	-1.034	110.489	.004															
						1.140	.010	33.79	.05	.03374	.094105	2.362	.014	2.65	.02	1.00	.02	17.5	2.0	18
19	-2675.7	3273.0	-1.032	111.629	.003															
						2.683	.008	82.41	.15	.03256	.094105	2.408	.006	2.65	.02	1.00	.02	14.7	1.6	19
20	-2758.1	3355.4	-1.029	114.312	.002															
						1.297	.008	39.78	.05	.03260	.094106	2.406	.009	2.65	.02	1.00	.02	14.8	1.8	20
21	-2797.9	3395.2	-1.028	115.609	.003															
						3.982	.010	119.92	.15	.03321	.094107	2.383	.005	2.65	.02	1.00	.02	16.2	1.5	21
22	-2917.8	3515.1	-1.026	119.591	.004															
						9.425	.012	287.20	.15	.03282	.094109	2.398	.002	2.65	.02	1.00	.02	15.3	1.4	22
23	-3205.0	3802.3	-1.030	129.416	.005															
						2.493	.011	76.50	.15	.03259	.094112	2.407	.008	2.65	.02	1.00	.02	14.7	1.7	23
24	-3281.5	3878.8	-1.033	131.509	.003															
						6.810	.009	210.66	.15	.03233	.094113	2.418	.003	2.65	.02	1.00	.02	14.1	1.4	24
25	-3492.2	4089.5	-1.043	138.319	.003															
						6.768	.009	204.30	.15	.03313	.094116	2.386	.003	2.65	.02	1.00	.02	16.0	1.4	25
26	-3696.5	4293.8	-1.057	145.087	.003															
						5.664	.008	176.10	.15	.03216	.094119	2.424	.003	2.65	.02	1.00	.02	13.7	1.4	26
27	-3872.6	4469.9	-1.071	150.751	.002															
						1.825	.008	55.40	.15	.03294	.094121	2.394	.009	2.65	.02	1.00	.02	15.5	1.8	27
28	-3928.0	4525.3	-1.076	152.576	.003															
						9.648	.009	291.50	.15	.03310	.094122	2.388	.002	2.65	.02	1.00	.02	15.9	1.3	28
29	-4219.5	4816.8	-1.104	162.224	.003															
						9.576	.009	291.00	.15	.03291	.094126	2.395	.002	2.65	.02	1.00	.02	15.4	1.3	29
30	-4510.5	5107.8	-1.135	171.800	.003															
						2.205	.009	71.60	.15	.03080	.094130	2.478	.007	2.65	.02	1.00	.02	10.4	1.7	30
31	-4582.1	5179.4	-1.143	174.205	.003															
						7.284	.008	224.20	.15	.03249	.094131	2.412	.002	2.65	.02	1.00	.02	14.4	1.3	31
32	-4806.3	5403.6	-1.169	181.289	.002															
						.663	.007	20.60	.05	.03218	.094134	2.424	.016	2.65	.02	1.00	.02	13.7	2.2	32
33	-4826.9	5424.2	-1.171	181.952	.002															
						1.640	.008	52.20	.15	.03142	.094134	2.454	.010	2.65	.02	1.00	.02	11.9	1.8	33
34	-4879.1	5476.4	-1.177	183.592	.003															
						2.113	.008	68.20	.15	.03098	.094135	2.471	.007	2.65	.02	1.00	.02	10.8	1.7	34
35	-4947.3	5544.6	-1.185	185.705	.002															
						2.013	.007	63.30	.15	.03180	.094136	2.439	.007	2.65	.02	1.00	.02	12.8	1.7	35
36	-5010.6	5607.9	-1.193	187.718	.002															
						1.830	.007	59.70	.15	.03065	.094137	2.484	.008	2.65	.02	1.00	.02	10.1	1.7	36
37	-5070.3	5667.6	-1.200	189.548	.002															
						1.503	.007	49.10	.05	.03224	.094137	2.422	.007	2.65	.02	1.00	.02	13.8	1.6	37
38	-5119.4	5716.7	-1.203	191.131	.002															
						.659	.007	20.40	.05	.03230	.094138	2.419	.017	2.65	.02	1.00	.02	14.0	2.2	38
39	-5139.8	5737.1	-1.215	191.790	.002															
						3.189	.008	97.20	.15	.03281	.094138	2.400	.005	2.65	.02	1.00	.02	15.2	1.5	39
40	-5237.0	5834.3	-1.233	194.979	.003															
						4.847	.008	150.30	.15	.03225	.094140	2.422	.003	2.65	.02	1.00	.02	13.8	1.4	40
41	-5387.3	5984.6	-1.247	199.826	.002															
						3.611	.008	114.00	.15	.03168	.094142	2.444	.004	2.65	.02	1.00	.02	12.5	1.5	41
42	-5501.3	6098.6	-1.252	203.437	.003															
						1.414	.009	44.20	.05	.03199	.094143	2.432	.009	2.65	.02	1.00	.02	13.2	1.8	42
43	-5545.5	6142.8	-1.256	204.851	.003															
						.898	.008	28.70	.05	.03129	.094144	2.459	.013	2.65	.02	1.00	.02	11.6	2.0	43
44	-5574.2	6171.5	-1.269	205.749	.002															
						3.272	.007	104.00	.15	.03146	.094144	2.453	.004	2.65	.02	1.00	.02	12.0	1.5	44
45	-5678.2	6275.5	-1.276	209.021	.002															
						1.758	.009	54.10	.15	.03250	.094146	2.412	.010	2.65	.02	1.00	.02	14.4	1.8	45
46	-5732.3	6329.6	-1.283	210.779	.004															
						1.914	.010	60.00	.15	.03190	.094146	2.436	.010	2.65	.02	1.00	.02	13.0	1.8	46

Table 14. Continued from previous page.

USGS BOREHOLE GRAVITY SURVEY: SHELL OIL CO TAYLOR 635
LOCATION: 30-3N-23W VENTURA OIL FIELD VENTURA COUNTY CALIFORNIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
47	-5792.3	6389.6	-1.290	212.693	.003	1.791	.009	58.00	.15	.03088	.094147	2.475	.009	2.65	.02	1.00	.02	10.6	1.8	47
48	-5850.3	6447.6	-1.297	214.484	.003	2.565	.008	82.50	.15	.03109	.094148	2.467	.006	2.65	.02	1.00	.02	11.1	1.6	48
49	-5932.8	6530.1	-1.307	217.049	.002	2.691	.007	85.50	.15	.03147	.094149	2.452	.005	2.65	.02	1.00	.02	12.0	1.5	49
50	-6018.3	6615.6	-1.318	219.740	.002	3.148	.008	100.20	.15	.03142	.094150	2.455	.005	2.65	.02	1.00	.02	11.8	1.5	50
51	-6118.5	6715.8	-1.330	222.888	.003	.700	.008	22.80	.05	.03070	.094151	2.483	.016	2.65	.02	1.00	.02	10.1	2.2	51
52	-6141.3	6738.6	-1.333	223.588	.002	3.807	.007	122.90	.15	.03098	.094152	2.472	.004	2.65	.02	1.00	.02	10.8	1.4	52
53	-6264.2	6861.5	-1.348	227.395	.002	5.593	.010	180.10	.15	.03105	.094153	2.469	.003	2.65	.02	1.00	.02	11.0	1.4	53
54	-6444.3	7041.6	-1.370	232.988	.005	.742	.011	24.60	.05	.03016	.094156	2.504	.020	2.65	.02	1.00	.02	8.9	2.4	54
55	-6468.9	7066.2	-1.373	233.730	.003	3.609	.010	121.60	.15	.02968	.094156	2.523	.005	2.65	.02	1.00	.02	7.7	1.5	55
56	-6590.5	7187.8	-1.388	237.339	.004	5.051	.010	166.91	.15	.03026	.094158	2.500	.003	2.65	.02	1.00	.02	9.1	1.4	56
57	-6757.4	7354.7	-1.408	242.390	.003	4.176	.010	133.89	.15	.03119	.094160	2.464	.004	2.65	.02	1.00	.02	11.3	1.5	57
58	-6891.3	7488.6	-1.424	246.566	.004	3.676	.010	121.71	.15	.03020	.094162	2.503	.005	2.65	.02	1.00	.02	8.9	1.5	58
59	-7013.0	7610.3	-1.438	250.242	.003	9.165	.009	300.79	.15	.03047	.094163	2.492	.002	2.65	.02	1.00	.02	9.6	1.3	59
60	-7313.8	7911.1	-1.472	259.407	.003	3.836	.009	126.40	.15	.03035	.094167	2.497	.004	2.65	.02	1.00	.02	9.3	1.5	60
61	-7440.2	8037.5	-1.486	263.243	.003	5.164	.010	169.70	.15	.03043	.094169	2.494	.003	2.65	.02	1.00	.02	9.5	1.4	61
62	-7609.9	8207.2	-1.505	268.407	.004	.527	.010	19.20	.05	.02745	.094171	2.611	.023	2.65	.02	1.00	.02	2.4	2.6	62
63	-7629.1	8226.4	-1.507	268.934	.003	2.701	.010	87.70	.15	.03080	.094172	2.480	.007	2.65	.02	1.00	.02	10.3	1.6	63
64	-7716.8	8314.1	-1.517	271.635	.004	1.961	.011	62.30	.15	.03148	.094173	2.453	.010	2.65	.02	1.00	.02	11.9	1.8	64
65	-7779.1	8376.4	-1.524	273.596	.004	27.370	.010	924.94	.15	.02959	.094174	2.527	.001	2.65	.02	1.00	.02	7.5	1.2	65
66	-8704.0	9321.3	-1.622	300.966	.003	5.683	.009	191.60	.15	.02966	.094186	2.525	.003	2.65	.02	1.00	.02	7.6	1.4	66
67	-8895.6	9492.9	-1.642	306.649	.003	2.001	.009	69.00	.15	.02900	.094189	2.551	.008	2.65	.02	1.00	.02	6.0	1.7	67
68	-8964.6	9561.9	-1.649	308.650	.003	3.129	.009	104.20	.15	.03003	.094190	2.510	.005	2.65	.02	1.00	.02	8.5	1.5	68
69	-9068.8	9666.1	-1.660	311.779	.003	.879	.009	30.20	.05	.02911	.094191	2.547	.014	2.65	.02	1.00	.02	6.3	2.0	69
70	-9099.0	9696.3	-1.663	312.658	.003	2.690	.009	87.20	.15	.03085	.094191	2.478	.006	2.65	.02	1.00	.02	10.4	1.6	70
71	-9186.2	9783.5	-1.672	315.348	.003	2.587	.009	87.40	.15	.02960	.094193	2.527	.006	2.65	.02	1.00	.02	7.4	1.6	71
72	-9273.6	9870.9	-1.681	317.935	.003	2.169	.009	74.90	.15	.03059	.094194	2.489	.007	2.65	.02	1.00	.02	9.8	1.7	72
73	-9344.5	9941.8	-1.688	320.104	.003	2.357	.010	78.10	.15	.03018	.094195	2.505	.007	2.65	.02	1.00	.02	8.8	1.7	73
74	-9422.6	10019.9	-1.696	322.461	.004	3.676	.011	122.90	.15	.02991	.094196	2.515	.005	2.65	.02	1.00	.02	8.2	1.5	74
75	-9545.5	10142.8	-1.708	326.137	.004	1.727	.010	59.40	.15	.02908	.094197	2.548	.009	2.65	.02	1.00	.02	6.2	1.8	75
76	-9604.9	10202.2	-1.714	327.864	.003	2.794	.009	93.00	.15	.03004	.094198	2.510	.006	2.65	.02	1.00	.02	8.5	1.6	76
77	-9697.9	10295.2	-1.723	330.658	.003	2.000	.009	67.90	.15	.02945	.094199	2.533	.008	2.65	.02	1.00	.02	7.1	1.7	77
78	-9765.8	10363.1	-1.730	332.658	.003	1.396	.009	47.30	.05	.02951	.094200	2.531	.009	2.65	.02	1.00	.02	7.2	1.7	78
79	-9813.1	10410.4	-1.735	334.054	.003	2.856	.009	95.60	.15	.02987	.094201	2.517	.006	2.65	.02	1.00	.02	8.1	1.5	79
80	-9908.7	10506.0	-1.744	336.910	.003	4.186	.009	140.60	.15	.02977	.094202	2.521	.004	2.65	.02	1.00	.02	7.8	1.4	80
81	-10049.3	10646.6	-1.757	341.096	.003	4.197	.009	142.60	.15	.02943	.094204	2.534	.004	2.65	.02	1.00	.02	7.0	1.4	81
82	-10191.9	10789.2	-1.770	345.293	.003	5.320	.009	176.50	.15	.03014	.094206	2.507	.003	2.65	.02	1.00	.02	8.7	1.4	82
83	-10368.4	10965.7	-1.786	350.613	.003	3.730	.012	123.80	.15	.03013	.094208	2.507	.005	2.65	.02	1.00	.02	8.7	1.5	83
84	-10492.2	11089.5	-1.797	354.343	.006	3.869	.013	128.75	.15	.03005	.094210	2.510	.005	2.65	.02	1.00	.02	8.5	1.5	84
85	-10620.9	11218.3	-1.808	358.212	.004															