Geological Circular 83-1

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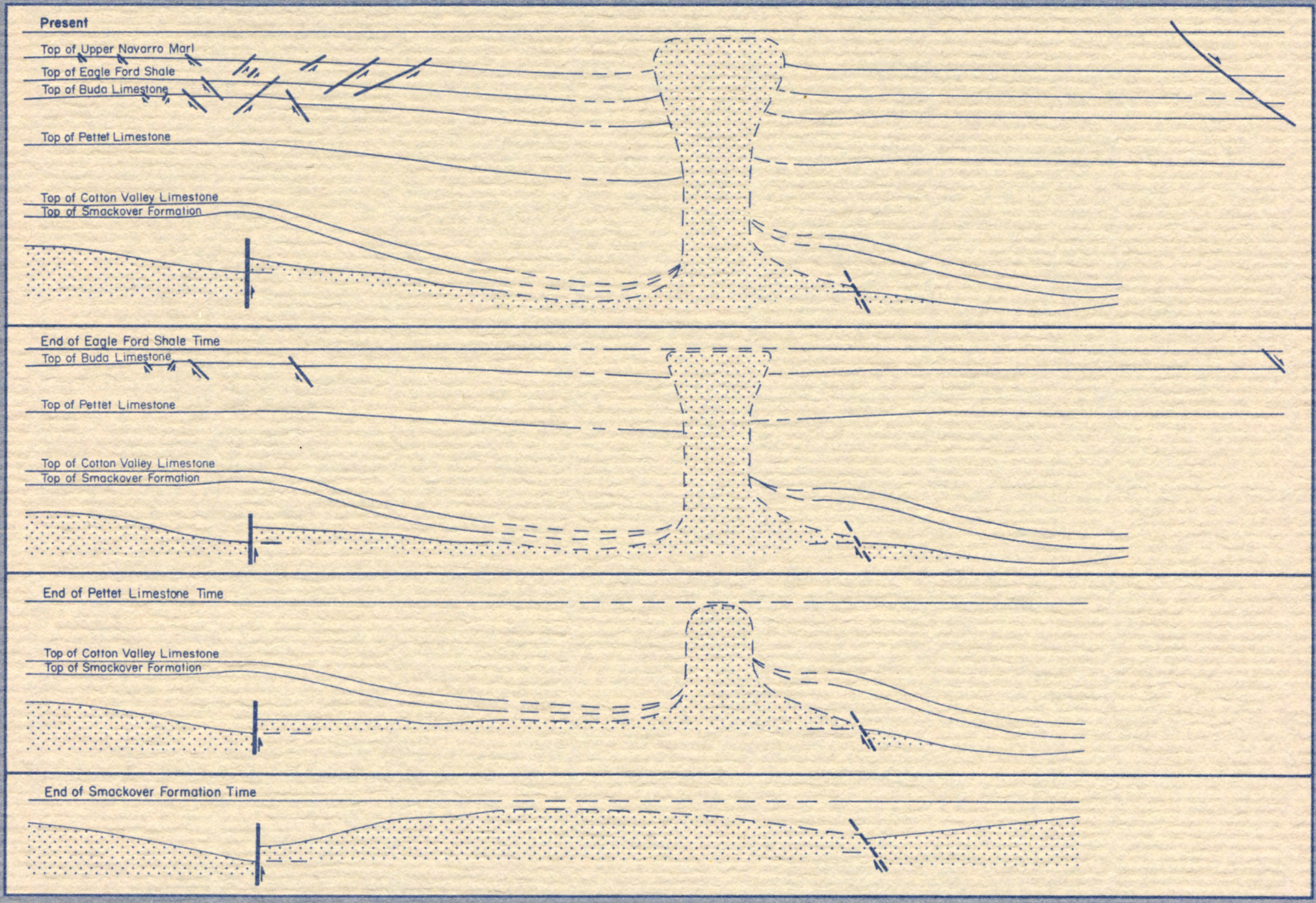

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Bureau of Economic Geology
W. L. Fisher, Director
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ABSTRACT

The top of mushroom-shaped Oakwood salt dome is approximately 210 m (700 ft) beneath the boundary of Freestone and Leon Counties near the southwestern end of the East Texas Basin. The dome is surrounded by Jurassic, Cretaceous, and lower Tertiary marine and nonmarine strata. A salt pillow initially formed in Late Jurassic "Smackover" time, when faulting contributed to uneven sediment loading of the Louann Salt. The dome began to grow vertically into a diapiric configuration during the deposition of Upper Jurassic - Lower Cretaceous clastics (Bossier - Travis Peak Formations) and probably remained near the depositional surface during most of its growth. The estimated average vertical rise of the top of salt at Oakwood salt dome shows a general decrease over time, from approximately 0.07 mm/yr (230 ft/m.y.) during Early Cretaceous time to 0.002 mm/yr (5 ft/m.y.) since early Tertiary (Reklaw) time. Hydrocarbons are produced from Woodbine sediments beneath the dome's overhang.

INTRODUCTION

Oakwood salt dome, located beneath the boundary of Freestone and Leon Counties, is one of the most southern of the salt domes that have modified Jurassic to Eocene strata within the East Texas Basin (fig. 1). Many of these salt structures, including Oakwood salt dome, evolved from broad salt pillows into salt stocks that now occur at shallow depths. Partly because of its favorable size and depth, Oakwood salt dome was evaluated by the Bureau of Economic Geology as a candidate site for a nuclear waste repository. A knowledge of its hydrologic and tectonic stability was, therefore, essential (Kreitler and others, 1980). This report utilizes the substantial body of subsurface well log (appendix tables A-1 and A-2) and geophysical data provided by hydrocarbon exploration of the dome area to describe the geologic framework around Oakwood salt dome and to define the growth history of the dome.

DOME GEOMETRY AND COMPOSITION

The shape and the composition of Oakwood salt dome are documented by 82 wells, including sidetrack holes, that penetrate cap rock or salt. Data also include a seismic profile provided by Law Engineering Testing Co. and a gravity model provided by Exploration Techniques, Inc. (1979).

Keywords: Oakwood salt dome, salt tectonics, radioactive waste disposal, East Texas

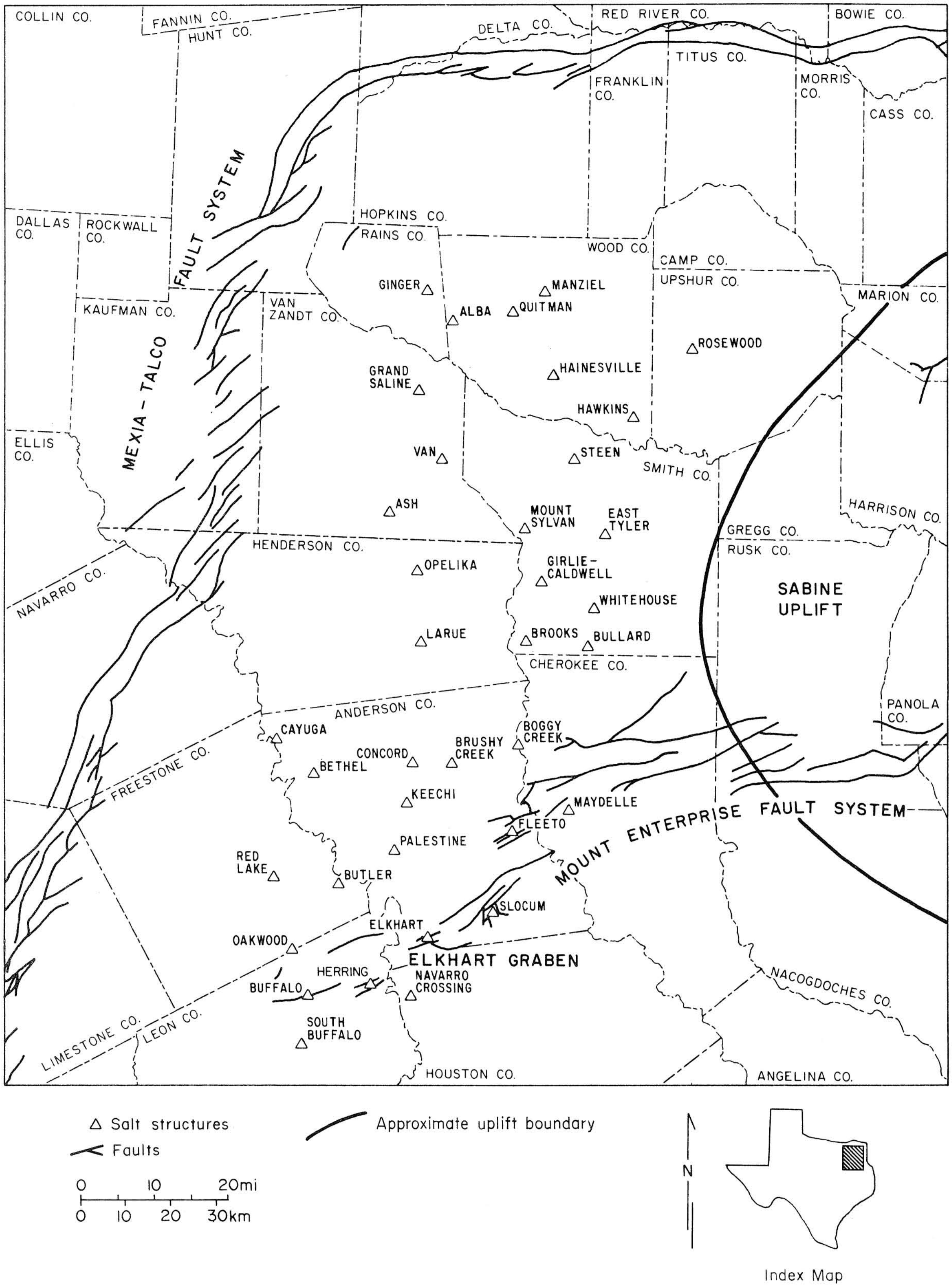

Figure 1. Major structural features, East Texas Basin.

Oakwood salt dome is a relatively flat-topped, mushroom-shaped salt stock that is approximately circular in map view (fig. 2). It passes vertically through about 5,000 m (16,400 ft) of strata (figs. 3 and 4). Beginning in Lower Cretaceous strata at a depth of about 3,048 m (10,000 ft), its overhang protrudes from 610 m to more than 914 m (2,000 to more than 3,000 ft) beyond the salt stock on all sides. The dome is overlain by cap rock that may follow the outline of the dome and continue under the overhang. The minimum recorded depths to cap rock and to salt are 214 m (703 ft) and 344 m (1,128 ft), respectively (appendix table A-2). An estimated 25 km^3 (6 mi^3) of salt, composed of halite and minor amounts of anhydrite, constitutes the dome.

Above the center of the dome, the cap rock consists of a lower anhydrite zone and an upper calcite zone (Kreitler and Dutton, 1981). Gravity modeling (Exploration Techniques, Inc., 1979) indicates an approximate cap-rock thickness of 137 m (450 ft) over the center of the dome, thinning toward the dome flanks (figs. 3 and 4). However, well logs record cap-rock thicknesses of 0 to 233 m (0 to 766 ft) above the salt (appendix table A-2).

A zone of limestone and anhydrite, possibly "cap-rock" material, has been penetrated beneath the domal overhang in at least 52 wells (appendix table A-2). It consists of 0 to 50 m (0 to 165 ft) of anhydrite structurally underlain by 5 to 96 m (18 to 315 ft) of limestone (fig. 5; appendix table A-2). Core descriptions indicate that the bluish-gray anhydrite is hard and dense. The gray limestone is also hard and dense, with sporadic vugs and fractures containing oil. Texture of the limestone varies from finely crystalline to brecciated and in places contains contorted laminations of darker limestone. The slower-than-normal sonic velocities of the limestone (fig. 5) suggest admixture of clay. This limestone has been described by drillers as a "gouge zone," but it and the overlying anhydrite may be continuous with the cap rock above the salt.

Several well logs indicate a shale zone within the domal overhang (fig. 5). The thin shale zone may be a layer separating two zones of lateral salt intrusion (Kupfer, 1970). The internal deformation of the salt during dome growth would preclude the lateral continuity of the shale across the entire dome.

STRATIGRAPHY AROUND OAKWOOD SALT DOME

The regional stratigraphic framework around Oakwood salt dome consists of alternating clastic and carbonate sequences (containing minor amounts of anhydrite) of

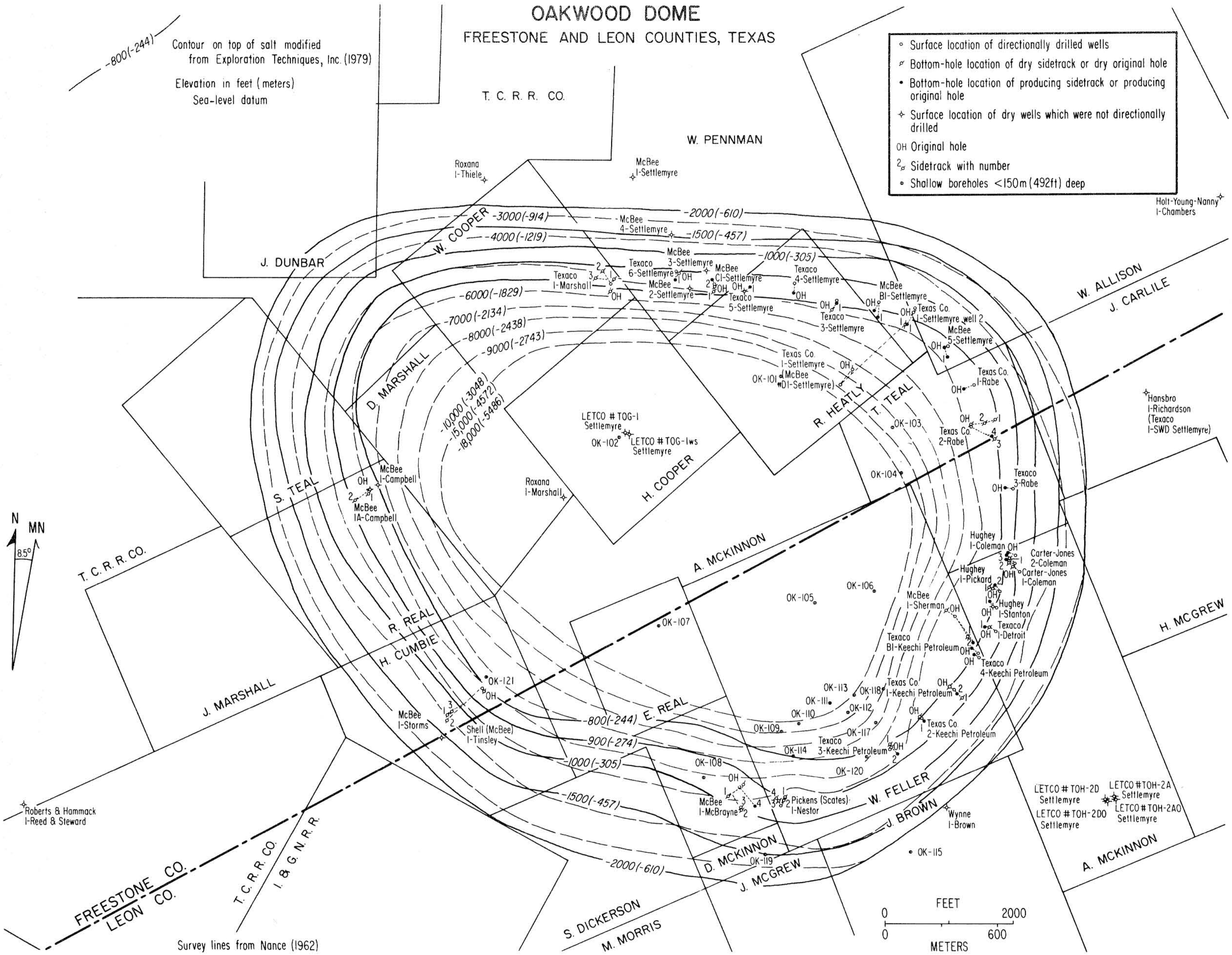

Figure 2. Structure map on top of salt, Oakwood salt dome. Dashed contours represent the salt surface beneath the domal overhang. Bottom-hole locations of sidetracks 3 and 4 of McBee #1 Sherman and sidetrack 5 of Pickens (Scates) #1 Nestor are unknown. Land survey names are in upper-case letters.

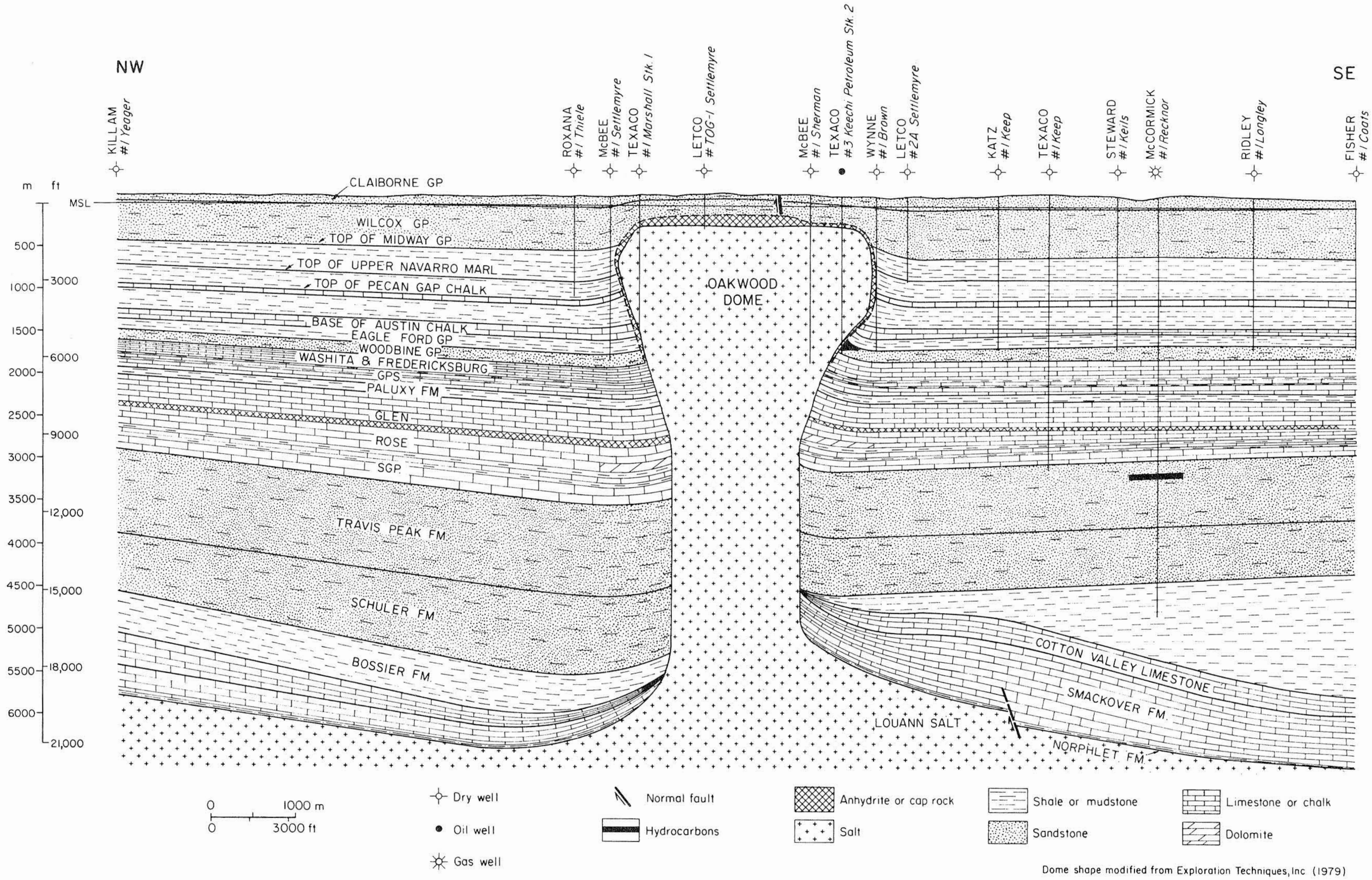

Figure 3. Northwest-southeast structural cross section through Oakwood salt dome. Geometry of deep strata flanking the dome is approximated from seismic data. Most wells on cross section are located on figure 2. Location of seismic line shown on figure 7.

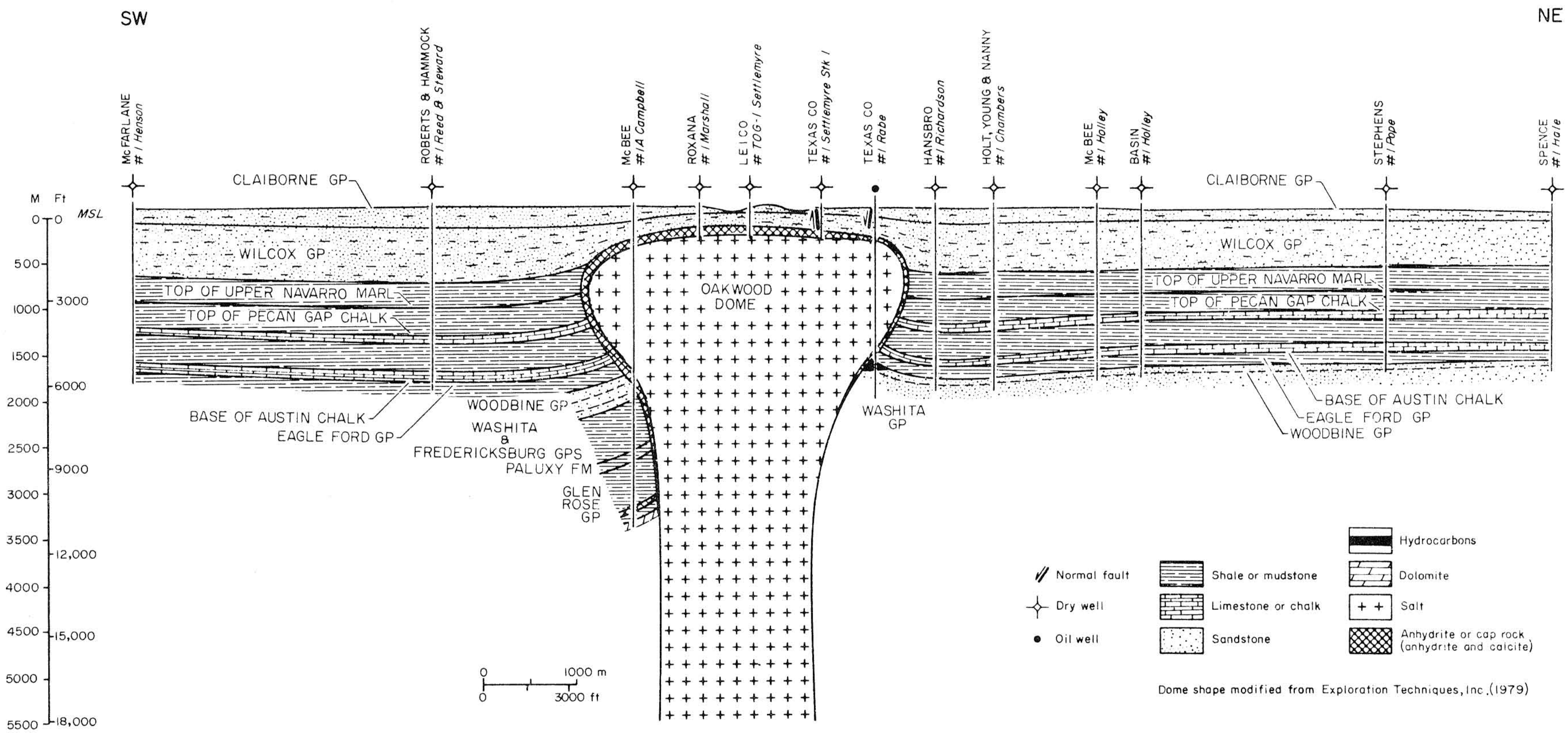

Figure 4. Southwest-northeast structural cross section through Oakwood salt dome. Most wells on cross section are located on figure 2.

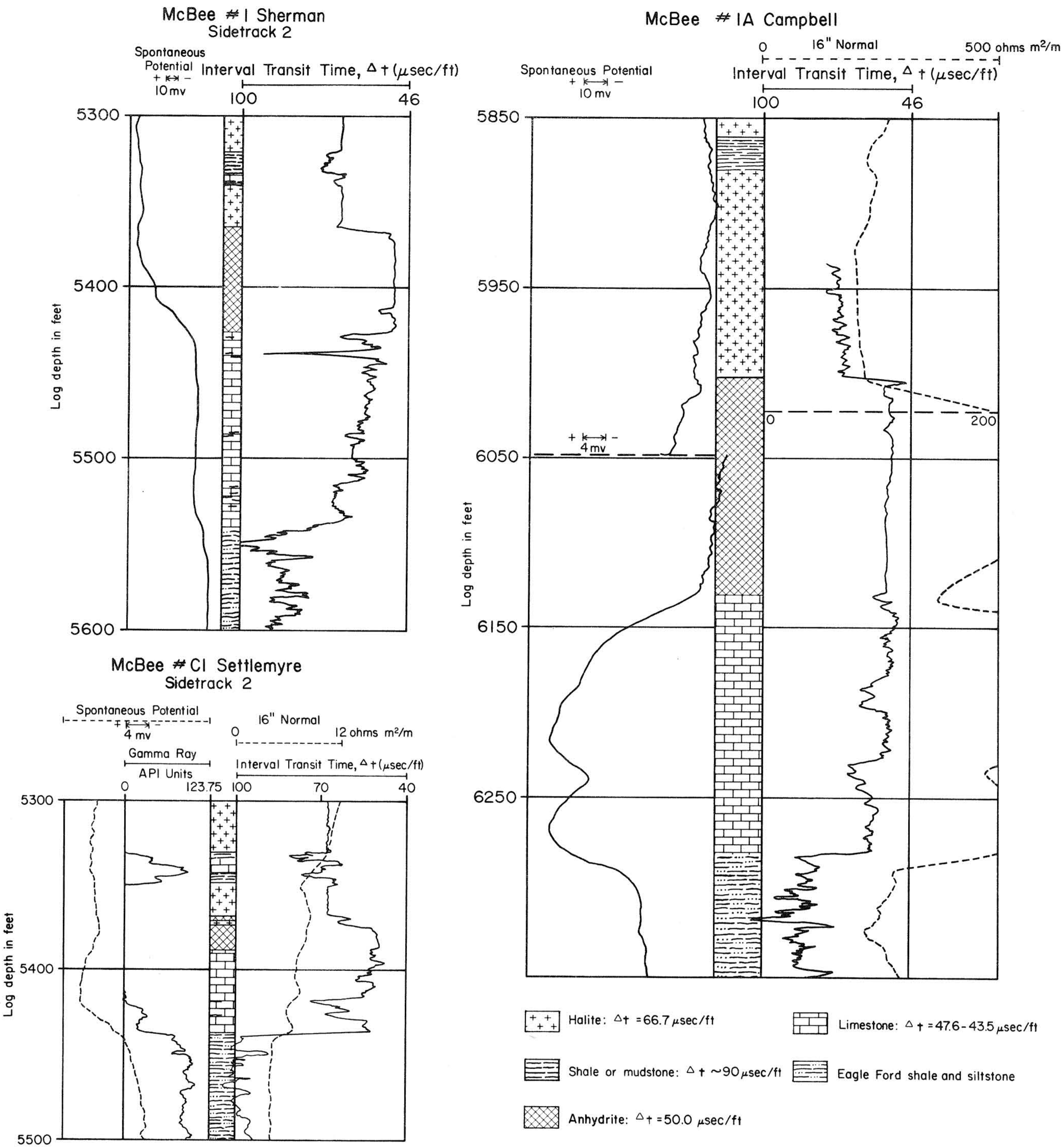

Figure 5. Electric log responses at the base of the overhang, Oakwood salt dome. Anhydrite and limestone below salt may be cap rock. Shale zone within salt may separate zones of lateral salt intrusion.

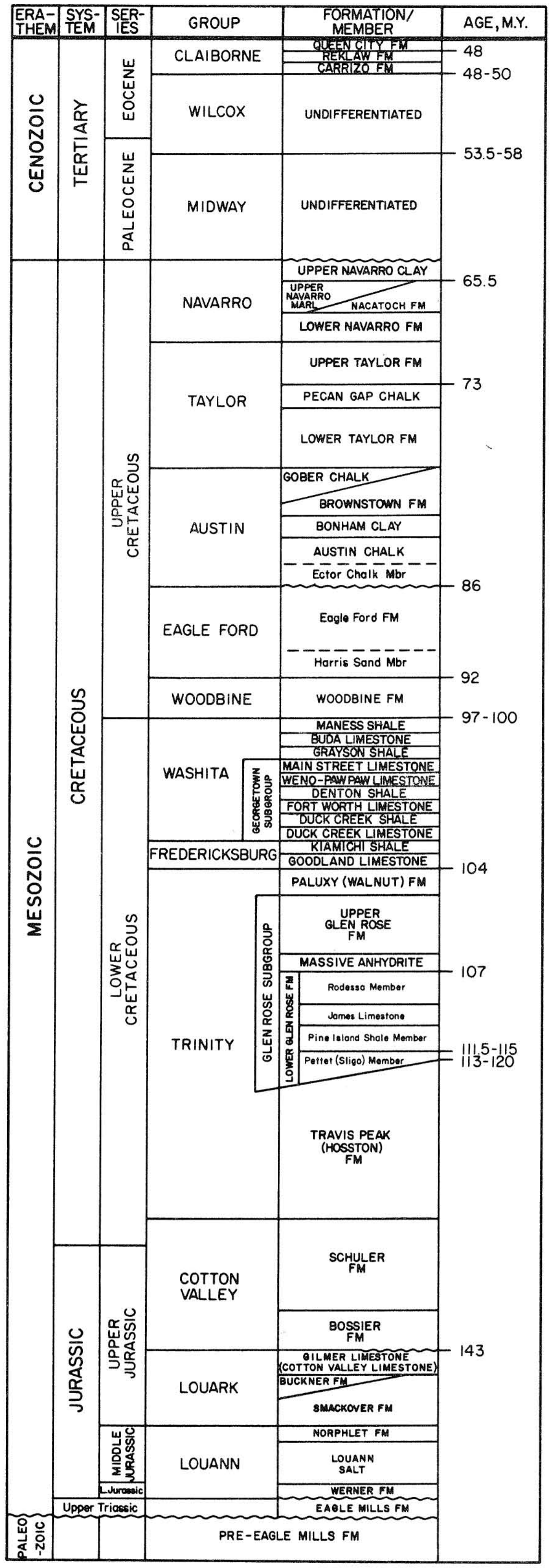

Figure 6. Stratigraphy near Oakwood salt dome (modified from Wood and Guevara, 1981). Absolute ages are from Nichols and others, 1968; Vail and others, 1977; Martinez and others, 1976; Berryhill and others, 1968; Law Engineering Testing Company, 1978, 1980; Van Hinte, 1976; and Gundersen and others, 1969.

Jurassic to Eocene age (figs. 3 and 6). Strata dip regionally toward the southeast. The movement of Jurassic Louann Salt to form Oakwood salt dome and other nearby salt structures syndepositionally modified younger strata. Local thickness variations near Oakwood salt dome indicate possible episodes of dome growth (thinning of strata over the dome) and also pinpoint the location of the rim syncline (relatively thick strata). Local variations in the dip of the strata may also result from dome growth.

Jurassic Strata

Jurassic strata include the Louann, the Louark, and most of the Cotton Valley Groups (fig. 6). The Louann Salt, the source of salt for Gulf Coast domes, has generally been dated as Jurassic (Imlay, 1943; Swain, 1949; Nichols and others, 1968), although its age has been disputed (Andrews, 1960). The original thickness of the Louann Salt is unknown because of subsequent salt migration, but estimates range to as much as 1,524 m (5,000 ft) for the East Texas Basin (Eaton, 1956; Shreveport Geological Society, 1968; Netherland, Sewell and Associates, 1976).

Jurassic strata have been penetrated by wells at three locations near Oakwood salt dome. No wells in the area have pierced sediments older than the Louann Salt. At the Red Lake salt ridge (fig. 7), about 10 km (6 mi) north-northwest (updip) of Oakwood Dome, the Louann Salt was penetrated by the Humble #2A Red Lake Gas Unit 3 well (figs. 8 and 9). The Skelly-Belco #1 Gehrels well at the Burleson Hill Field 9 km (5 mi) west-northwest of the dome (fig. 9) penetrated the Smackover Formation. Three kilometers (2 mi) southeast (downdip) of the dome, the McCormick #1 Recknor well penetrated the Bossier Formation (fig. 3). Interpretation of Jurassic strata using well data has been supplemented by seismic profiles (figs. 8 and 9).

Notable variations in the thickness of the Jurassic section near Oakwood salt dome include thickening of Smackover strata southwest from Red Lake salt ridge to the Burleson Hill area. Smackover strata are also unusually thick downdip of and adjacent to the dome (fig. 3). The Bossier Formation thickens downdip from the dome (fig. 3). Specific data on thickness and lithology of strata are available only for the wells previously mentioned.

At Red Lake salt ridge, 15 m (48 ft) of Norphlet silty sandstones directly overlie the Louann Salt. These sediments are overlain by 351 m (1,150 ft) of Smackover carbonates. The Smackover Formation thickens to the southwest to about 1,220 m (4,000 ft) at Burleson Hill anticline (fig. 7). The Buckner Formation overlies Smackover strata above

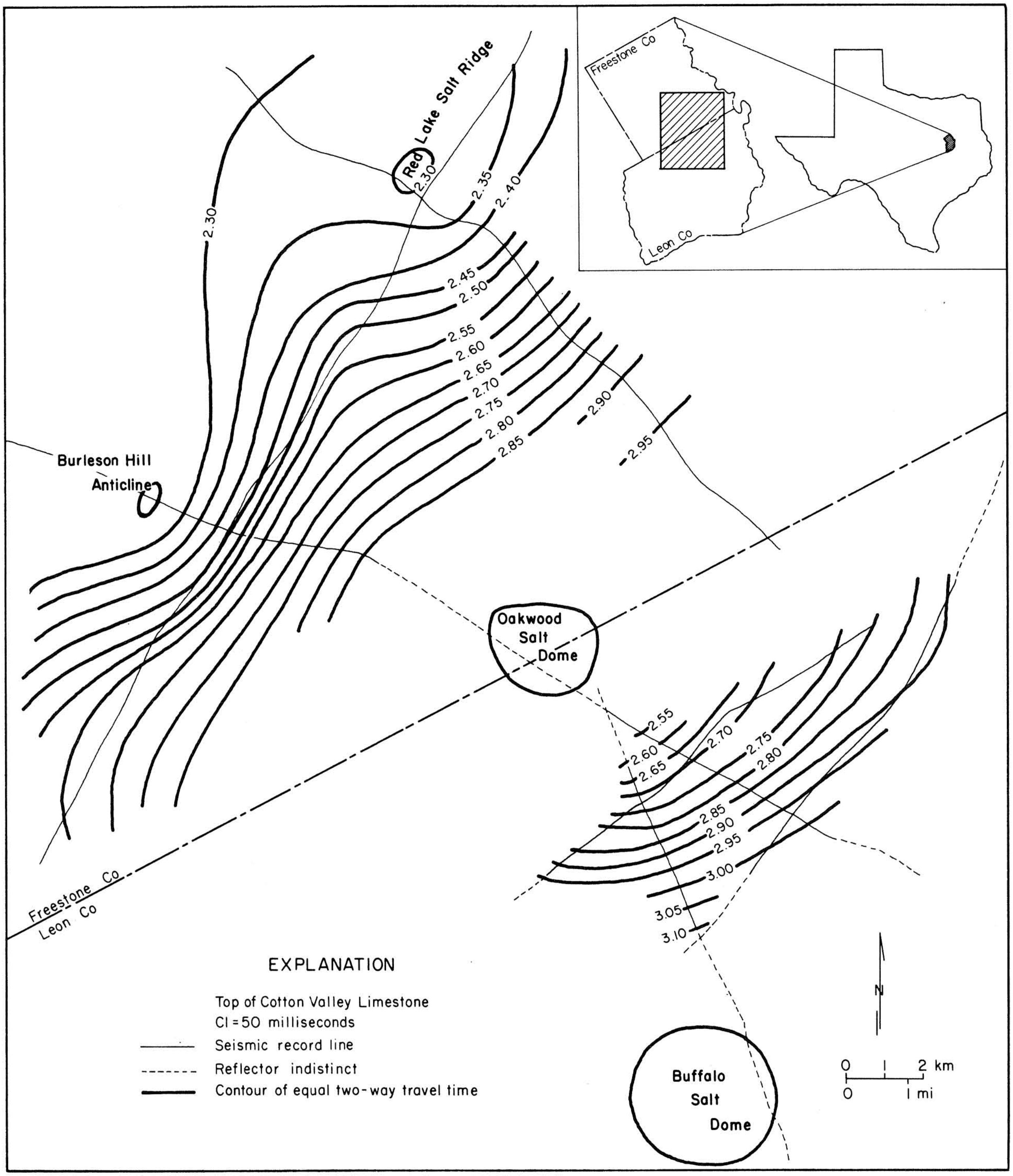

Figure 7. Structure map on top of Cotton Valley Limestone, Oakwood salt dome area, indicates locations of Burleson Hill anticline, Red Lake salt ridge, and Buffalo Dome. Locations of seismic coverage for figures 3, 8, and 9 are shown.

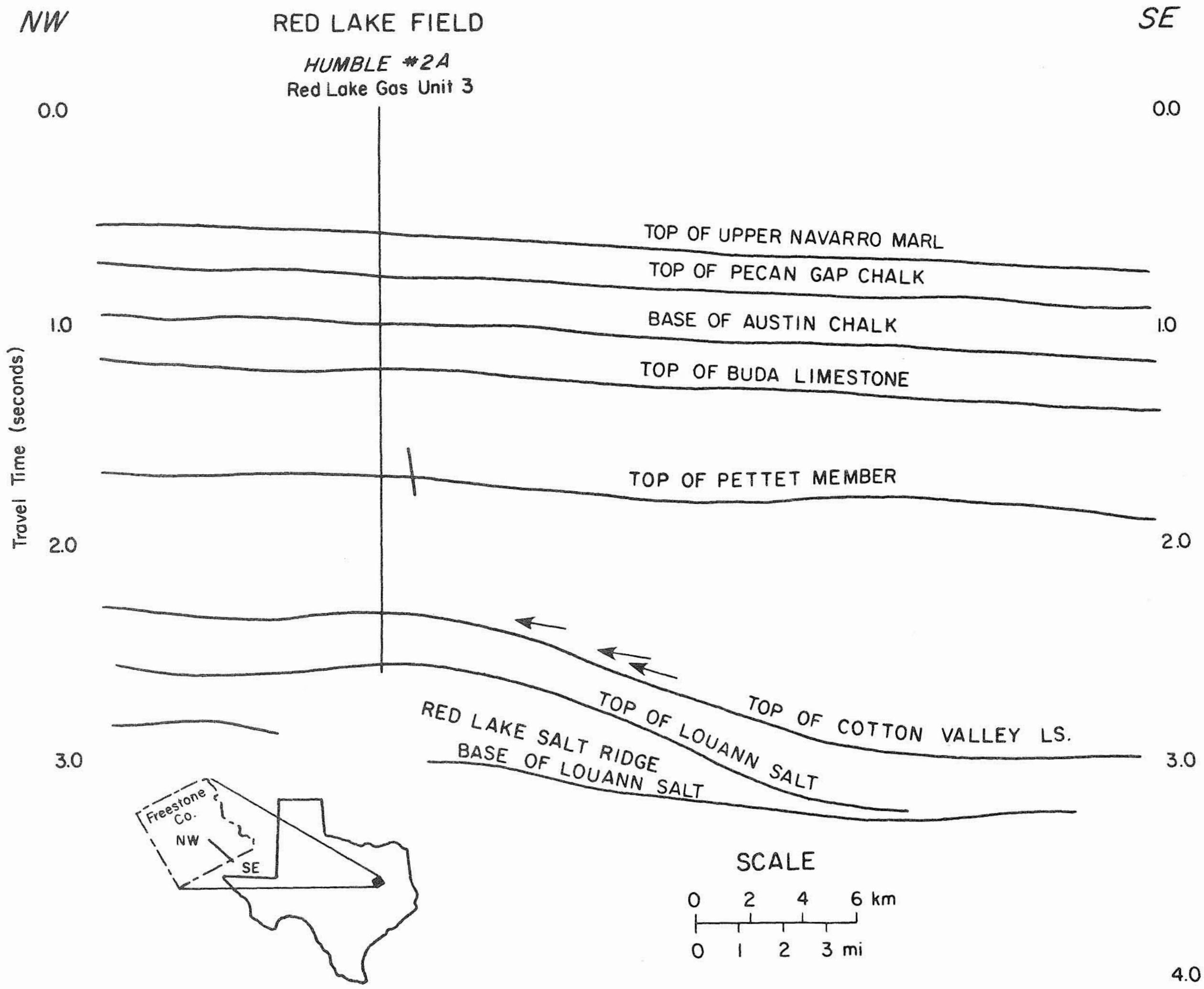

Figure 8. Interpretation of northwest-southeast seismic section through Red Lake salt ridge. Arrows above the Cotton Valley Limestone indicate onlap of Bossier sediments onto an existing Cotton Valley Limestone high. Arching of the basal Louann Salt reflector at the northwestern end of the section may be a velocity pullup effect caused by thickening of overlying Smackover - Cotton Valley Limestone section; arch at Red Lake salt ridge is caused by salt. Location of seismic line shown on figure 7.

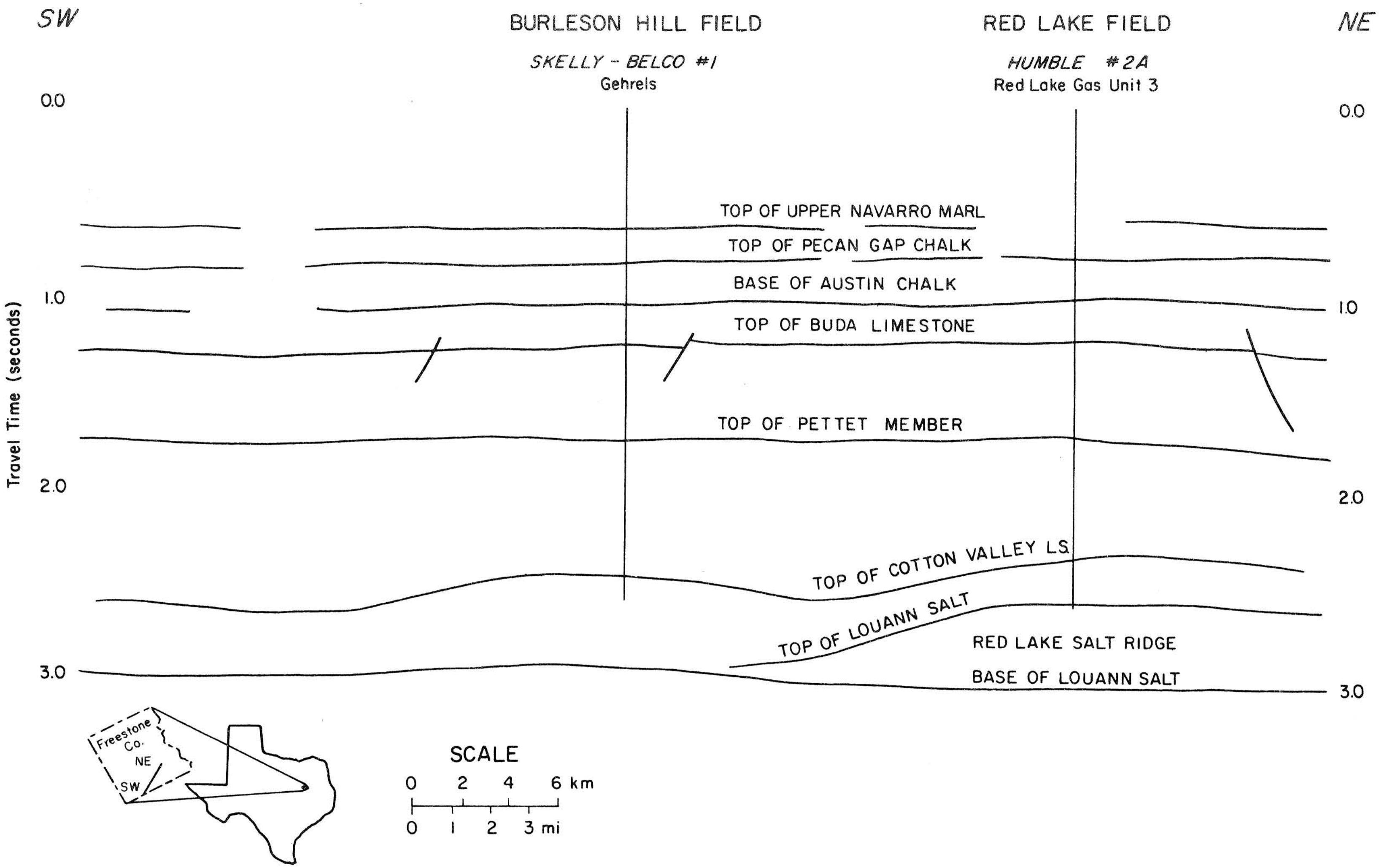

Figure 9. Interpretation of southwest-northeast seismic section through Burleson Hill anticline and Red Lake salt ridge. Arching of basal Louann Salt reflector beneath Burleson Hill Field may be a velocity pullup effect caused by thickening in the overlying Smackover - Cotton Valley Limestone section. Location of seismic line shown on figure 7.

the Red Lake salt ridge and is predominantly limestone and anhydrite. It probably grades laterally into the more limy upper part of the Smackover Formation around Oakwood salt dome (Swain, 1949). The argillaceous Cotton Valley Limestone directly overlies Smackover limestones in the central part of the East Texas Basin (Nichols and others, 1968). In the Burleson Hill area, the Cotton Valley Limestone is 306 m (1,005 ft) thick. Above it, the Bossier Formation consists predominantly of shales. Three kilometers (2 mi) southeast of the dome, the Bossier Formation is more than 448 m (1,470 ft) thick (fig. 3). Sandstones and shale of the Schuler Formation are 649 m (2,130 ft) thick and form the uppermost Jurassic and lowermost Cretaceous unit around Oakwood salt dome. No angular unconformities are evident in the Jurassic section near the dome, although local erosional unconformities may have formed over the dome's crest during its early salt-pillow stage.

Lower Cretaceous Strata

Lower Cretaceous strata include the uppermost Cotton Valley Group and the Trinity, Fredericksburg, and Washita Groups (fig. 6). These strata, especially the Massive Anhydrite, Paluxy Formation, and the Fredericksburg and Washita Groups, thicken toward the dome (figs. 10 and 11).

The Jurassic and lowermost Cretaceous Schuler Formation grades conformably upward into sandstones and shales of the Lower Cretaceous Travis Peak Formation. The Travis Peak Formation is approximately 802 m (2,630 ft) thick adjacent to the northwest side of the dome.

Conformably overlying the Travis Peak Formation is the Lower Glen Rose Formation. Its four conformable members, the Pettet, Pine Island, James, and Rodessa, have been penetrated about 2 km (1.25 mi) southeast of the dome (fig. 3) in the Texaco #1 Keep well. Here the basal Pettet Member is 155 m (508 ft) thick and consists of nonporous, fossiliferous limestones and gray, calcareous shales. The overlying Pine Island shales and subordinate limestones are 26 m (85 ft) thick. The James Limestone Member is 33 m (108 ft) thick and contains subordinate shale. Rodessa strata include limestone, dolomite, anhydrite, and shale, having a total thickness of 150 m (493 ft). Shale is most common in the lower part of the unit, and carbonates and subordinate anhydrite predominate in the upper part (fig. 10). Near Oakwood salt dome the Rodessa Member contains a thick, porous dolomite bed.

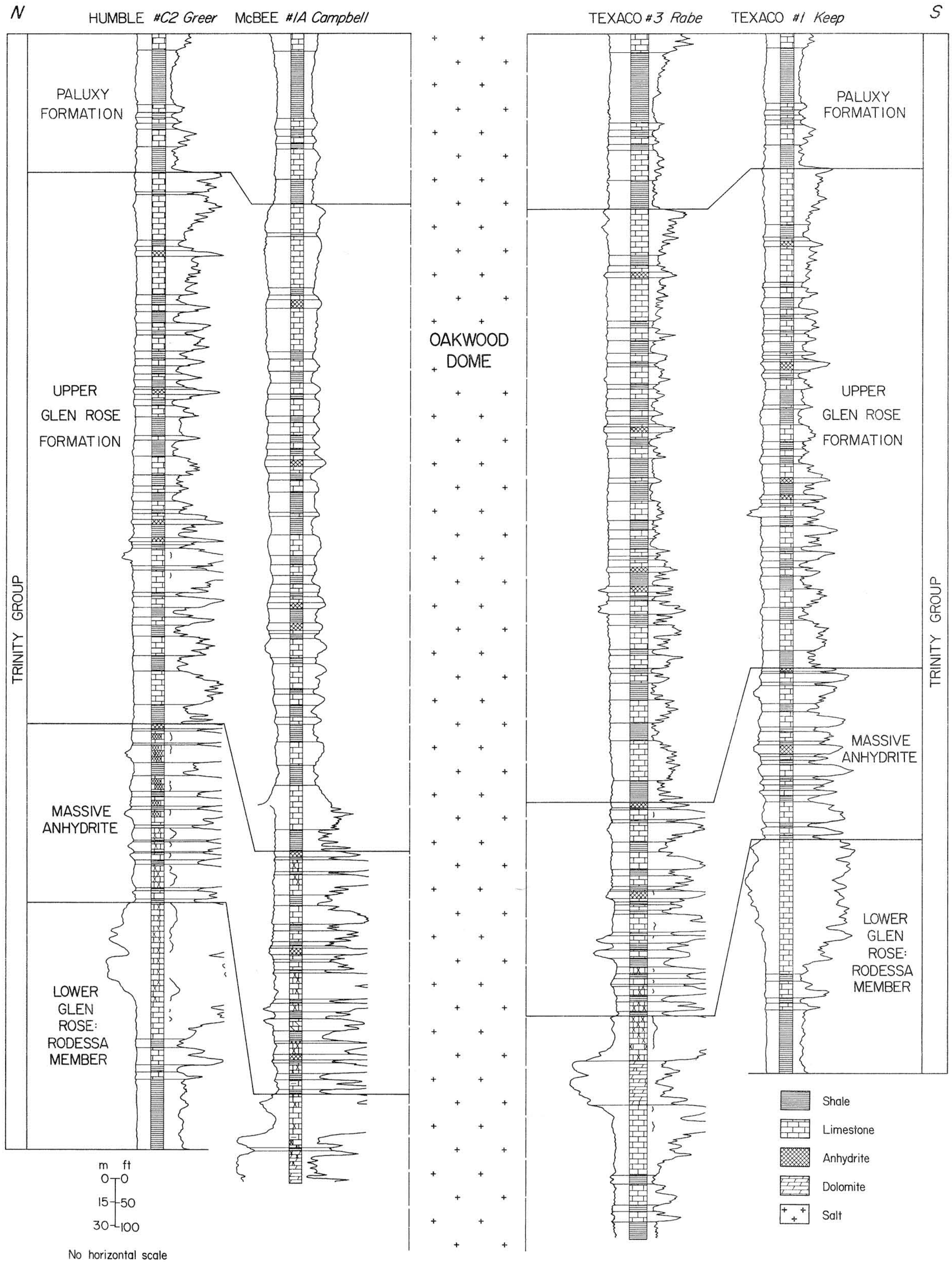

Figure 10. Spontaneous potential and electrical resistivity well log curves for Lower Cretaceous strata (upper Trinity Group), Oakwood salt dome area. Cross section datum is top of Trinity Group.

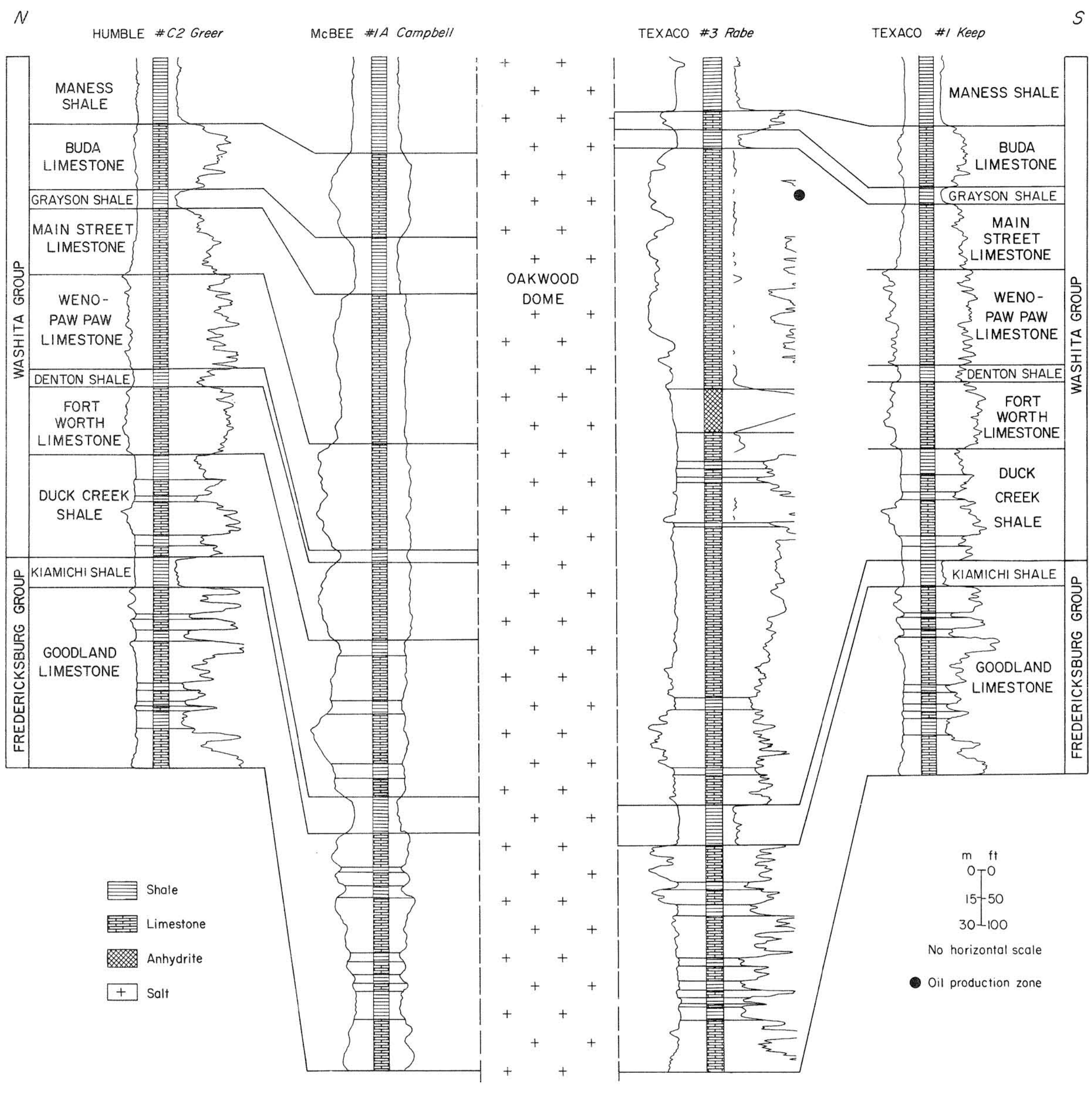

Figure 11. Spontaneous potential and electrical resistivity well log curves for Lower Cretaceous strata (Washita and Fredericksburg Groups), Oakwood salt dome area. Cross section datum is top of Washita Group.

The Massive Anhydrite conformably overlies the Lower Glen Rose Formation and consists of limestone, anhydrite, and shale (fig. 10). The unit thickens domeward from 110 m (360 ft) 2 km southeast of the dome to 155 m (508 ft) at the western edge of the dome where strata dip westward into the rim syncline at 6° to 12°. True thickness is at least 151 m (496 ft). The Upper Glen Rose Formation conformably overlies the Massive Anhydrite and consists of interbedded limestones and shales and minor anhydrite stringers. The unit thickens domeward from 321 m (1,052 ft), 2 km southeast of the dome, to 421 m (1,380 ft) at the western edge where strata dip westward into the rim syncline at 5° to 33°; true thickness there is at least 353 m (1,157 ft). The Paluxy Formation conformably overlies the Upper Glen Rose Formation and consists of shale, marl, and minor limestone. Paluxy strata thicken from 86 m (281 ft), 2 km southeast of the dome, to an apparent thickness of 112 m (369 ft) 0.7 km (0.4 mi) east of the dome. Caughey (1977) refers to these shales and marls south of the Paluxy sand facies as the Walnut Formation.

Limestones and shales of the Fredericksburg and Washita Groups (fig. 11) conformably overlie the Trinity Group. The Fredericksburg Group thickens from 116 m (381 ft), 2 km southeast of the dome, to an apparent thickness of 145 m (476 ft) at the western edge of the dome; the Washita Group also thickens from 273 m (896 ft) to an apparent thickness of 402 m (1,320 ft).

Washita strata penetrated by Texaco #3 Rabe are unusually limy and include a 24-m-thick (78-ft-thick) anhydrite bed (fig. 11). The apparent lack of shale or limestone interbeds in the anhydrite and its absence in nearby wells suggest that it is not a primary deposit but a residual accumulation on the dome margin, perhaps continuous with the anhydrite zone beneath the overhang (fig. 5). A local unconformity or a fault may have caused the thinning of the Buda and Maness Formations at the Texaco #3 Rabe well (fig. 11). Around Oakwood salt dome, the Maness Shale is equivalent to prodelta shelf deposits of the Pepper Shale (Oliver, 1971).

Upper Cretaceous Strata

The well-known regional unconformity above the Washita Group in the Gulf Coast Basin is not apparent near Oakwood salt dome. Maness shales, absent elsewhere in the Gulf Coast, appear to be transitional between the Washita Group and the sandstones and shales of the Woodbine Group in the East Texas Basin (fig. 12). The Woodbine Group attains an apparent thickness of 197 m (647 ft) beneath the domal overhang and dips from 45° to 90°. Oliver (1971) inferred that the Woodbine sandstones around Oakwood salt dome are part of a coastal-barrier facies formed by the reworking of sediments from the

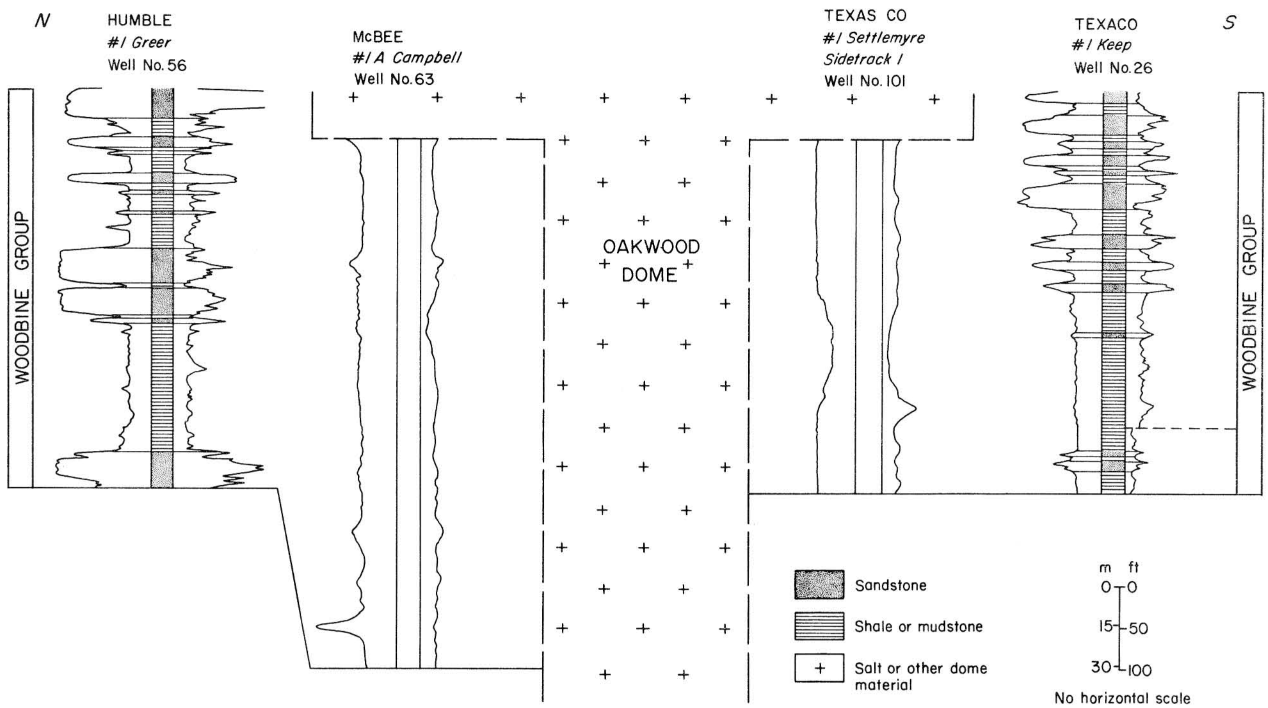

Figure 12. Spontaneous potential and electrical resistivity well log curves for Woodbine strata, Oakwood salt dome area. Low contrast between high-salinity drilling fluids beneath the dome overhang and Woodbine fluids makes delineation of Woodbine sandstones on electric logs difficult.

Freestone delta, which developed simultaneously in the central area of the East Texas Basin. Beneath the overhang at Oakwood salt dome, the gray Woodbine sandstones and shales are pyritic and lignitic. The sandstones are very fine to medium grained; porosity values range from 3.2 to 28.3 percent, and permeability values range from 0 to 2,325 millidarcys. The more porous and permeable zones have produced oil.

The overlying gray-to-black Eagle Ford shales are commonly sandy and pyritic and are locally interbedded with siltstone, volcanic ash, or limestone. The sandstones and siltstones near the base of the Eagle Ford Group (Harris Sand) may have been derived from deltas along the western flank of the Sabine Uplift before the maximum transgression of Eagle Ford seas (Oliver, 1971). Eagle Ford sediments thicken toward Oakwood salt dome to a maximum true thickness of 108 m (345 ft) at the dome (figs. 13 and 14).

A regional unconformity separates the Eagle Ford Group from chalk and shale of the overlying Austin Group. The Gober Chalk normally represents the uppermost formation of the Austin Group, but it is absent at the edge of the dome (fig. 13). The Austin Group and

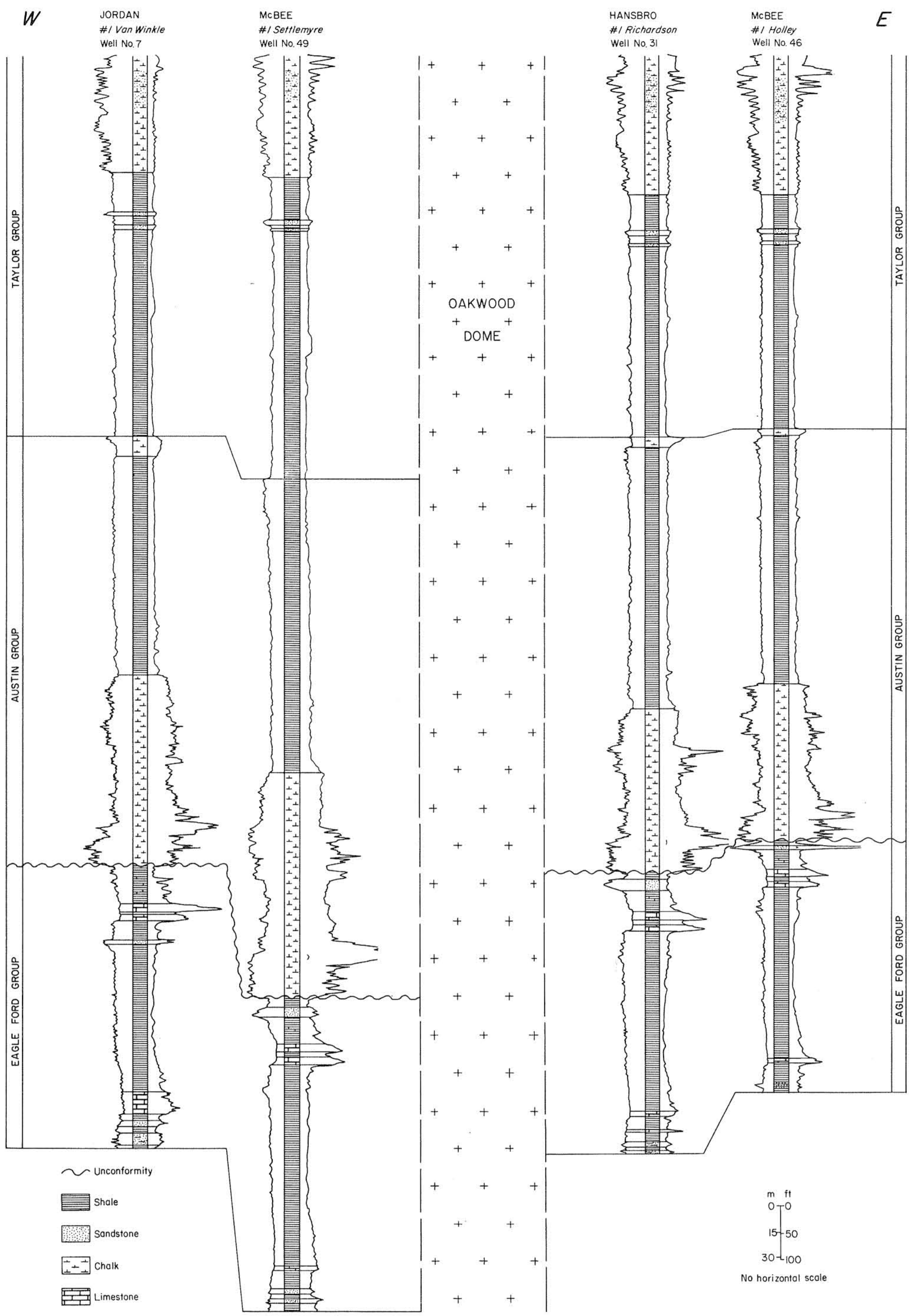

Figure 13. Spontaneous potential and electrical resistivity well log curves for Upper Cretaceous strata (Eagle Ford, Austin, and Taylor Groups), Oakwood salt dome area. Cross section datum is top of Pecan Gap Chalk.

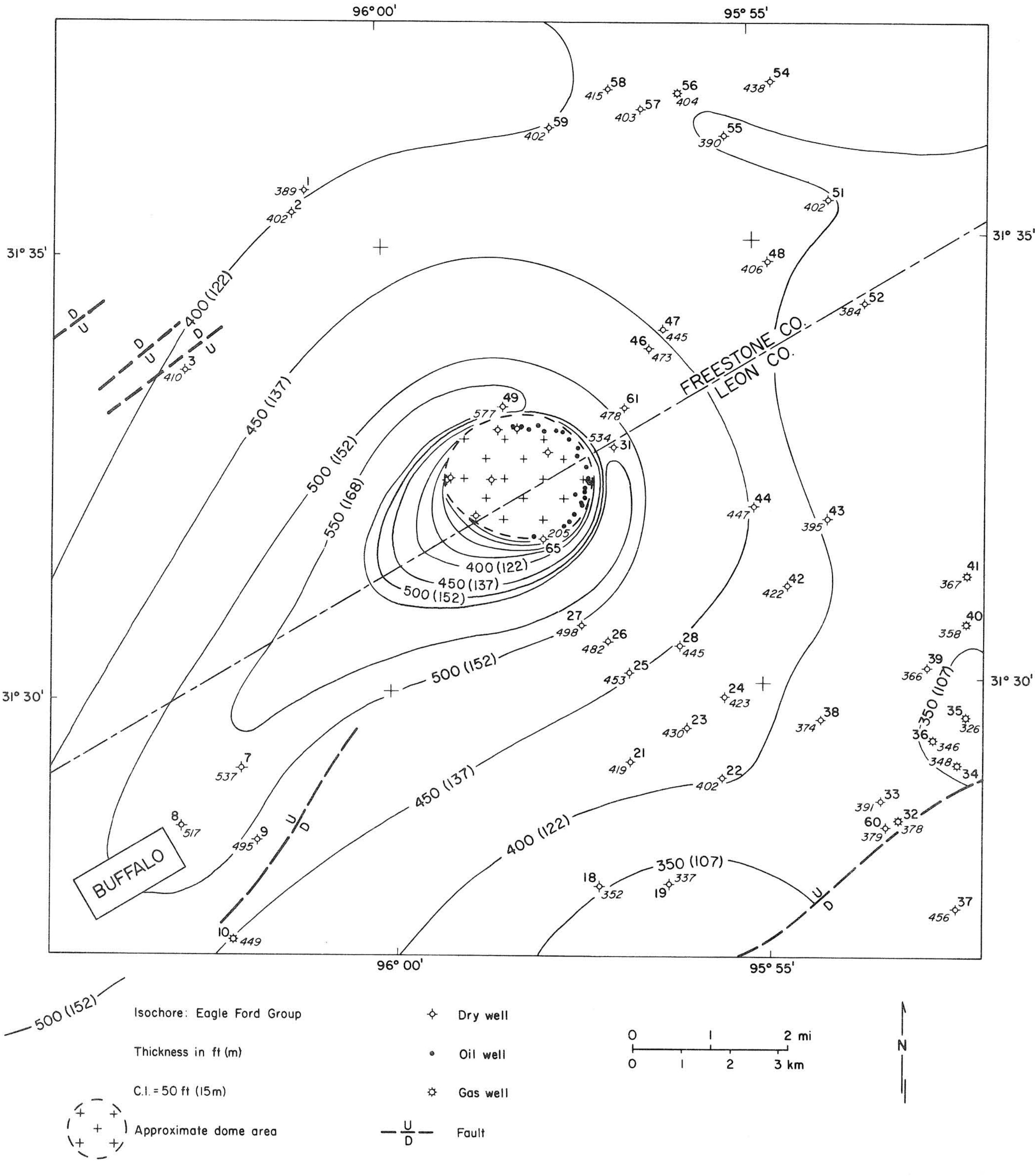

Figure 14. Isochore map of Eagle Ford strata, Oakwood salt dome area.

the conformably overlying Taylor Group thicken toward the dome (fig. 15). The Taylor Group consists of upper and lower shale sections separated by the Pecan Gap Chalk (figs. 13 and 16).

The upper and lower contacts of the conformably overlying Navarro Group cannot be precisely determined with electric logs (fig. 16). The Navarro shales are generally light gray, micaceous, and microfossiliferous (Nichols and others, 1968). These shales are interrupted by the more resistive Upper Navarro Marl (fig. 16), which is a calcareous shale containing abundant burrows and pellets. This marl thins or disappears toward the dome. A 2-m-thick (8-ft-thick) bed of Nacatoch sandstone is preserved in the rim syncline of Oakwood salt dome (fig. 16). The Upper Taylor Formation and the Navarro Group thicken toward the dome (figs. 17 and 18).

Tertiary Strata

The Paleocene Midway Group, consisting of fossiliferous, lignitic shale, siltstone, and very fine grained sandstone, appears to thicken toward the dome (fig. 18). Midway sediments grade conformably upward into shales and sandstones of the Paleocene and Eocene Wilcox Group (fig. 19). Fisher and McGowen (1967) noted that near Oakwood salt dome the lower part of the Wilcox is part of the meandering channel facies of the Mount Pleasant Fluvial System. Sediments of both the Wilcox and Claiborne Groups thicken into the rim syncline of Oakwood salt dome; however, they are thinner and have been uplifted adjacent to and over the dome (figs. 3, 4, 20, and 21).

STRUCTURE OF THE OAKWOOD SALT DOME AREA

Structure in the Oakwood salt dome area is dominated by faults and folds that principally resulted from salt tectonics. They are superimposed on a regional southeastward dip ranging from approximately 0.7° (60 ft/mi or 11 m/km) on top of the Upper Navarro Marl to 1.4° (125 ft/mi or 24 m/km) on top of the Travis Peak Formation.

Faults

Most of the faults within the Oakwood salt dome area appear to have resulted from salt flowage, and all exhibit normal displacement. Some of the faults are related to development of the dome, including faults associated with the rim syncline and radial faults related to vertical movement of the dome. Other faults southeast of Oakwood salt

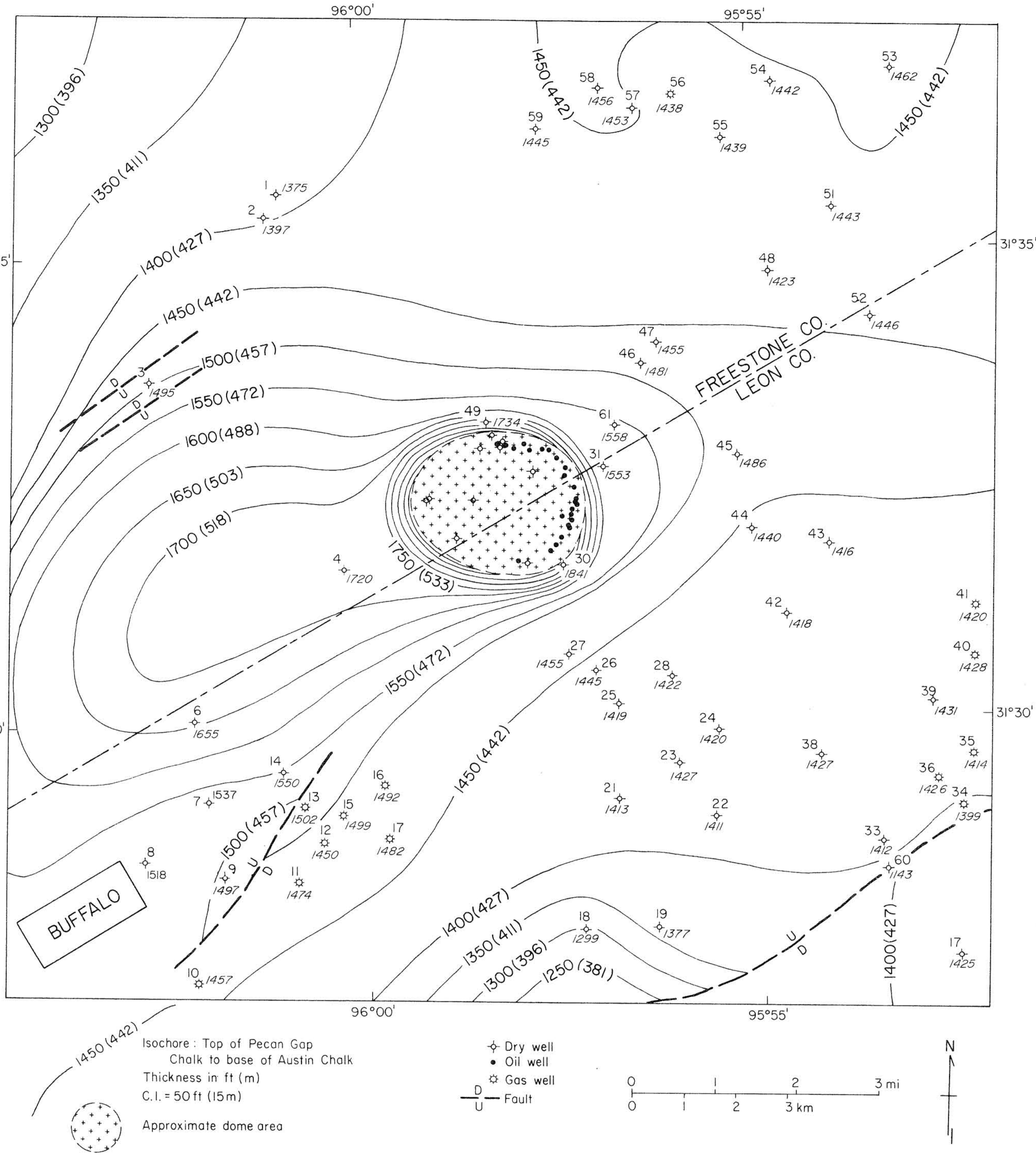

Figure 15. Isochore map of strata from base of Austin Chalk to top of Pecan Gap Chalk, Oakwood salt dome area.

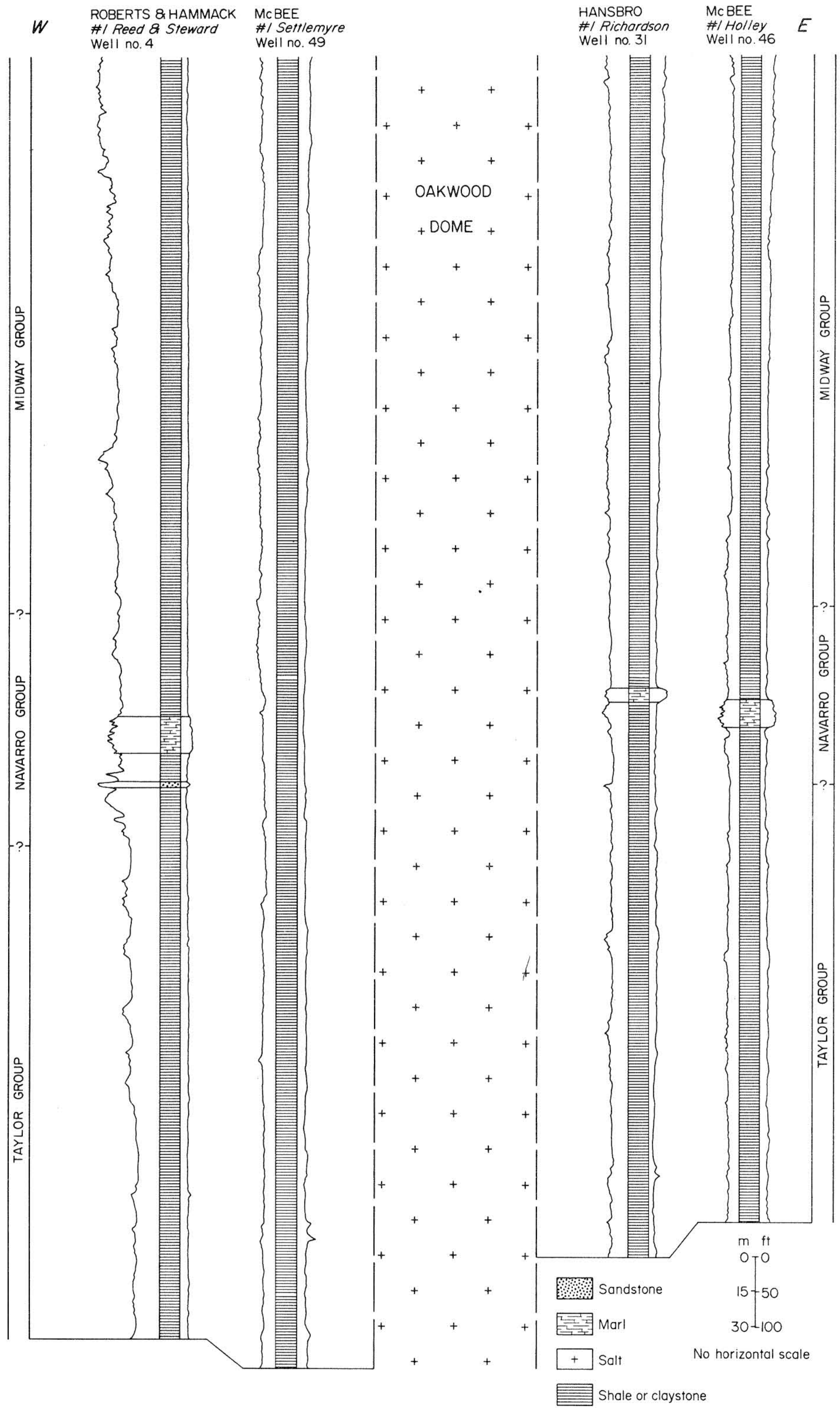

Figure 16. Spontaneous potential and electrical resistivity well log curves for Upper Cretaceous strata of the upper Taylor and Navarro Groups and Paleocene strata of the Midway Group, Oakwood salt dome area. Cross section datum is top of Midway Group. The Nacatoch Formation was penetrated by Roberts and Hammack #1 Reed and Steward.

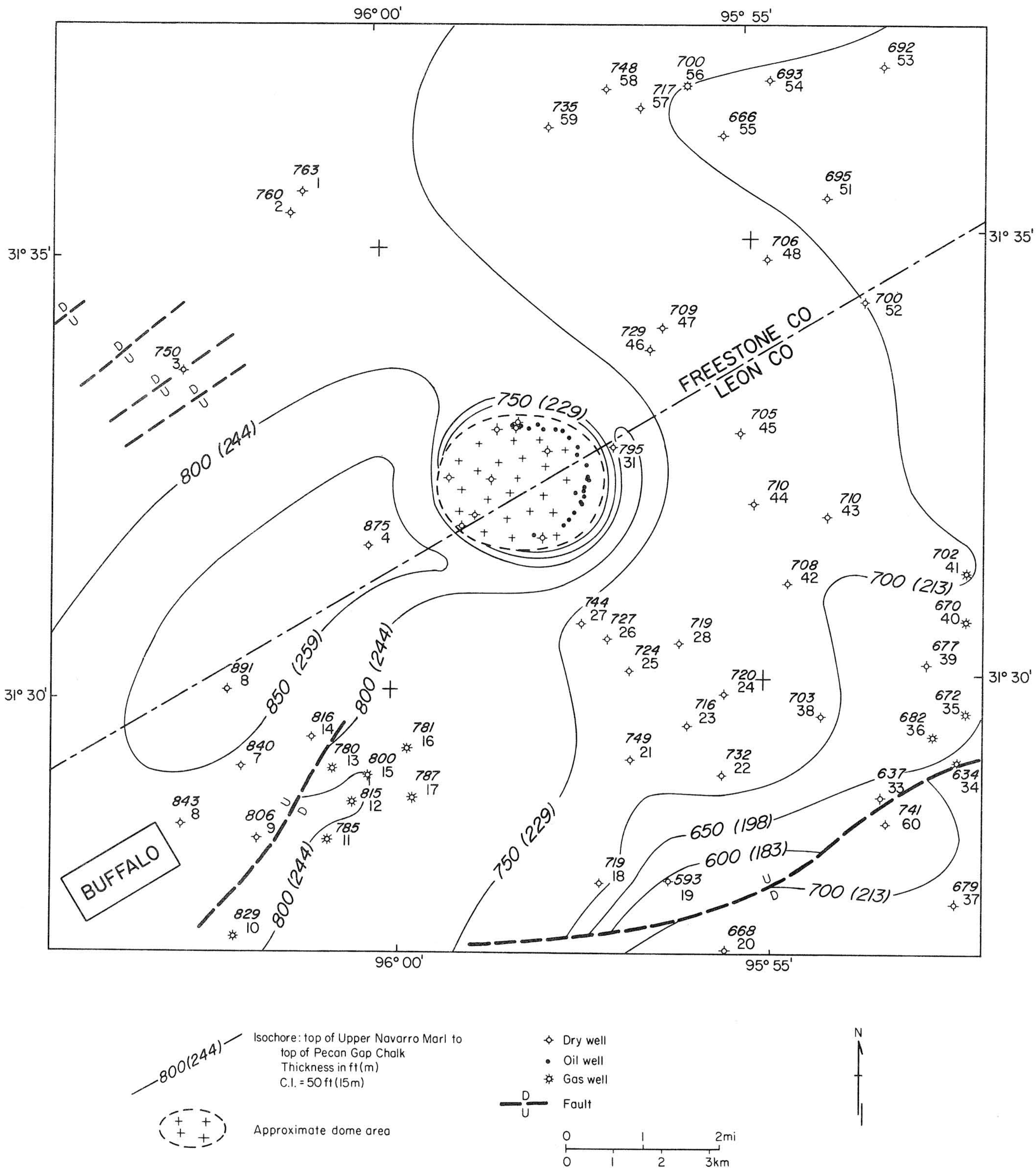

Figure 17. Isochore map of strata from top of Pecan Gap Chalk to top of Upper Navarro Marl, Oakwood salt dome area.

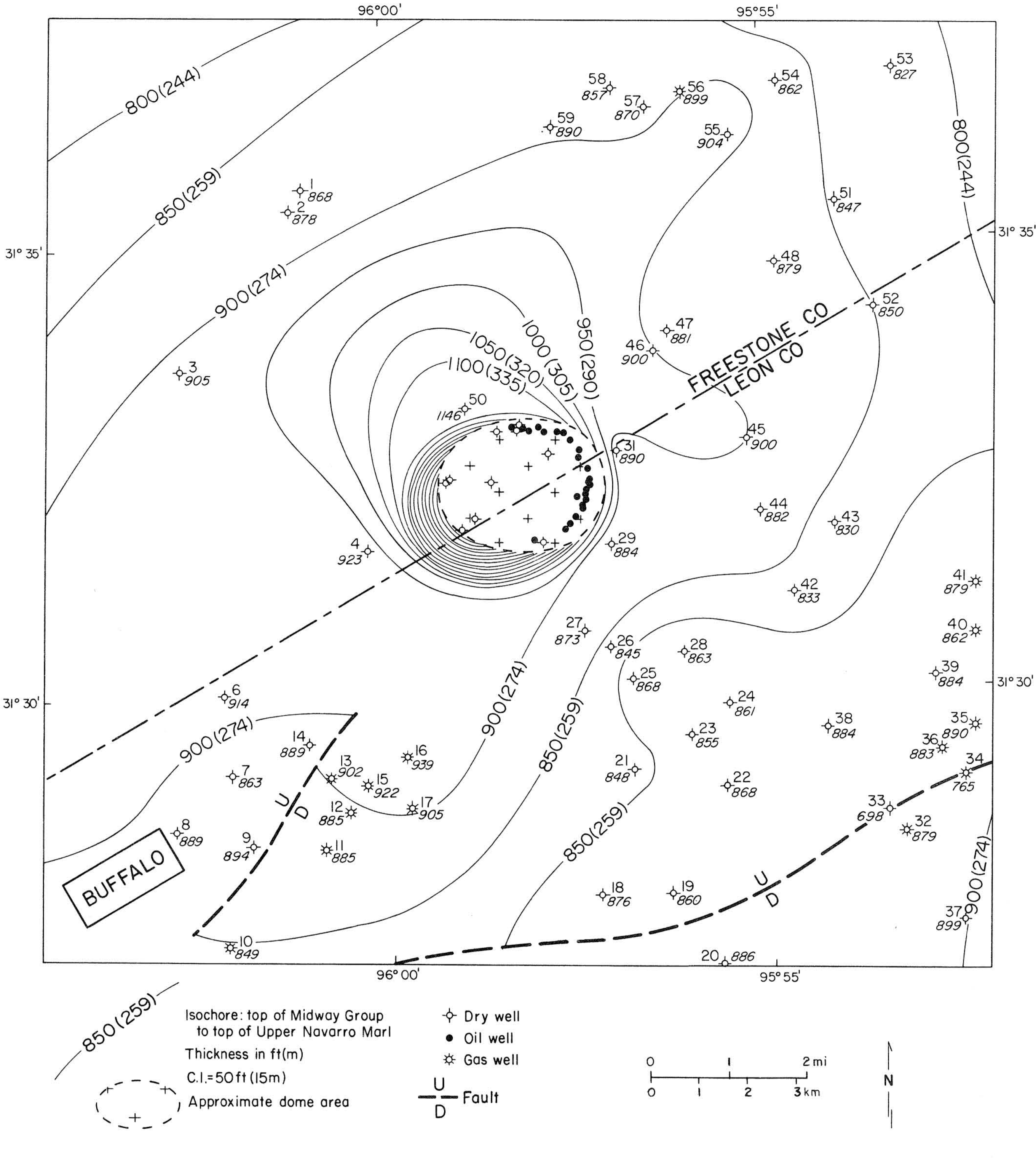

Figure 18. Isochore map of strata from top of Upper Navarro Marl to top of Midway Group, Oakwood salt dome area.

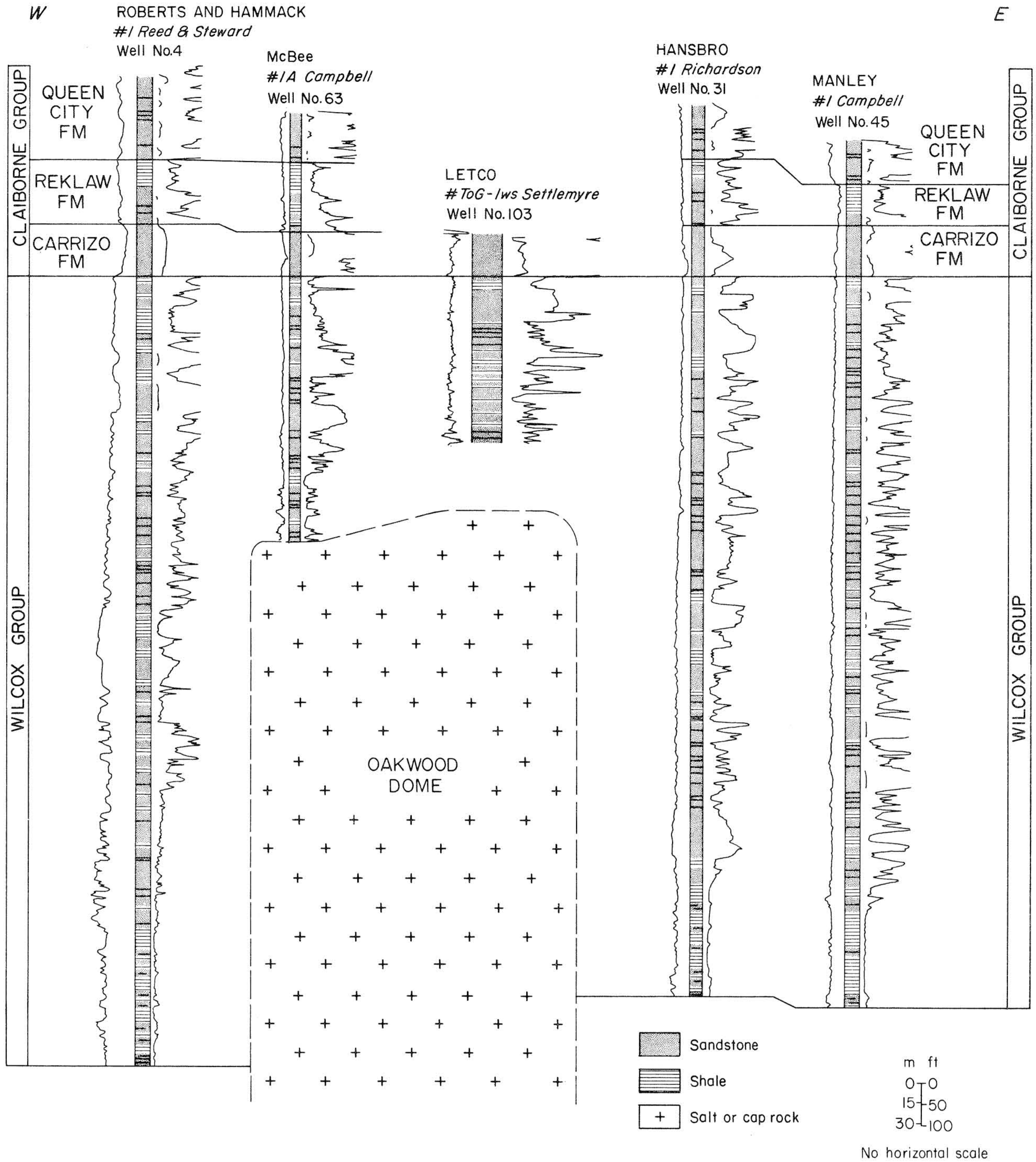

Figure 19. Spontaneous potential and electrical resistivity well log curves for Paleocene and Eocene strata of the Wilcox and Claiborne Groups, Oakwood salt dome area. Cross section datum is top of Wilcox Group.

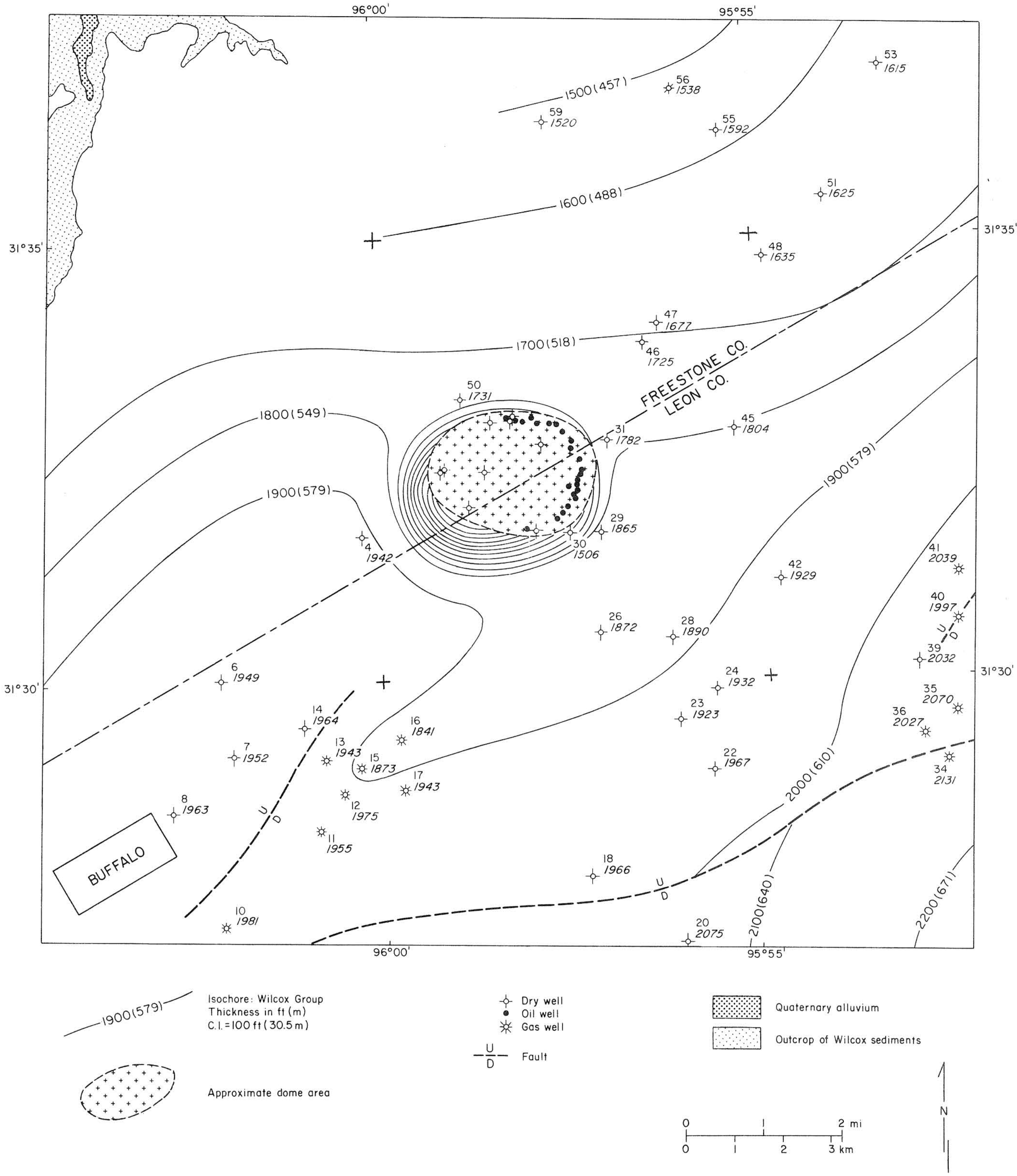

Figure 20. Isochore map of Wilcox strata, Oakwood salt dome area. Surface mapping from Barnes (1967, 1970).

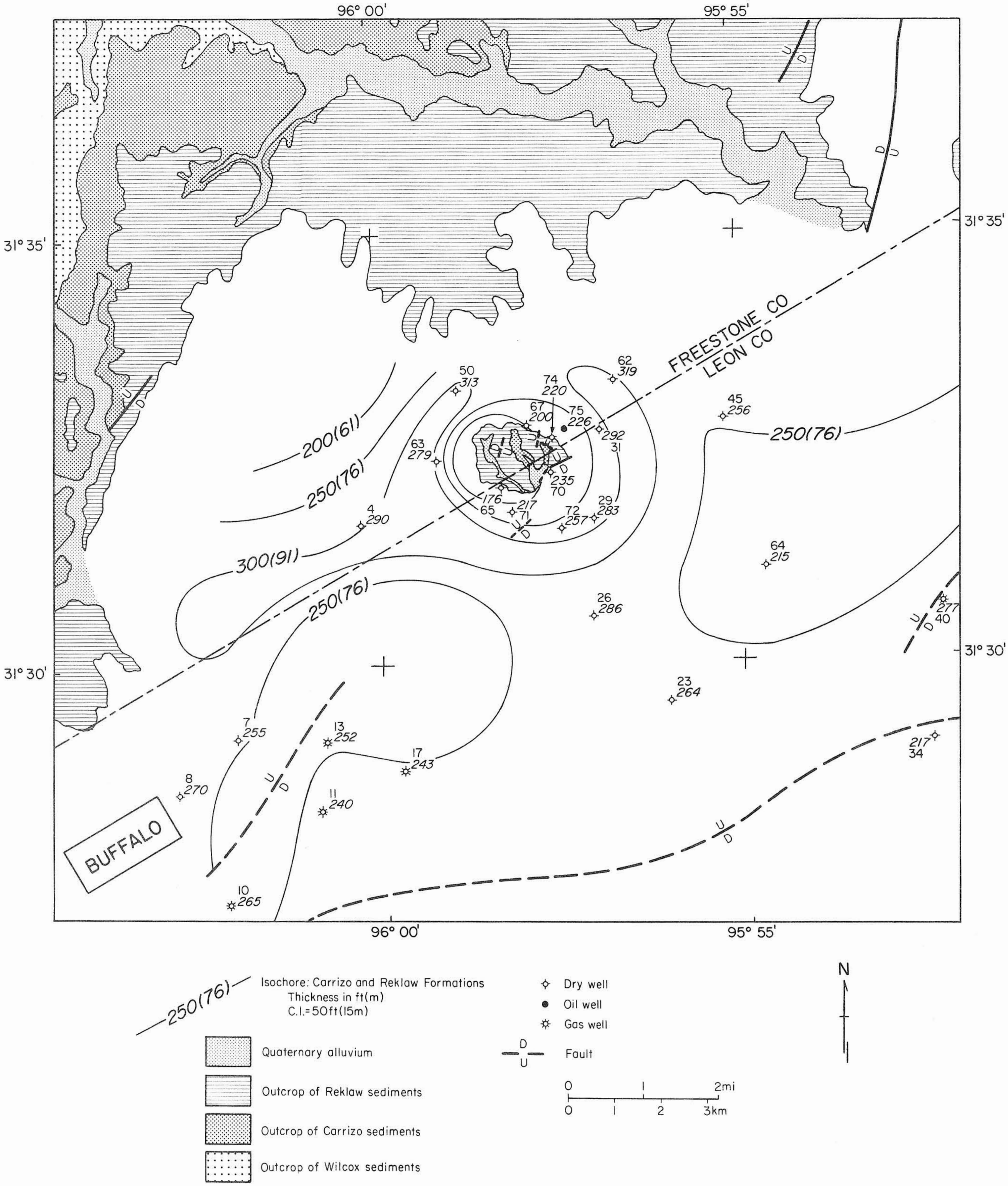

Figure 21. Isochore map of Carrizo and Reklaw strata, Oakwood salt dome area. Surface mapping from Barnes (1967, 1970) and Kreitler and others (1980).

dome are part of the Elkhart Graben - Mount Enterprise Fault System and its associated deep salt structures.

One fault contributed to the initial development of Oakwood salt dome. Syndepositional faulting of the Louann Salt and Smackover limestones northwest of the dome (fig. 22) suggests that early patterns of sedimentation and salt flowage were structurally controlled. The accumulation of thick Smackover limestones on the downthrown side of the fault created the core of an anticlinal structure over which the Burleson Hill Field is developed (fig. 7). The thickened Smackover strata initiated movement of salt into the early pillow configuration of Oakwood salt dome. Because the fault does not displace strata younger than Smackover age, it is unlikely that it influenced subsequent salt movement.

Subsidence of sediments into a rim syncline southwest of Oakwood salt dome produced normal faults updip on the northwest flank of the rim syncline in the area of flexing. These faults cut Upper Cretaceous strata (figs. 23, 24, 25, and 26), and may extend into the Tertiary section, but seismic reflectors are weak, and well control is insufficient to define accurately the upward extent of the faults (figs. 27 and 28). Surface mapping of Tertiary sediments (Barnes, 1967, 1970), however, has identified one fault in the area whose origin may also be traced to this synclinal folding (fig. 29). It is enigmatic why flexing there has not broken older, more competent beds that are more tightly folded. A fault on the southern flank of the previously mentioned rim syncline (figs. 23, 24, 25, 26, 27, and 28) may have resulted from similar flexing of strata.

The presence of radial faults around Oakwood salt dome is suggested by the structural configuration of the upper surface of the Woodbine Group (fig. 23). One of these inferred radial faults may also account for thinning of Maness and Buda strata in the Texaco #3 Rabe well (fig. 11). These faults are related to vertical movement of the dome; however, their vertical extent cannot be determined because of limited well control. The faults have not been detected by surface mapping.

A fault southeast of Oakwood salt dome is one of numerous faults within the regional Elkhart Graben - Mount Enterprise Fault System (figs. 23 to 29). This system of faults trends approximately east-west near the southern end of the East Texas Basin and appears to be associated with several deep salt structures (fig. 1). For example, the fault southeast of Oakwood salt dome is associated with the Buffalo salt dome. Well and seismic reflection data indicate that the fault cuts strata at least as old as the Woodbine Group. Nearby, a less extensive growth fault and associated rollover structure occur within Midway and Wilcox sediments southeast of Oakwood salt dome (figs. 27 and 28).

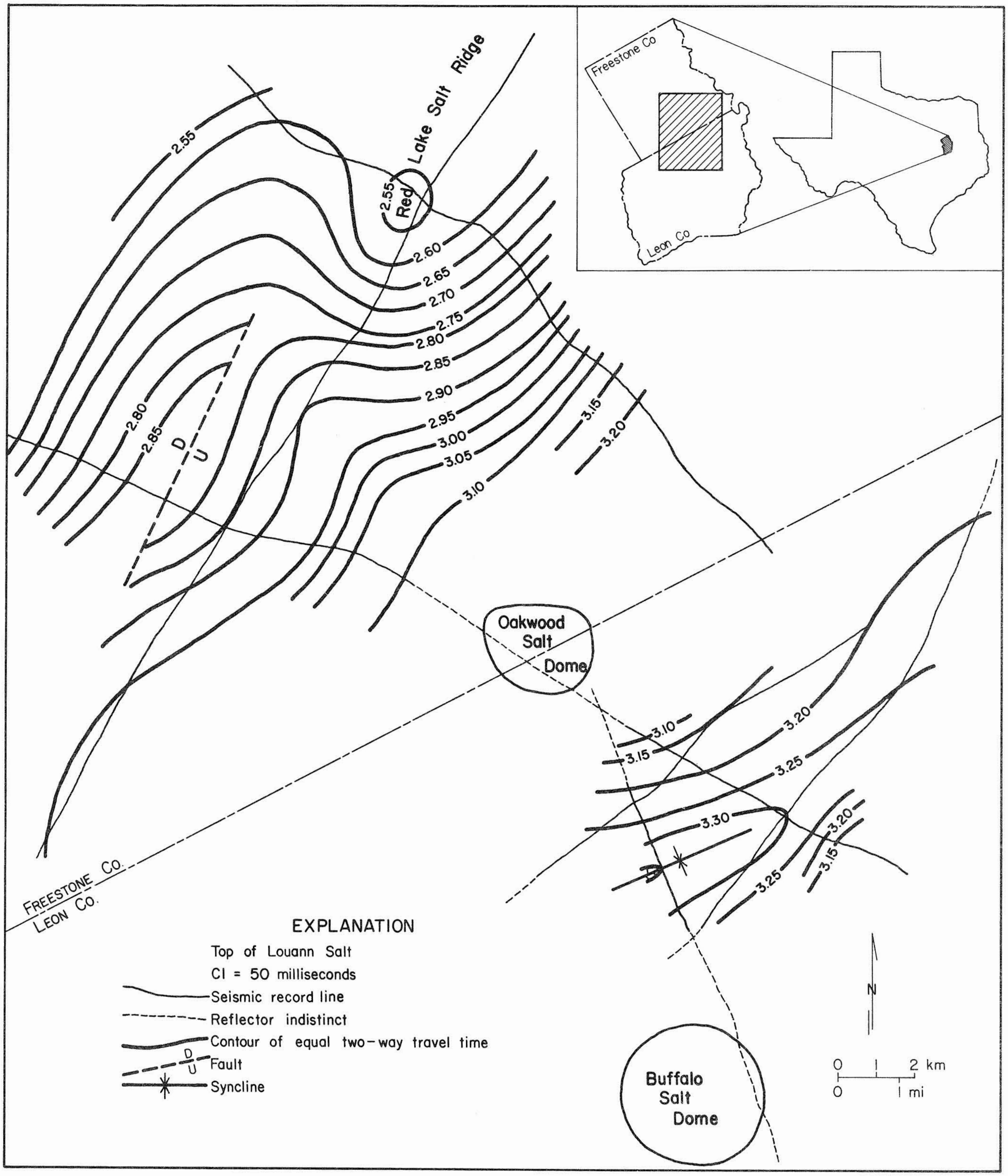

Figure 22. Structure map on top of Louann Salt, Oakwood salt dome area.

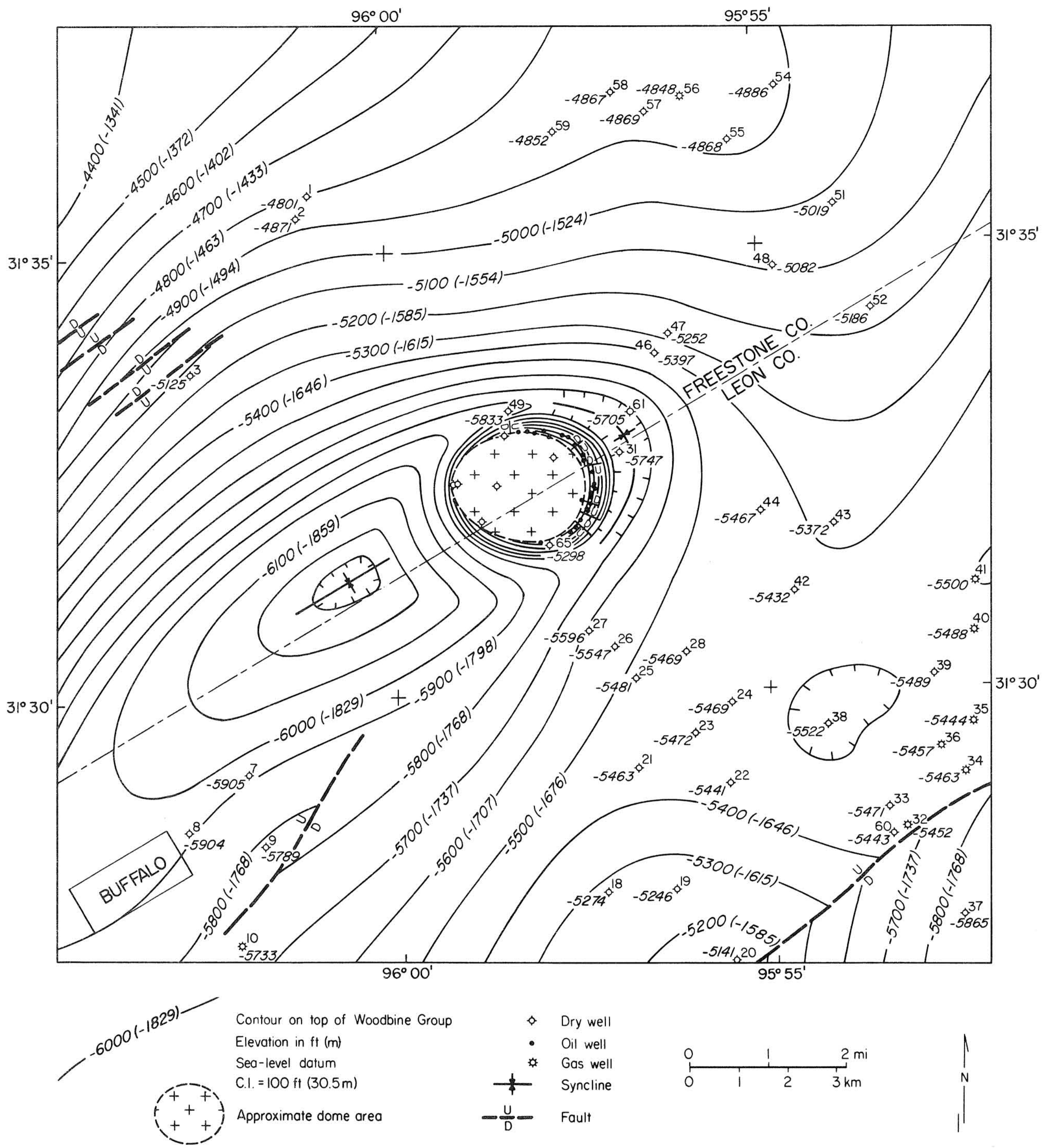

Figure 23. Structure map on top of Woodbine Group, Oakwood salt dome area.

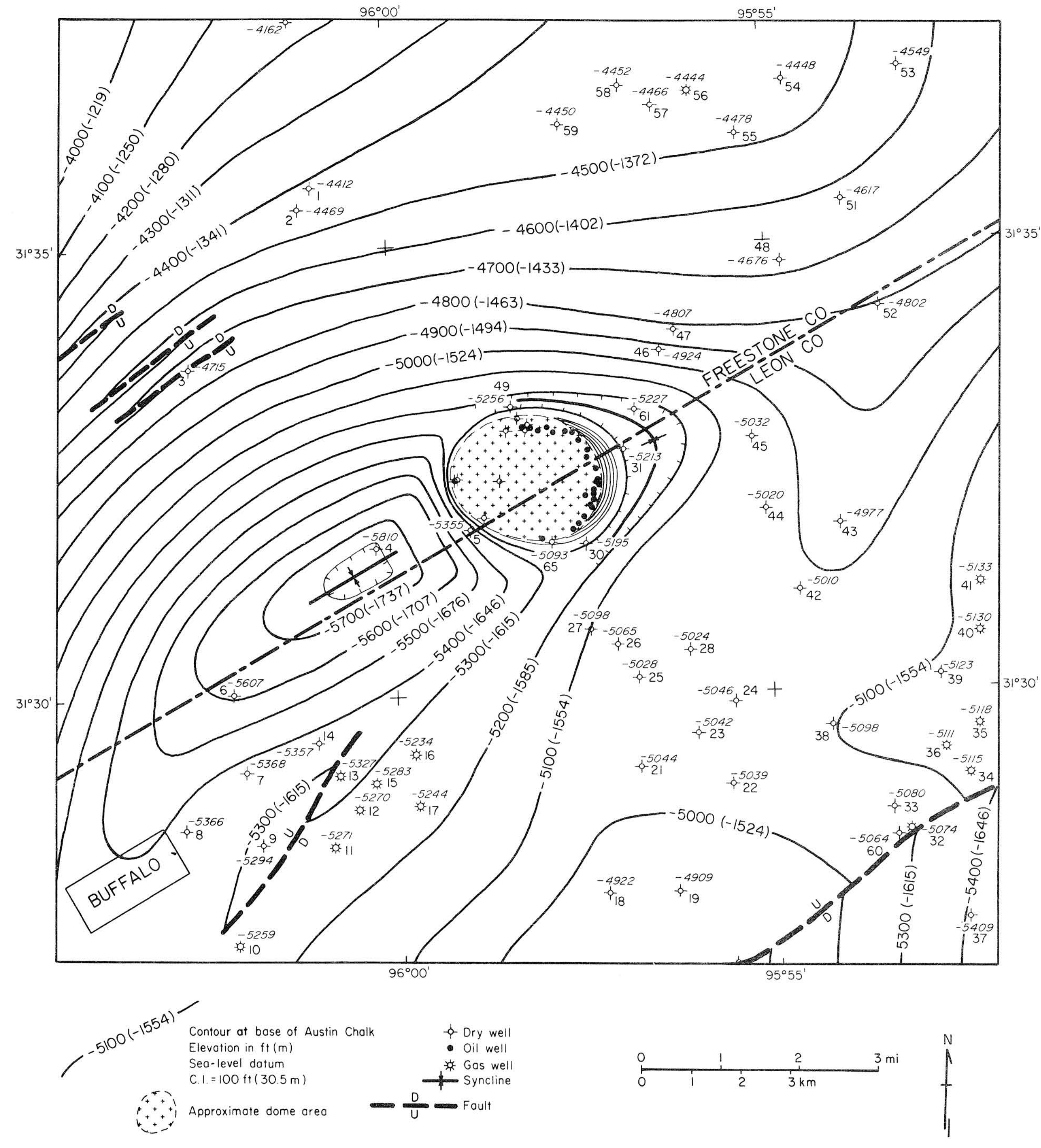

Figure 24. Structure map at base of Austin Chalk, Oakwood salt dome area.

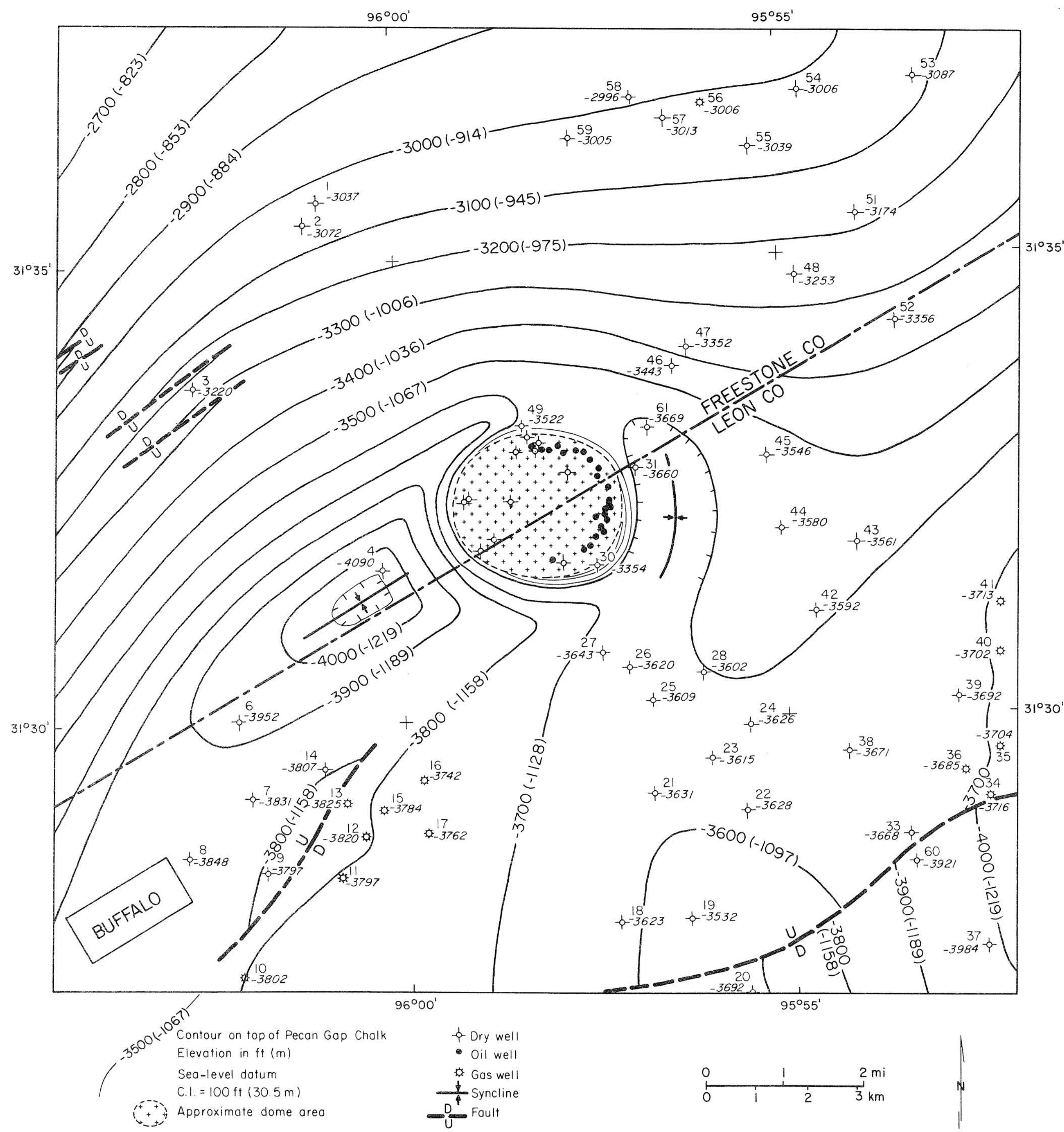

Figure 25. Structure map on top of Pecan Gap Chalk, Oakwood salt dome area.

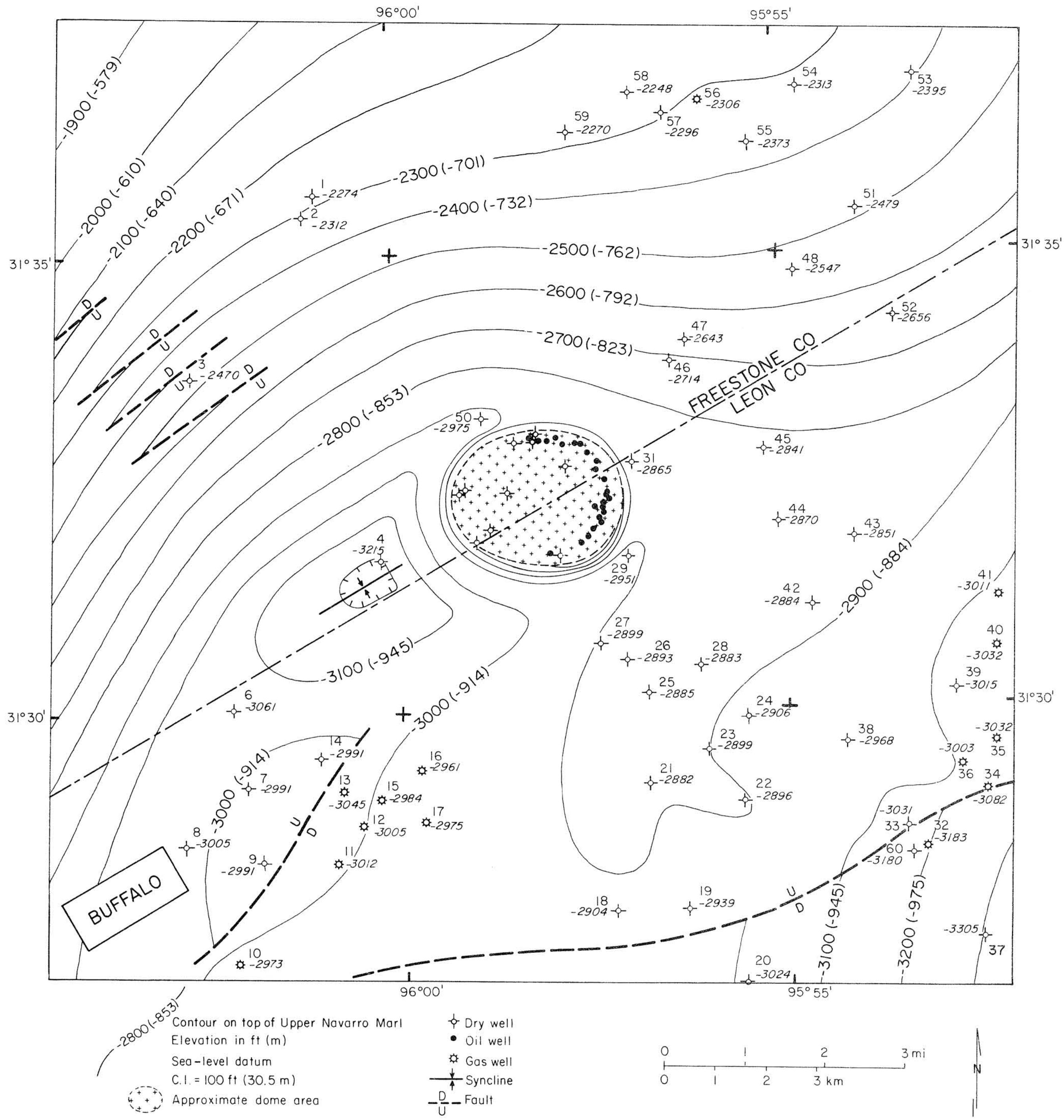

Figure 26. Structure map on top of Upper Navarro Marl, Oakwood salt dome area.

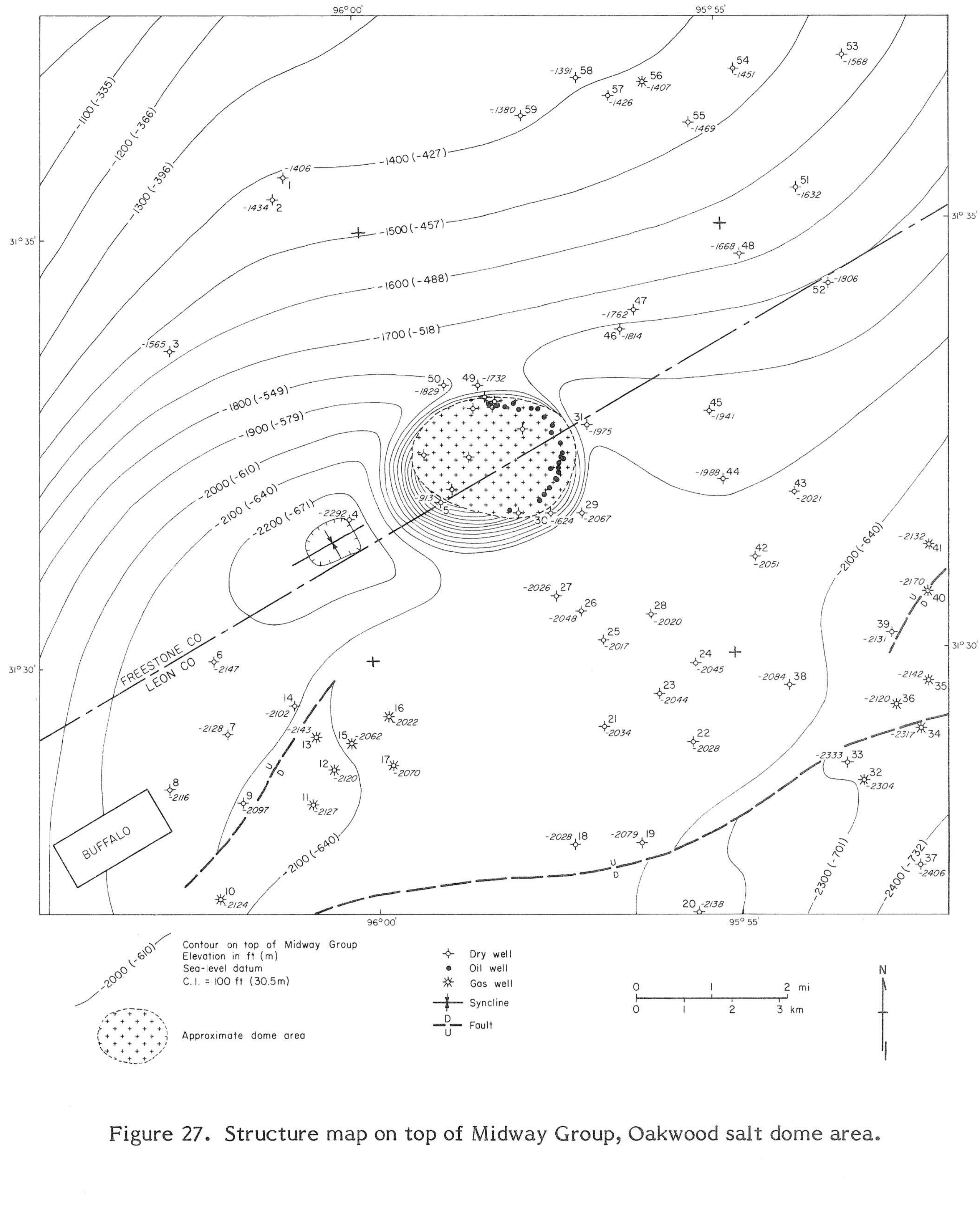

Figure 27. Structure map on top of Midway Group, Oakwood salt dome area.

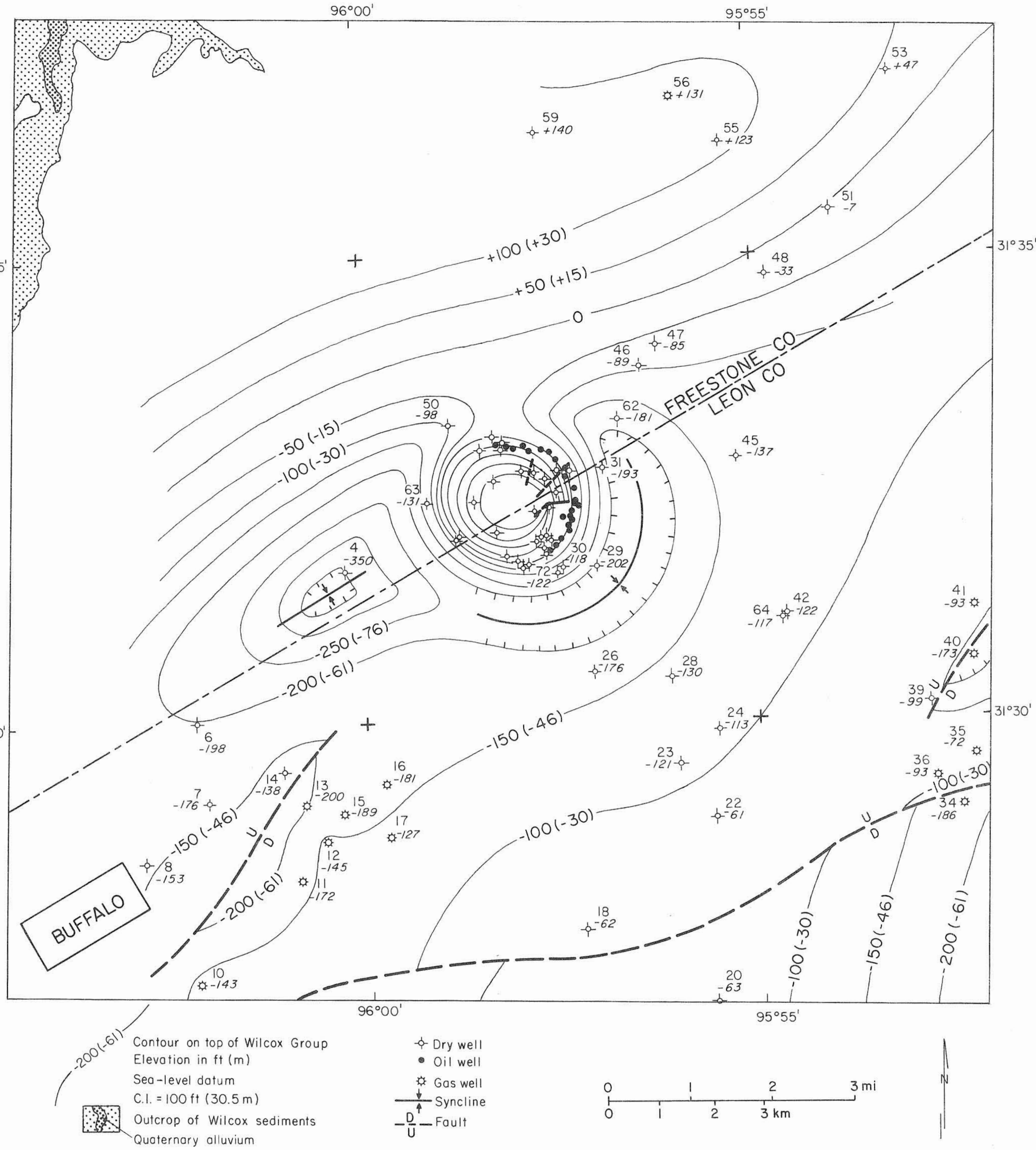

Figure 28. Structure map on top of Wilcox Group, Oakwood salt dome area. Surface geology from Barnes (1967, 1970). Faults over dome from Kreitler and others (1980).

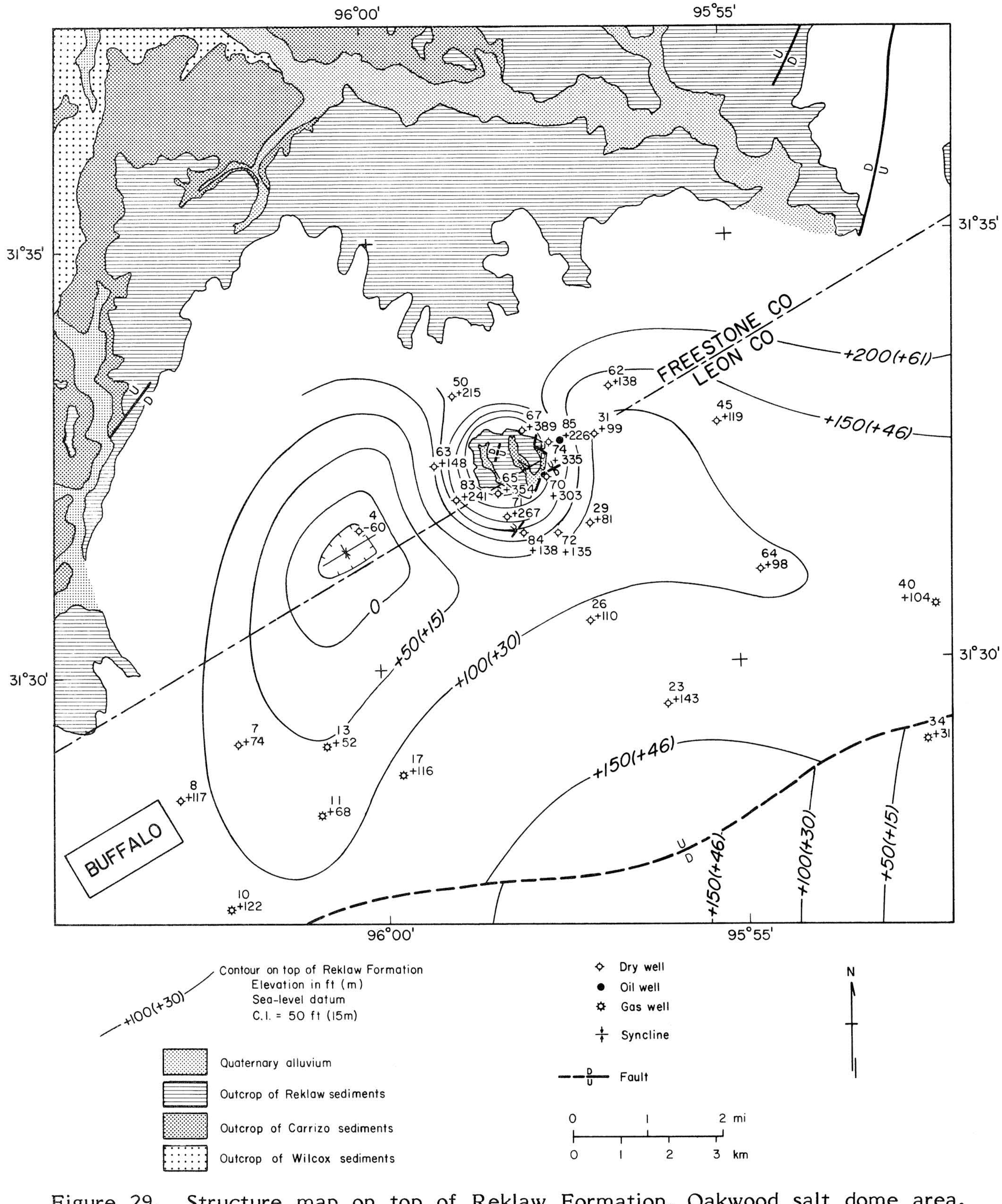

Figure 29. Structure map on top of Reklaw Formation, Oakwood salt dome area. Surface geology from Barnes (1967, 1970) and Kreitler and others (1980).

Folds

Flow of salt also induced folding of strata in the Oakwood salt dome area. The formation of Red Lake salt ridge to the northwest and of Buffalo salt dome to the southeast of Oakwood salt dome arched overlying strata. Northwest of Oakwood dome, post-Louann strata dip domeward at 1° to 15°. Southwest of Oakwood salt dome, salt withdrawal into Oakwood and perhaps surrounding domes formed a southwest-northeast-trending syncline (figs. 23 to 29). Growth of the Oakwood salt stock domed overlying Tertiary sediments and upturned strata along the sides of the dome to create a relatively narrow syncline encircling the north, east, and south flanks of the dome (figs. 23 to 29).

DOME GROWTH HISTORY

The growth history of Oakwood salt dome can be reconstructed sequentially by restoring major seismic reflectors to a horizontal attitude. A palinspastic reconstruction (fig. 30) was made from a seismic record section that had been converted to a depth section by using a single velocity function derived from an integrated sonic log. The reconstruction assumes that depositional surfaces were initially horizontal and that most deformation of post-Louann strata resulted from salt flowage.

Thickness variations displayed by the Upper Jurassic Smackover Formation near Oakwood salt dome indicate that mobilization of the Louann Salt in the area began before the end of Smackover deposition. The close association of a Smackover thick with a fault through the top-of-Louann-Salt reflector northwest of the dome suggests that the early differential sediment loading on the salt in the area was, at least locally, fault controlled.

Dome growth became predominantly vertical and the dome assumed a diapiric configuration during the influx of clastics between Cotton Valley Limestone (Late Jurassic) and Pettet (Early Cretaceous) time; a rim syncline formed adjacent to the western flank of the dome. This synclinal area remained the principal source for salt that fed the stock. Because a basal salt reflector is not evident on the seismic record, the amount of source salt still available for dome growth cannot be determined.

A postulated fault southeast of the dome appears to have disconnected salt on the downthrown side from salt on the upthrown block during Cotton Valley Limestone - Pettet time. Consequently, salt withdrawal on the southeast side of the dome was restricted to the relatively small area between the diapir and the inferred fault. The Cotton Valley Limestone - Pettet thickness southeast of Oakwood salt dome resulted from salt flowage into Buffalo salt dome to the south.

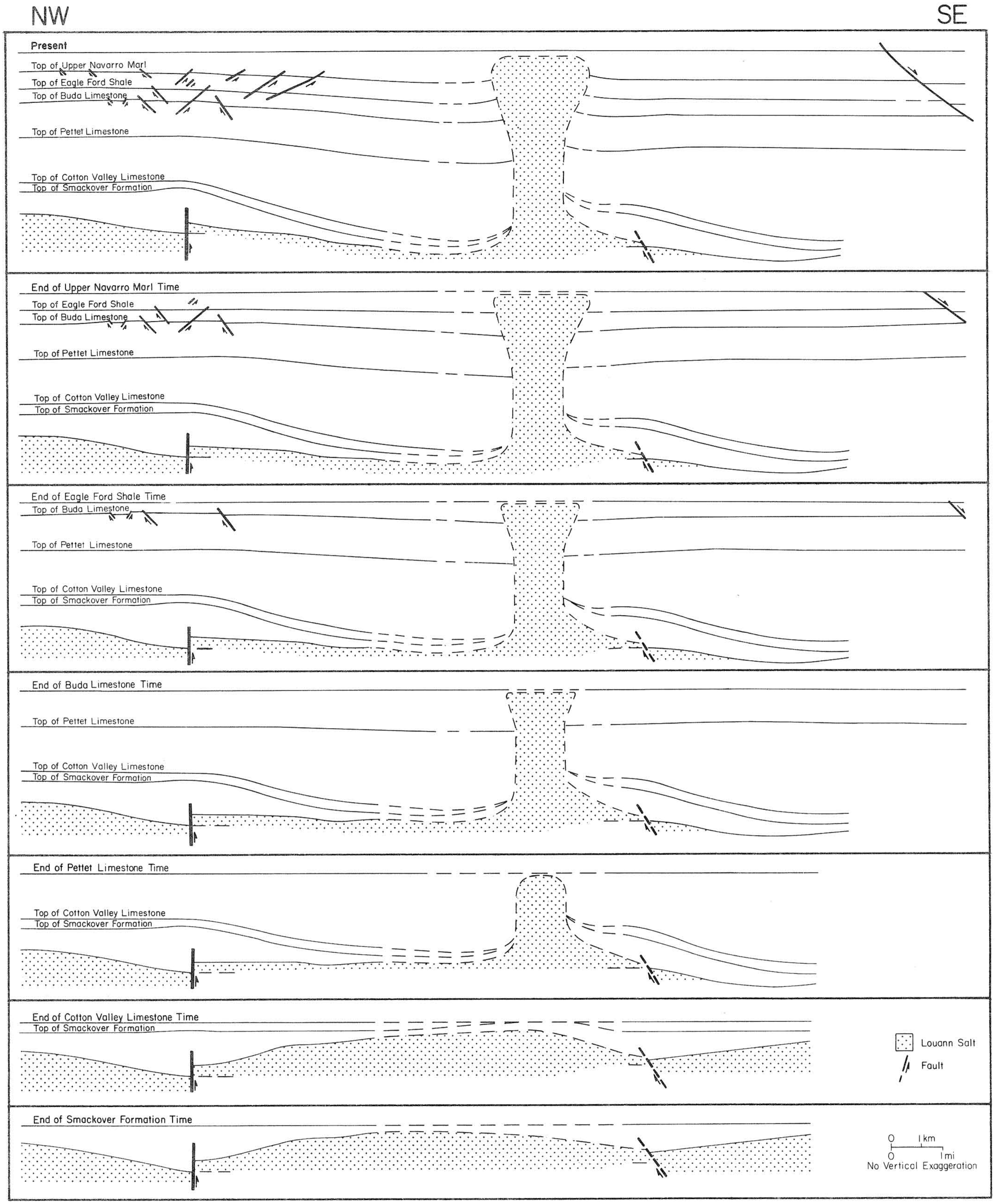

Figure 30. Palinspastic reconstruction of salt dome growth, Oakwood salt dome. Dashed lines indicate areas of poor seismic reflections. Seismic line for this reconstruction is oriented as shown in figure 7.

Dome growth continued during the remainder of the Cretaceous Period. The small amount of stratal disruption near the dome and the absence of compressed strata to account for the volume now occupied by the dome suggest that the dome stayed at or near the depositional surface during most of the period. The model for Oakwood salt dome depicts a relatively thin sedimentary cover over the salt stock, but it is possible that the dome was occasionally exposed because Jurassic and Cretaceous sediments have been removed from above the dome.

Palinspastic reconstruction indicates that the overhang at Oakwood salt dome formed during Early Cretaceous time after deposition of the Pettet Limestone (fig. 30), but the cause of its formation is unclear. Ramberg (1981) discussed several methods of overhang development. The top of a salt dome may spread laterally when it reaches the surface or when it grows into a layer having relatively low density. Conversely, if the dome encounters an impenetrable layer that resists vertical growth, the top of salt may flatten out beneath the layer as growth is redirected laterally to create an overhang. The top of Oakwood salt dome was at or near the surface during Early Cretaceous time, so it may have spread laterally over the surface or into relatively less dense unconsolidated sediments. Alternately, the Lower Cretaceous limestone strata, possibly together with the cap rock, may have impeded vertical growth. Several lines of evidence support the latter. Rapidly consolidating Lower Cretaceous carbonates and rapidly thickening cap rock were the first relatively dense strata encountered by the dome. Also, the Lower Cretaceous shelf carbonates suggest that the area was submerged at the time, and extrusion of salt would have had to have been very rapid to surpass dissolution of salt and to allow development of an overhang. Finally, the regular shape of the overhang (fig. 3) indicates impediment of growth and not sporadic extrusion of salt. Once the sides of the dome became nonvertical, their dip was perpetuated during later growth of the dome.

During the Tertiary Period, sedimentation rates exceeded the rate of rise of the top of the dome. The dome was covered by upper Wilcox clastics and later by Claiborne clastics. Growth since Wilcox time has arched and thinned strata over the dome crest. The dome is now covered by approximately 213 m (700 ft) of Tertiary sediments. Whether this depth of burial was typical in the past is not known.

DOME GROWTH RATES

Four methods are available to estimate the vertical growth rates of Oakwood salt dome, and each method is applied to different periods of dome growth, depending on available data. Assumptions vary among the methods, and none of the procedures allow for compaction of sediments.

The first method used the growth model discussed previously (fig. 30) to estimate the rate of rise of the top of Oakwood salt dome. The model assumes that the top of the dome remained at or near the surface of deposition and, therefore, that the rate of rise of the top of the dome equaled the sedimentation rate. Given this assumption, the average vertical growth rate is then equal to the maximum thickness of strata adjacent to the dome, divided by the absolute time required to deposit the strata (table 1). If significant compaction of sediments around the dome has occurred, then the calculated rates are too low.

The second method for estimating vertical growth involves measuring stratigraphic thinning over the dome to estimate the rate of vertical dome growth during early Claiborne time. It is assumed that the surface of deposition was initially horizontal and that thinning of Carrizo and Reklaw strata over Oakwood salt dome indicates uplift of the units during their deposition. The maximum amount of thinning over the dome divided by the time required to deposit the unit equals the average vertical growth rate of the dome for that time interval (table 2). If dome movement caused topographic relief over the dome at the end of Wilcox time, then these estimates are in error.

A more recent vertical growth rate for Oakwood salt dome can be estimated on the basis of structural relief over the dome. This third method assumes that horizontal depositional surface existed and that structural relief indicates uplift of the dome since the end of Reklaw time. The amount of structural relief of the selected Claiborne stratum over the dome divided by the time since its deposition is equal to the average rate of relative uplift from the time of its deposition to the present (table 3). If the stratum was not initially horizontal over the dome, the estimate is incorrect.

A fourth method for evaluating the vertical growth rate of Oakwood salt dome estimates the volume of salt that moved into the dome. The volume of sediment thickening in the rim syncline surrounding the dome is equated with the volume of salt that simultaneously flowed into the dome (table 4). If sediments compacted after salt flowage, then they may have displaced greater volumes of salt than this method indicates. This method assumes that the volume of salt which flowed into the dome during each specified time interval was neither extruded nor dissolved from the dome during that time interval; if extrusion or dissolution occurred, then the method actually measures the rise of salt within the dome instead of the rise of the top of the dome. This procedure also assumes that none of the salt from the rim synclinal area flowed into neighboring salt

Table 1. Average vertical growth rates of Oakwood salt dome from Cotton Valley Limestone to Wilcox time, based on sedimentation rates.

Stratigraphic Interval	**Absolute Time, m.y.**	**Maximum Thickness of Strata Adjacent to Dome, m (ft)**	**Average Vertical Growth Rate = Maximum Thickness of Strata ÷ Absolute Time, mm/yr (ft/m.y.)**
Top of Cotton Valley Limestone - top of Pettet Limestone	28.0-31.5	2,073 (6,800)	0.07 (216-243)
Top of Pettet Limestone - top of Buda Limestone	11.5-18.0	1,305 (4,280)	0.07-0.11 (238-372)
Top of Buda Limestone - top of Eagle Ford Group	11.0-14.0	658 (2,160)	0.05-0.06 (154-196)
Top of Eagle Ford Shale - top of Upper Navarro Marl	20.5	610 (2,000)	0.03 (98)
Top of Upper Navarro Marl - top of Midway Group	7.5-12.0	274 (900)	0.02-0.04 (75-120)

ASSUMPTIONS:

1. Top of dome remained at or near the surface of deposition, and therefore vertical growth of dome equaled sedimentation rate.
2. Compaction of sediments around the dome has been negligible.

Table 2. Average vertical growth rate of Oakwood salt dome during early Claiborne time, based on stratigraphic thinning.

Stratigraphic Interval	Average Thickness Off Dome, m (ft)	Minimum Thickness Over Dome, m (ft)	Maximum Thinning Over Dome, m (ft)	Absolute Time, m.y.	Average Vertical Growth Rate = Maximum Thinning ÷ Absolute Time, mm/yr (ft/m.y.)
Top of Wilcox Group - top of Reklaw Formation (fig. 21)	76 (250)	54 (176)	22 (74)	2	0.01 (37)

ASSUMPTIONS: 1. Surface of deposition over the dome was initially horizontal.

2. Stratigraphic thinning indicates domal uplift during deposition of unit.

Table 3. Average vertical growth rate of Oakwood salt dome since Reklaw time, based on structural relief.

Stratigraphic Horizon	Structural Relief, m (ft)	Time Since Deposition, m.y.	Average Vertical Growth Rate = Structural Relief ÷ Time Since Deposition, mm/yr (ft/m.y.)
Top of Reklaw Formation (fig. 29)	76 (250)	48	0.002 (5)

ASSUMPTIONS: 1. Surface of deposition at end of Reklaw time was horizontal.

2. Structural relief indicates domal uplift since end of Reklaw time.

Table 4. Average vertical growth rates of Oakwood salt dome from Eagle Ford to Queen City time, based on volumetric measurements of rim synclines.

Stratigraphic Interval	**Average Thickness, m (ft)**	**Volume of Thickening, m^3 (ft^3)**	**Area of Stock Growth, m^2 (ft^2)**	**Vertical Rise of Dome = Volume of Thickening ÷ Area of Growth, m (ft)**	**Absolute Time, m.y.**	**Average Vertical Growth Rate = Vertical Rise of Dome ÷ Absolute Time mm/yr (ft/m.y.)**
Eagle Ford Group	137 (450)	1.8×10^9 (6.3×10^{10})	6.2×10^6 (6.7×10^7)	285 (940)	3 - 8	0.04 - 0.09 (120 - 310)
Top of Eagle Ford Group to top of Pecan Gap Chalk	427 (1,450)	4.7×10^9 (1.7×10^{11})	7.8×10^6 (8.4×10^7)	620 (2,025)	13	0.05 (156)
Top of Pecan Gap Chalk to top of Upper Navarro Marl	229 (750)	2.6×10^9 (9.05×10^{10})	7.9×10^6 (8.5×10^7)	325 (1,064)	7.5	0.04 (140)
Top of Upper Navarro Marl to top of Midway Group	274 (900)	1.5×10^9 (5.2×10^{10})	7.3×10^6 (7.9×10^7)	215 (655)	7.5 - 12	0.02 - 0.03 (55 - 87)
Wilcox Group	503 (1,700)	4.0×10^9 (1.4×10^{11})	7.2×10^6 (7.7×10^7)	555 (1,820)	3.5 - 10	0.06 - 0.16 (182 - 520)
Carrizo and Reklaw Formations	76 (250) (1.9×10^{10})	5.4×10^8 (7.7×10^7)	7.2×10^6	75 (250)	2	0.04 (125)

ASSUMPTIONS:

1. Volume of sediment thickening in rim syncline = volume of salt that flowed into dome.
2. None of the salt from the rim synclinal area flowed into neighboring salt structures (for example, Buffalo, Red Lake) during the specified time intervals.
3. No salt extrusion or salt dissolution, including cap-rock formation, occurred during the specified time intervals.

structures during each specified time interval. If these two assumptions are invalid, then the calculated vertical growth rates are too high. Volumes of sediment thickening were calculated from isochore maps by subtracting average regional strata thicknesses from rim syncline strata thicknesses and multiplying by area of rim syncline. Corrections were made to account for the apparent thickening of strata near the dome caused by steep dips. The vertical rise of the dome during each depositional episode was determined by dividing the volume of sediment thickening by the area (map view) of the salt stock growth. Then the average vertical growth rates of the dome were obtained by dividing the vertical rise by the absolute time for each stratigraphic interval (table 4).

Growth rates for Oakwood salt dome estimated by the four methods are compared in table 5. Rates estimated by the first and second methods are mostly lower than those provided by the fourth method. These differences may reflect salt dissolution and cap-rock formation, salt extrusion, or salt flowage into neighboring salt structures, all of which would affect the fourth method. Overall, the four methods indicate a general decline in vertical growth rate through time for Oakwood salt dome.

HYDROCARBON PRODUCTION

Seventy-two wells have been drilled through the base of the Oakwood salt dome overhang in exploration for hydrocarbons. These wells include 26 holes originating at ground level and 46 sidetrack holes originating in the salt and extending into strata beneath the overhang. These sidetrack holes were initiated or kicked out (whip-stocked) at elevations ranging from -412 m (-1,352 ft) to -1,576 m (-5,170 ft) (appendix table A-2). Of 10 additional wells drilled into the dome, 7 terminated in salt, 1 in cap rock above the salt, 1 in the anhydrite zone beneath the salt, and 1 in the "gouge zone" beneath the overhang (which may also be cap-rock material).

Hydrocarbons have been produced at Oakwood Dome Field from beneath the overhang on the north, east, and south sides of the dome. Production has been solely from Woodbine sandstones, although the Texaco #3 Rabe well was completed in the Main Street Limestone as well as in the Woodbine Group. Accumulation of oil on the east side of the dome may be due to the higher structural position of the Woodbine sandstones in that area (fig. 23). Stratigraphic units as deep as the Rodessa Member have been penetrated on the east and west sides of the dome.

Production from the Oakwood Dome Field began in 1958 at Texas Company #1 Rabe well (upper right-hand side of fig. 2). More than 2 million barrels of oil were produced

Table 5. Comparison of vertical dome growth rates by the four methods presented in tables 1 through 4, in mm/yr (ft/m.y.).

Stratigraphic Horizon	Method 1 (Based on Sedimentation Rate)	Method 2 (Based on Stratigraphic Thinning)	Method 3 (Based on Structural Relief)	Method 4 (Based on Volumetric Measurements)
Top of Cotton Valley Limestone				
	.07 (216-243)			
Top of Pettet Limestone				
	.07-.11 (238-372)			
Top of Buda Limestone				
	.05-.06 (154-196)			
Top of Woodbine Group				
				.04-.09 (120-310)
Top of Eagle Ford Group				
	.03 (98)			.05 (156)
Top of Pecan Gap Chalk				
				.04 (140)
Top of Upper Navarro Marl				
	.02-.04 (75-120)			.02-.03 (55-87)
Top of Midway Group				
				.06-.16 (182-520)
Top of Wilcox Group				
		.01 (37)		.04 (125)
Top of Reklaw Formation				
			.002 (5)	
Present				

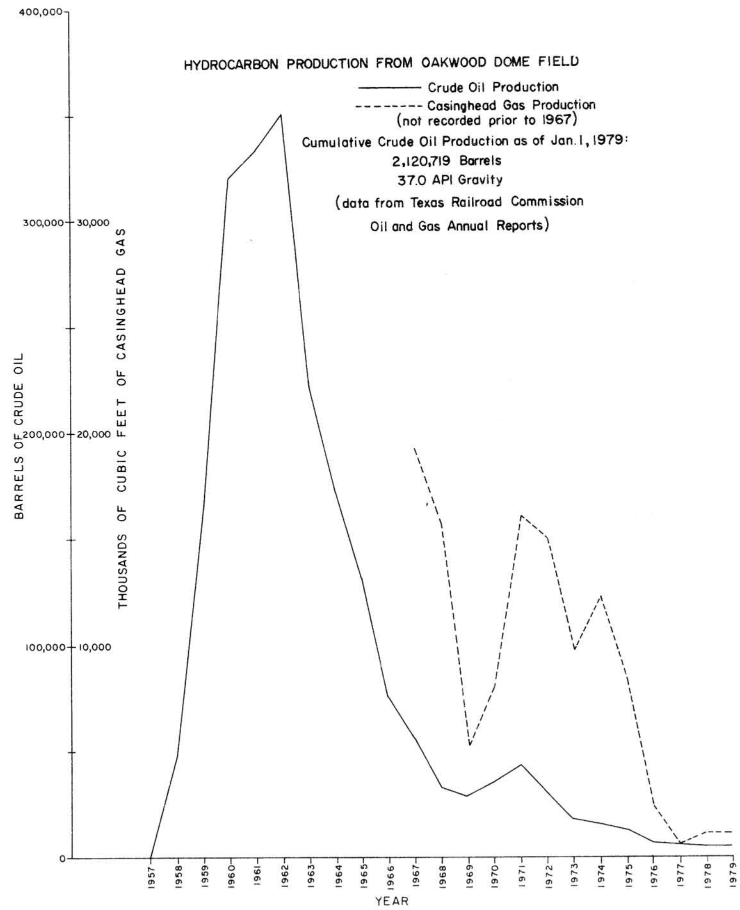

Figure 31. Hydrocarbon production history, Oakwood Dome Field.

through 1978. Twenty-three wells have produced; however, only two, Hughey #1 Coleman (13 bbl daily allowable) and Texas Company #2 Rabe (4 bbl daily allowable), are currently producing oil. Oil production has generally declined since 1962 (fig. 31). Texas Company #1 Rabe and Texaco #3 Rabe are shut-in wells. Hughey #1 Pickard and Hansbro #1 Richardson (Texaco #1 SWD Settlemyre) are permitted for salt-water disposal.

SUMMARY

The top of Oakwood salt dome is approximately 210 m (700 ft) beneath the Freestone - Leon county line in East Texas. The dome is a mushroom-shaped stock topped by an anhydrite-calcite cap rock that may follow the outline of the dome and continue under the domal overhang. The dome is surrounded by carbonate and clastic strata of

Jurassic to Eocene age, the structural and stratigraphic configuration of which has primarily been controlled by salt flowage into the dome and into neighboring salt structures.

Oakwood salt dome began to grow in Late Jurassic (Smackover) time when syndepositional faulting northwest of the dome created differential sediment loading on the Louann Salt. The dome evolved from a pillow to a diapiric configuration during the influx of Late Jurassic to Early Cretaceous clastic sediments, probably concurrent with the formation of a southwest-northeast-trending salt-withdrawal syncline southwest of the dome. In post-Jurassic time, a fault apparently isolated the dome from salt sources to the southeast.

The dome probably remained at or near the depositional surface during most of the Cretaceous Period. Upper Wilcox sediments buried the dome, but Tertiary strata were arched and thinned by continued dome growth. The rate of rise of the top of the dome appears to have decreased through time from 0.07 mm/yr (230 ft/m.y.) in the Early Cretaceous to 0.002 mm/yr (5 ft/m.y.) since Eocene (Reklaw) time. A domal overhang formed during the deposition of Lower Cretaceous carbonates. Since 1958, more than 2 million barrels of oil have been produced from Woodbine sandstones beneath the overhang.

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APPENDIX

Table A-1. Data for wells 1 through 4 and 6 through 62 in area around Oakwood salt dome.

Well No.	Well Name	Ground-Level Elevation, ft	Total Depth, ft	Deepest Unit Drilled
1	Killam #1 Killam	404	5,325	Woodbine
2	Killam #1 Yeager	417	5,425	Woodbine
3	Killam #1 Hartley	419	5,645	Woodbine
4	Roberts & Hammack #1 Reed & Steward	391	6,475	Eagle Ford
6	McFarlane #1 Henson	269	6,260	Eagle Ford
7	Jordan #1 Van Winkle	290	6,240	Woodbine
8	Lake #1 Burroughs	365	6,287	Woodbine
9	Frankel #1 Cochran	362	6,247	Woodbine
10	Phillips #1 Coldiron	333	6,120	Woodbine
11	Roberts & Hammack #1 Albright	341	5,800	Eagle Ford
12	Roberts & Hammack #A1 Albright	297	5,810	Eagle Ford
13	Roberts & Hammack #1 Jeter Chastain	293	5,875	Eagle Ford
14	Marino #1 Harrington	269	5,850	Eagle Ford
15	Roberts & Hammack #2 Jeter	265	5,786	Eagle Ford
16	Roberts & Hammack #1 Cadenhead & Wasson	275	5,731	Eagle Ford
17	Roberts & Hammack #1 Cadenhead-Lamon	325	5,810	Eagle Ford
18	Murray & Mitchell #1 Pearlstone	310	5,676	Woodbine
19	Hughes #1 Pearlstone	276	5,566	Woodbine
20	Fisher #1 Lee	320	5,700	Woodbine
21	Rowe #1 Keils	302	5,910	Woodbine
22	Fisher #1 Coats	245	5,750	Woodbine
23	Ridley #1 Longley	334	5,878	Woodbine
24	Carlson #1 Coats	248	5,795	Woodbine
25	Steward #1 Keils	344	6,100	Woodbine
26	Texaco #1 Keep	390	10,707	Travis Peak
27	Katz #1 Keep	336	6,051	Woodbine
28	Schneider #1 Roach	280	6,274	Woodbine
29	LETCO #TOH-2A Settlemyre	383	3,403	Navarro
30	Wynne #1 Brown	317	6,092	Woodbine
31	Hansbro #1 Richardson (Texaco #1 — SWD Settlemyre)	326	6,512	Woodbine
32	Akard #1 Thrash	226	6,277	Woodbine
33	Evans #1 Thrash	228	5,800	Woodbine
34	Humble #3 S. W. Oakwood	240	5,801	Woodbine
35	Humble #4 S. W. Oakwood	225	5,800	Woodbine
36	Humble #2 S. W. Oakwood	255	5,840	Woodbine
37	Smith, Amdruso, & Whitestone #1 Thrash	281	6,715	Maness
38	Gulley #1 McBrayne	327	6,025	Woodbine
39	Humble #1 Harrod	236	5,846	Woodbine
40	Humble #11 S. W. Oakwood	311	5,910	Woodbine
41	Humble #1 Wynne	242	5,845	Woodbine
42	Lake #1 Leon Plantation	392	5,929	Woodbine
43	Carter-Gragg #1 Holley & Campbell	338	5,818	Woodbine
44	Texas Co. #1 Prasifka	390	6,001	Woodbine
45	Manley #1 Campbell	405	5,914	Eagle Ford
46	McBee #1 Holley	384	5,873	Woodbine
47	Basin #1 Holley	327	5,640	Woodbine
48	Stephens #1 Pope	405	6,116	Maness
49	McBee #1 Settlemyre	440	6,358	Woodbine
50	Roxana #1 Thiele	395	3,955	Taylor
51	Spence #1 Hale	282	5,423	Woodbine
52	Carter-Gragg #1 Holly	283	6,149	Buda
53	Graham & Howard #1 Britton	352	5,363	Woodbine
54	Humble #5 Butler	311	5,252	Woodbine
55	Humble #B1 Greer	300	5,299	Woodbine
56	Humble #1 Greer	282	5,814	Buda
57	Epperson #1 Greer	277	5,175	Woodbine
58	Humble #C1 Greer	281	5,275	Woodbine
59	Humble #C2 Greer	370	9,894	Pettet
60	Akard #2 Thrash	226	5,750	Woodbine
61	Holt, Young, & Nanny #1 Chambers	416	6,195	Woodbine
62	LETCO #TOH-5D Settlemyre	421	673	Wilcox

Table A-2. Data for wells 5 and 63 through

Well No.	Well Name	Ground-Level Elevation, ft	Total Depth, ft	Deepest Unit Drilled	Elevation of Top of Cap Rock, ft	Elevation of Top of Salt, ft	Cap-Rock Thickness, ft	Elevation of Base of Salt, ft
5	McBee #1 Storms	366	6,102	Eagle Ford	-1,557	-1,577	20	-3,227
63	McBee #1A Campbell	408	11,119	Rodessa	-786	-1,552	766	-5,583
	Sidetrack 1		6,427	Woodbine				-5,502
	Sidetrack 2		6,344	Woodbine				-5,423
64	Harrison #1 Leon Plantation	390	2,353	Wilcox				
65	LETCO #OK-107	375	200	Wilcox				
66	LETCO #TOG-1 Settlemyre	356	1,356	Salt	-357	-815	458	
67	LETCO #OK-101	410	248	Wilcox				
68	LETCO #OK-104	390	238	Wilcox				
69	LETCO #OK-105	325	300	Wilcox				
70	LETCO #OK-106	355	300	Wilcox				
71	LETCO #OK-108	370	318	Carrizo				
72	LETCO #OK-115	315	443	Wilcox				
73	McBee #1 Sherman	382	6,612	Salt	-628			
	Sidetrack 1		6,184	Buda				-5,085
	Sidetrack 2		5,767	Woodbine				-4,970
	Sidetrack 3		5,750	Woodbine				
	Sidetrack 4		5,728	Woodbine				
74	LETCO #OK-103	385	300	Wilcox				
75	Texas Co. #1 Rabe	390	5,863	Woodbine	-690	-780	90	-4,840
76	McBee #2 Settlemyre	420	1,435	Salt	-600	-870	270	
77	McBee #3 Settlemyre	425	1,258	Salt	-573	-794	221	
78	McBee #4 Settlemyre	445	2,320	Salt	-1,645	-1,705	60	
79	Texaco #3 Settlemyre	450	5,806	Woodbine		-802		-4,927
	Sidetrack 1		5,847	Woodbine				-4,869
80	Texaco #5 Settlemyre	433	5,836	Woodbine		-814		-4,994
	Sidetrack 1		5,851	Woodbine				-4,933
81	Texaco #1 Detroit	403	5,801	Woodbine	-704	-802	98	-4,797
	Sidetrack 1		5,750	Woodbine				-4,808
82	McBee #1 McBrayne	361	6,045	"Gouge Zone"		-906		-5,391
	Sidetrack 1		5,777					
	Sidetrack 2		5,779	Woodbine				-5,106
	Sidetrack 3		5,799	Eagle Ford				
	Sidetrack 4		5,710	Woodbine				
83	Texaco #4 Keechi Petroleum	352	5,749	Woodbine		-853		-4,898
84	Hughey #1 Pickard	412	5,821	Woodbine		<-896		-4,820
	Sidetrack 1		5,813	Woodbine				-4,834
	Sidetrack 2		5,723	Woodbine				-4,824
85	Texaco #4 Settlemyre	449	5,850	Woodbine		-812		-4,866
86	McBee #B1 Settlemyre	463	5,813	Woodbine	-687	-822	135	-4,767
	Sidetrack 1		5,740	Woodbine				-4,825
87	Texaco #B1 Keechi Petroleum	370	5,775	Woodbine		-880		-4,930
88	McBee #5 Settlemyre	385	5,760	Woodbine	-636	-805	169	-4,730
	Sidetrack 1		5,700	Woodbine				-4,723
89	Carter-Jones #1 Coleman	414	5,812	Woodbine		-976		-4,871
	Sidetrack 1		5,750	Woodbine				-4,886
	Sidetrack 2		5,720	Woodbine				-4,920
	Sidetrack 3		5,660	Woodbine				-4,911
90	Hughey #1 Coleman	415	5,732	Woodbine				-4,888
91	Carter-Jones #2 Coleman	414	5,676	Woodbine				-4,916
92	Pickens (Scates #1 Nestor)	319	5,704	Woodbine		-880		-4,977
	Sidetrack 1		5,663					-4,967
	Sidetrack 2		5,760	Woodbine				
	Sidetrack 3		5,662					
	Sidetrack 4		5,668	Woodbine				-5,018
	Sidetrack 5		5,715	Woodbine				-4,978
93	Hughey #1 Stanton	413	5,800	Woodbine	-684	-797	113	-4,792
	Sidetrack 1		5,725	Woodbine				
94	Texaco #3 Rabe	419	10,595	Rodessa	-708	-802	94	-4,930
95	Texaco #3 Keechi Petroleum	322	5,700	Eagle Ford	-620	-806	186	
	Sidetrack 1		5,680	Eagle Ford				
	Sidetrack 2		5,723	Woodbine				-4,904

123 drilled over Oakwood salt dome.

Elevation of Base of Anhydrite Zone, ft	Anhydrite Zone Thickness, ft	Elevation of Base of "Gouge Zone," ft	"Gouge Zone" Thickness, ft	Unit Below "Gouge Zone"	Elevation Sidetrack Started, ft	Status of Surface Location*
-3,317	90	-3,347	30	Pecan Gap Chalk		
-5,711	128	-5,866	155	Woodbine		
		-5,817	315	Woodbine	-4,980	
-5,476	53			Eagle Ford	-2,782	
						Located; no cemented hole found
-5,250	165	-5,308	58	Eagle Ford	-1,626	
-5,031	61	-5,145	114	Eagle Ford	-4,105	
					-5,170	
	None	-4,885	45	Eagle Ford		Located; pump slab; hole is capped
						Located; no cemented hole found
						Possibly located
						Located; no cemented hole found
		-4,947		Woodbine		Located; pump slab; cement possibly covering hole
		-4,899		Eagle Ford	-3,939	
-5,053	59	-5,201	148	Woodbine		Located; pump slab; no cemented hole found; possibly covered
-4,963	30	-4,983	20	Eagle Ford	-3,603	
						Probable site located
		-4,850		Eagle Ford	-4,214	
						Located; no cemented hole found
					-2,689	
					-3,438	
		-5,316		Eagle Ford	-4,573	
		-5,116			-1,743	
		-4,923	25	Eagle Ford		Probable site located
		-4,856	36	Woodbine?		Located; hole is capped
		-4,861	27	Woodbine		
		-4,856	32	Eagle Ford	-4,322	
		-4,962	96	Eagle Ford		Located; no cemented hole found
-4,817	50	-4,937	120	Eagle Ford		Located; cement block possibly covering hole
		-4,938	113	Eagle Ford	-4,051	
		-5,045	115	Eagle Ford		Probable site located
		-4,925	195	Eagle Ford		Located; no cemented hole found
		-4,895	172	Eagle Ford	-4,075	
		-4,889	18	Eagle Ford		Site not located
		-4,936	50	Eagle Ford	-4,101	
		-4,955	35	Eagle Ford		
		-4,952	41	Eagle Ford	-4,853	
		-4,930	42	Eagle Ford		Located; pump still operating
		-4,957	41	Eagle Ford		Site not located
				Austin Chalk		Located; pump slab; no cemented hole found
					-4,168	
					-4,382	
					-3,968	
					-3,394	
			None	Eagle Ford		
		-4,845	53	Eagle Ford		Probable site located
				Eagle Ford	-4,427	
	None	-4,958	28	Eagle Ford		Located; pump slab; hole is capped
		-5,235		Eagle Ford		Located; no cemented hole found
		-5,198		Eagle Ford	-3,996	
	None	-4,986	82	Eagle Ford	-4,281	

Table A-2

Well No.	Well Name	Ground-Level Elevation, ft	Total Depth, ft	Deepest Unit Drilled	Elevation of Top of Cap Rock, ft	Elevation of Top of Salt, ft	Cap-Rock Thickness, ft	Elevation of Base of Salt, ft
96	Texas Co. #1							
	Settlemyre Well 2	432	5,840	Woodbine				-4,869
	Sidetrack 1		5,789	Woodbine				-4,871
97	Texas Co. #2 Keechi Petroleum	364	5,832	Eagle Ford				
	Sidetrack 1		5,752	Woodbine				
98	Texas Co. #1 Keechi Petroleum	354	6,091	Woodbine	-711	-843	132	
	Sidetrack 1		5,892	Woodbine				
	Sidetrack 2		5,748	Woodbine				-4,857
99	Texaco #6 Settlemyre	414	5,845	Woodbine	-649	-723	74	-4,937
	Sidetrack 1		5,753	Woodbine				-4,944
100	McBee #C1 Settlemyre	436	5,788	Woodbine		-797		-5,016
	Sidetrack 1		5,803	Woodbine				-4,992
	Sidetrack 2		5,766	Woodbine				-4,926
101	Texas Co. #1 Settlemyre							
	(McBee #D1 Settlemyre)	400	10,215		-479	-842	363	
	Sidetrack 1		6,568	Grayson				-5,241
102	Texaco #1 Marshall	405	5,764	Anhydrite		-805		-5,314
	Sidetrack 1		5,913	Woodbine				-5,280
	Sidetrack 2		6,137	Woodbine				-5,135
	Sidetrack 3		5,887	Woodbine				-5,129
103	LETCO #TOG-1WS Settlemyre	356	600	Wilcox				
104	LETCO #TOH-2D-2 Settlemyre	383	605	Wilcox				
105	LETCO #TOH-2D Settlemyre	375	622	Wilcox				
106	LETCO #TOH-2A2 Settlemyre	375						
107	Roxana #1 Marshall	440	877	Cap Rock	-263			
108	McBee #1 Campbell	412	1,855	Salt	-898	-1,003	105	
109	Shell (McBee) #1 Tinsley	435	6,500	Salt	-653	-843	190	
	Sidetrack 1 (Shell)		6,350	Woodbine				
	Sidetrack 2 (McBee)		6,421	Woodbine				-5,289
	Sidetrack 3 (McBee)							
110	LETCO #OK-102 Settlemyre	370	300	Wilcox				
111	LETCO #OK-121 Settlemyre	435	300	Reklaw				
112	LETCO #109 Settlemyre	351	50	Queen City				
113	LETCO #110 Settlemyre	330	51	Queen City				
114	LETCO #111	328	51	Queen City				
115	LETCO #112	336	50	Queen City				
116	LETCO #113	374	58	Queen City				
117	LETCO #114	341	47	Queen City				
118	LETCO #117	365	46	Queen City				
119	LETCO #118	374	44	Queen City				
120	LETCO #119	355	297	Reklaw				
121	LETCO #120	353	51	Queen City				
122	Texas Co. #2 Rabe	385	6,115					
	Sidetrack 1		5,925					
	Sidetrack 2		5,799					
	Sidetrack 3		5,857					
	Sidetrack 4		5,891					
123	Creighton #1 Holley	382	5,395	Woodbine				

*E. W. Collins, personal communication, 1980

(cont.)

Elevation of Base of Anhydrite Zone, ft	Anhydrite Zone Thickness, ft	Elevation of Base of "Gouge Zone," ft	"Gouge Zone" Thickness, ft	Unit Below "Gouge Zone"	Elevation Sidetrack Started, ft	Status of Surface Location*
		-4,959	90	Eagle Ford		Located; cement block possibly covering hole
		-4,934	63	Eagle Ford	-3,539	
		-5,166		Eagle Ford		Located; pump slab; no cemented hole found
		-5,006		Eagle Ford	-3,837	
		-5,105		Eagle Ford		Located; no cemented hole found
		-4,902		Eagle Ford	-3,290	
-4,897	40	-5,040	143	Eagle Ford	-4,157	
		-4,987	50	Eagle Ford		Located; pump slab; no cemented hole found; possibly covered
-4,964	20	-5,001	37	Eagle Ford	-4,511	
		-5,228	212	Woodbine		Located; no cemented hole found
		-5,178	186	Woodbine	-3,728	
		-4,996	70	Eagle Ford	-1,963	
				Goodland		Located; no cemented hole found
		-5,350	109	Woodbine	-1,352	
						Located; no cemented hole found
		-5,393	113	Eagle Ford	-3,965	
		-5,265	130		-3,308	
					-4,484	
						Site not located
						Located; no cemented hole found
		-5,303		Eagle Ford		
		-5,332	43	Eagle Ford		
					-3,772	
						Located; pump still operating
					-2,915	
					-3,801	
					-2,483	
					-3,615	