Revised Stratigraphic Correlations, Upper Cretaceous (Lower Campanian to Middle Maastrichtian) Taylor Group, Southwestern Texas

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ABSTRACT

Established correlations of the Upper Cretaceous Taylor Group in southwestern Texas are based upon surface exposures that are small and discontinuous due to effects of the Balcones Fault Zone, truncation by the Bigfoot Unconformity, and cover by younger deposits. A 34 well log cross section extending for 160 miles along the Balcones Fault Zone from Seguin to the Rio Grande River documents a more complete Taylor Group interval than is observed in the adjacent surface exposures. Stratigraphic relations displayed differ from established correlations and revisions are proposed.

The Anacacho Formation in its type area is divided into a 450 foot thick Basal Member and an overlying 400 foot thick Massive Member. The Massive Member occurs in the subsurface from Kinney to Medina County, but it only is exposed at the surface in the Anacacho Mountains. The Basal Member occurs in the subsurface continuously between Seguin and the Rio Grande River and it represents all outcrops of the Anacacho Formation outside the few Massive Member exposures in the mountains. The entire subsurface Anacacho section is dated using correlation to fossiliferous limestone exposures in the Anacacho Mountains and along the Rio Grande. The Basal Anacacho Member contains late Austin fossil fauna (early Campanian) while the Massive Anacacho Member is early Taylor in age (middle to late Campanian). These age assignments suggest an upward movement of the Austin-Taylor contact within the stratigraphic section in southwestern Texas relative to the central Texas area.

The Pecan Gap Formation overlies the Basal Anacacho Member as a westward thinning wedge present continuously from Seguin to Medina County, and some limestone exposures in Bexar and Medina counties previously described and mapped as Anacacho are actually the age-equivalent Pecan Gap. In Kinney and Maverick counties, the Upson Clay overlies the Basal Anacacho Member and never is in depositional contact with Austin

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Chalk. The Upson Clay represents a rapid westward facies change from the age-equivalent Massive Anacacho Member limestones observed in the Anacacho Mountains, and no substantiated evidence exists for the occurrence of Upson Clay east of its type area in Kinney and Maverick counties.

Recognition of a late Austin faunal assemblage in the Basal Anacacho Member has implications for long held stratigraphic assignments in southwestern Texas. Evidence is presented which documents limestone exposures in southern Kinney and northern Maverick counties previously designated and mapped as Austin Chalk on the basis of fossil content actually represent a continuation of the Anacacho Formation westward from the Anacacho Mountains. This includes exposures near Spofford and along the Rio Grande, and a geologic subcrop map supports this proposed revision.

INTRODUCTION

Upper Cretaceous Taylor Group rocks crop out in a narrow belt extending from northeast Texas to the Rio Grande River in southwestern Texas (Fig . 1). Established Taylor Group correlations in southwestern Texas are based upon surface exposures which are small and discontinuous due to intense faulting within the Balcones Fault Zone, truncation of substantial portions of the Upper Taylor by the regional Taylor-Navarro Bigfoot Unconformity (Ewing, 2013), and cover by younger Navarro Escondido, Eocene Wilcox Group, and Quaternary alluvial deposits (Fig. 2). Outcrop of a complete interval of Taylor Group strata does not exist in any one southwestern Texas location, so a study of the entire Taylor Group stratigraphy requires supplementation of outcrop data with adjacent subsurface data through the use of electric well logs.

METHODS

Hundreds of shallow well logs were acquired, correlated, and utilized to construct three cross sections which reveal stratigraphic correlations different from those currently accepted. The predominant cross section A–A' is a 34 well stratigraphic section located adjacent to the Taylor outcrop belt and extending 160 miles between Seguin and the Rio Grande River. Figure 3A is a stratigraphic column of southwestern Texas Gulfian strata illustrating accepted correlations used in recent publications by prominent geological organizations. Figure 3B presents the same interval with the proposed revisions. Well log data and outcrop descriptions were then used to prepare a geological subcrop map based upon these revisions—see subsequent section on Western Limit of Anacacho Limestone, including Figure 8.

RESULTS

Anacacho Formation

Hill and Vaughan (1898) report that in the Anacacho Mountains immediately overlying the Austin Chalk is 300–400 feet of limestone described as shell debris or coarse detrital reef containing huge asphalt deposits, whichthey named the Anacacho Limestone. Eastward across Uvalde and Medina counties, discontinuous, thin Anacacho exposures contain more clay and marl than in the mountains, and this lithologic change has been interpreted as a facies change. The most complete study of the Anacacho Limestone is by Hazzard et al. (1956), which includes measured and described stratigraphic sections from the northern Anacacho Mountains of Kinney County. The difficulty in defining the exact stratigraphic position of the Austin-Taylor contact in outcrop is discussed by R. T. Hazzard, who after hearing ideas proposed by W. S. Adkins (Hazzard et al., 1956, p. 123), placed the contact in the middle of the Anacacho Formation. Cross

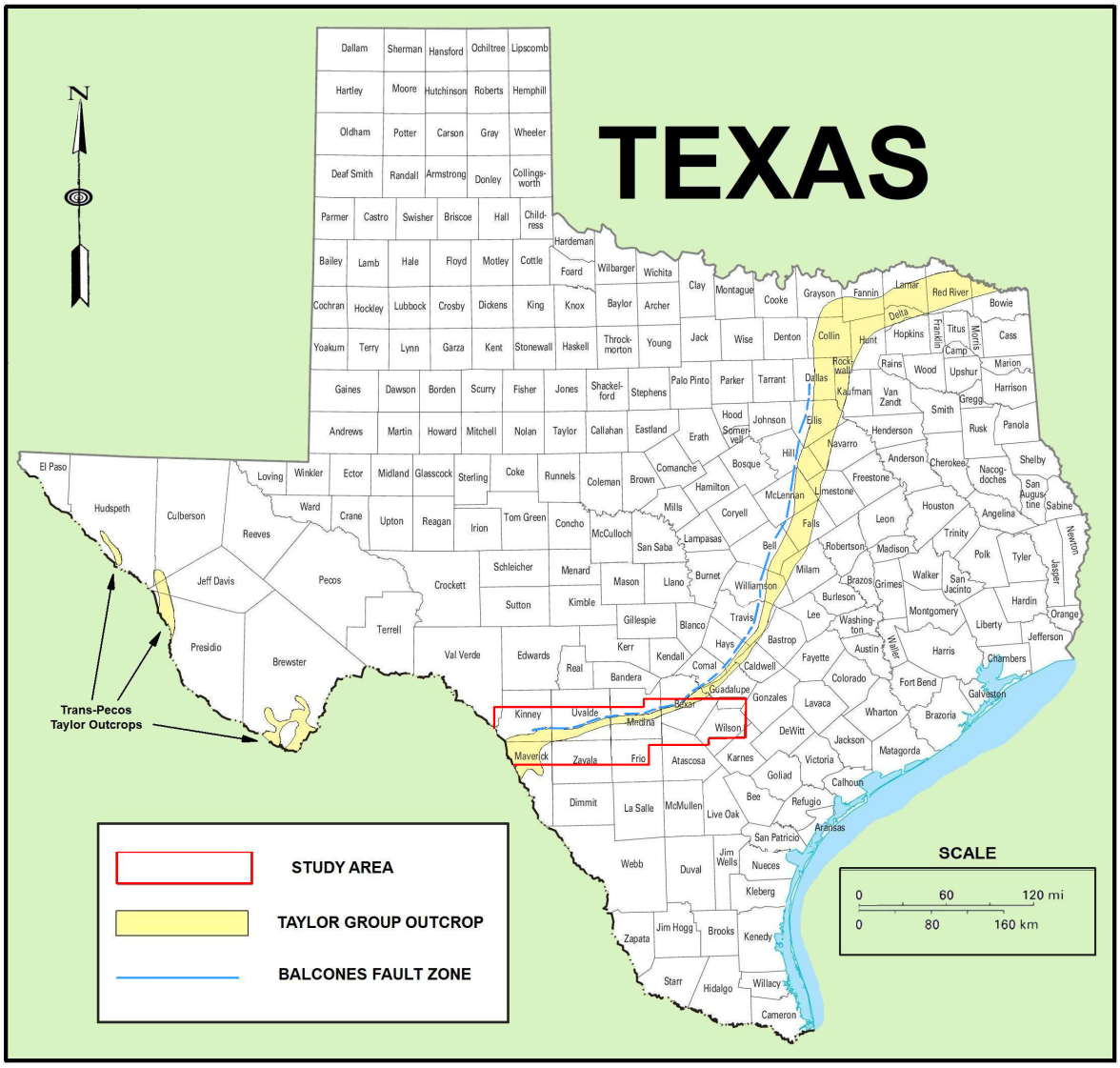


Figure 1. Location of the Taylor Group outcrop belt, the Balcones Fault Zone, and the study area.

section A–A' (Figs. 4 and 5) supports many of Hazzard et al.'s proposals and the Anacacho Formation is divided into a 450 foot thick Basal Member and an overlying 400 foot thick Massive Member with the contact defined by Gamma Ray curve signature on well logs. The Massive Member occurs in the subsurface continuously from Kinney to Medina County, but up to 600 feet of Anacacho erosion along the outcrop belt limits exposures to the southern half of the Anacacho Mountains and a few outcrops on the northern peaks (Fig. 4). All other Anacacho exposures between the Rio Grande and San Antonio are Basal Anacacho Member and therefore the change from coarse detrital limestone in the mountains to a more argillaceous Anacacho in the east is due to lithological change from Massive to Basal members. Cross section B–B' (Fig. 6) utilizes several well logs from Anacacho core holes, and these are tied to the measured section

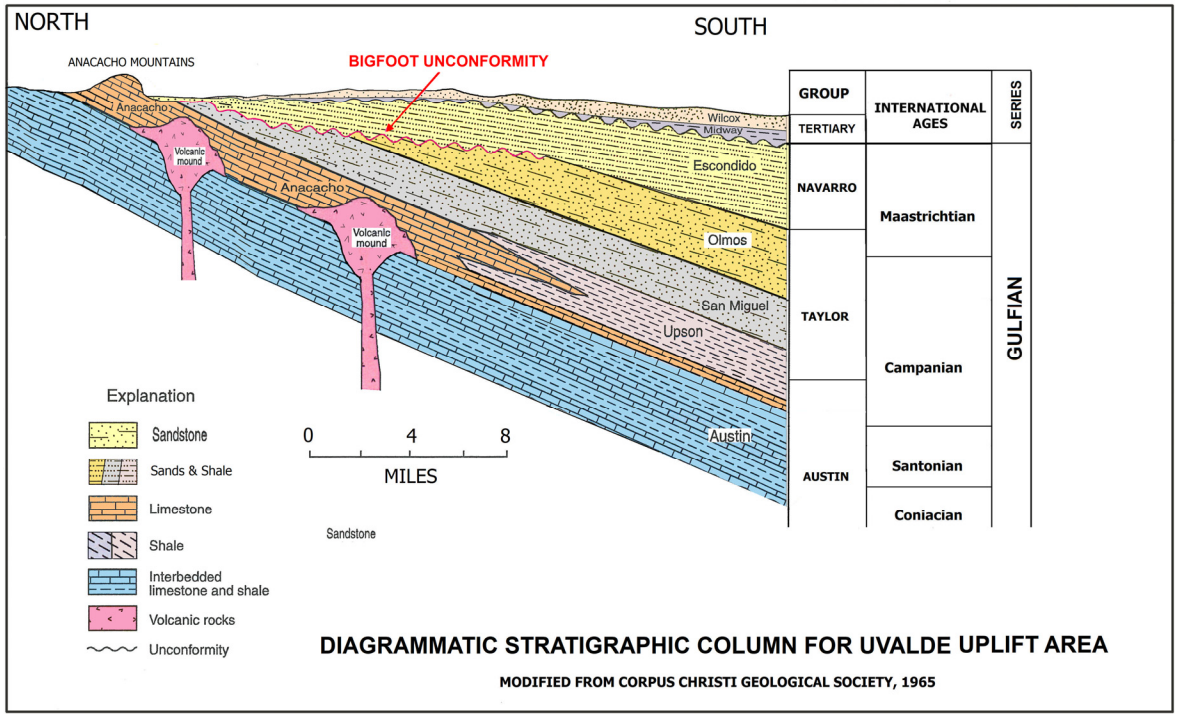


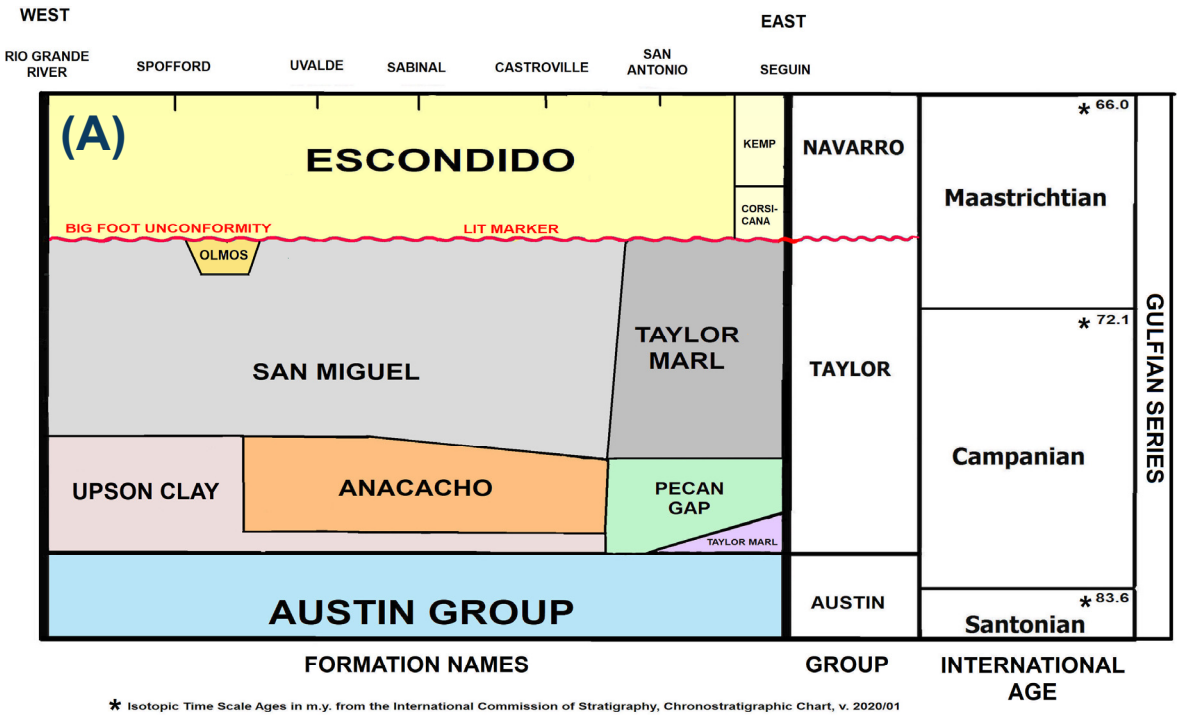
Figure 2. Diagrammatic stratigraphic column for Uvalde Uplift area.

of Hazzard et al. (1956) that is exposed in the Anacacho Mountains. Correlation of the surface Anacacho containing its abundant fossil content with the subsurface on cross section B–B' allows the Basal Anacacho to be assigned a late Austin age (early to middle Campanian) while the Massive Member is middle to late Campanian in age. The Massive Member extends a short distance southward into the Maverick basin before it interfingers with the Upson Clay.

Pecan Gap and Upson Clay

Section A–A' indicates the Pecan Gap enters eastern Bexar County as a 360 foot thick layer of chalk and chalky marl, which thins westward before it finally feathers out in western Medina County. The Pecan Gap occupies the same stratigraphic position and contains similar fossils as the Massive Anacacho Member (Hazzard et al., 1956, p. 121), which can lead to misidentification, and some outcrops in Bexar and Medina counties described and mapped as Anacacho are actually Pecan Gap (Kennedy and Cobban, 2001).

The Upson Clay has been named and described by Dumble (1892) who reported it to overlie the Austin Chalk, but no description of the actual basal contact of the main body of Upson in its type area along the Rio Grande is ever provided. Udden (1907) and Getzendaner (1930) stated that the Upson consists of 400–550 feet of dark gray clay and shale present in northern Maverick and southern Kinney counties that underlies the sandstones and sandy shales of the San Miguel Formation. The Upson Clay represents an abrupt westward facies change of the age-equivalent Massive Anacacho Member into clays that extend to the Rio Grande River. Cross section A–A' demonstrates that the Upson Clay overlies the Basal Anacacho Member continuously between the Anacacho Mountains and the Rio Grande River, and it never is in depositional contact with the older Austin Chalk. Some geologists suggest that a 20–30 foot thick clay layer un-



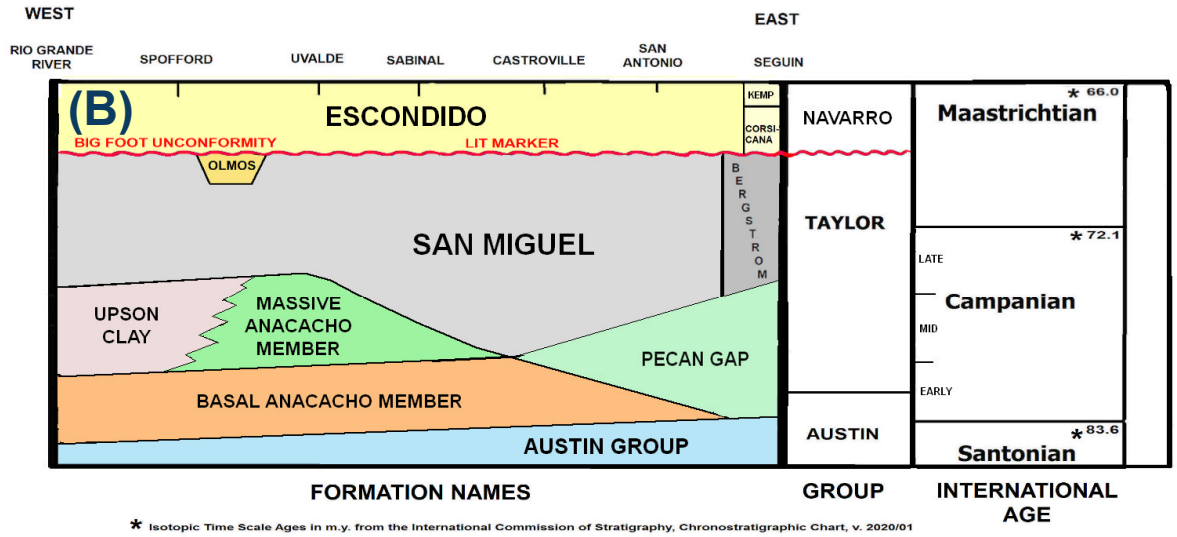


Figure 3. (A) Stratigraphic column of Gulfian age strata for the study area that illustrates current, accepted correlations and stratigraphic nomenclature used in recent publications by many different authors and prominent geological organizations. (B). Stratigraphic column for same strata as (A) with proposed revisions based upon new geological information obtained from shallow well logs displayed on cross sections A–A', B–B', and C–C'. Neither (A) nor (B) are to vertical scale and no indication of formation thickness is implied. The diagrams are time schematic and all hiatus events are excluded.

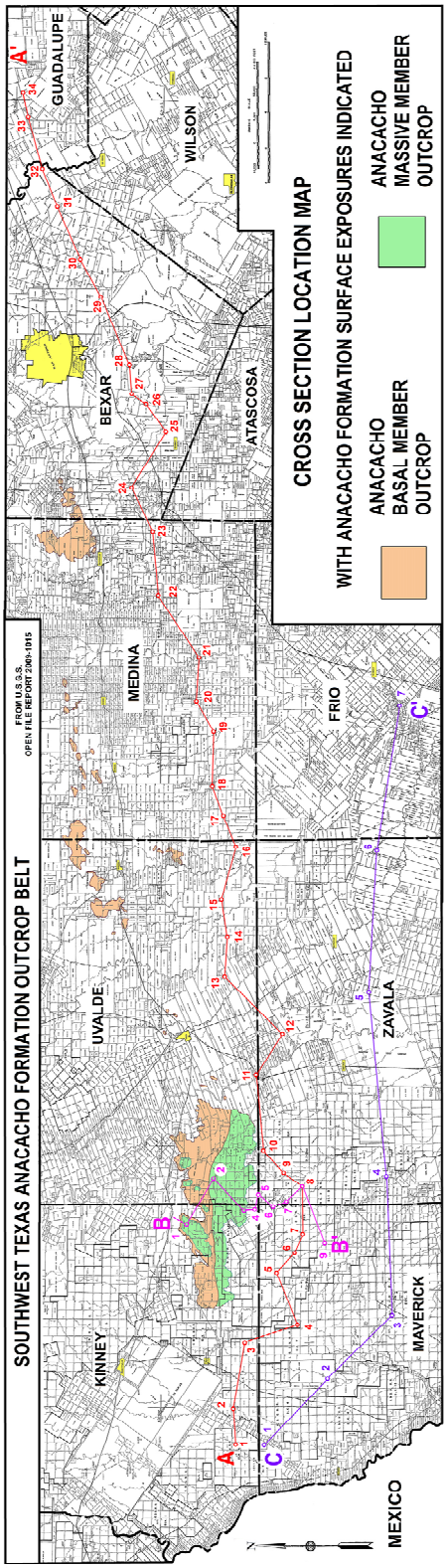


Figure 4. Location map of cross section A–A' and outcrop exposures of the Anacacho Formation.

derlying lower Anacacho limestones along the northwestern base of the Anacacho Mountains escarpment represents an eastern extension of the Upson Clay under the Anacacho Mountains, which then continues eastward into Uvalde and Medina counties. Correlation of logs from wells drilled adjacent to this escarpment, including the Leeco G&O Co. #1 Pauline Franks, clearly show that this clay layer is not Upson but is an argillaceous layer in the lower Basal Anacacho Member. Numerous other Taylor Group stratigraphic studies in Uvalde and Medina counties report no substantiated occurrence of Upson Clay east of Kinney County (Vaughan, 1900; Udden, 1907; Deussen, 1924; Sayre, 1936; Stephenson, et al, 1942; Brown, 1965). It is proposed here to confine the term Upson Clay to its type area of Kinney and Maverick counties.

Western Limit of Anacacho Limestone

No explanation for the abrupt disappearance of the Anacacho Formation west of the Anacacho Mountains has ever been offered and no exposures of Anacacho Formation have ever been reported or mapped west of the Anacacho Mountains (Vaughan, 1900; Getzendaner, 1930). Adkins (1932) and Hazzard et al. (1956) suggested the reason for the apparent disappearance of Anacacho Limestone west of the Anacacho Mountains is miscorrelation between the Anacacho Mountains section and the limestone exposures along the Rio Grande. Hazzard et al.'s (1956) assignment of a late Austin age to the lower Anacacho has been questioned by many geologists, and while some disagree, the work of other paleontologists have confirmed that the Austin-Taylor contact rises in the stratigraphic section as one proceeds to the southwest from the Central Texas type areas that placed late Austin fauna in lower Anacacho limestones (McNulty, 1955; Murray, 1961; Brown, 1965; Elder, 1996). In northwest Maverick County just south of the Kinney County line, a series of limestone exposures occur along a 6 mile stretch of the Rio Grande and also up the valleys of both Las Moras and Tequesquite creeks for about four miles. Other similar limestones are exposed along Lindsey Creek two miles northeast from Spofford in south central Kinney County, and also all along the base of the northwest side of the Anacacho mountain escarpment. These limestones contain a lithology characteristic of the lower Anacacho, and yet the rocks contain fauna common to both

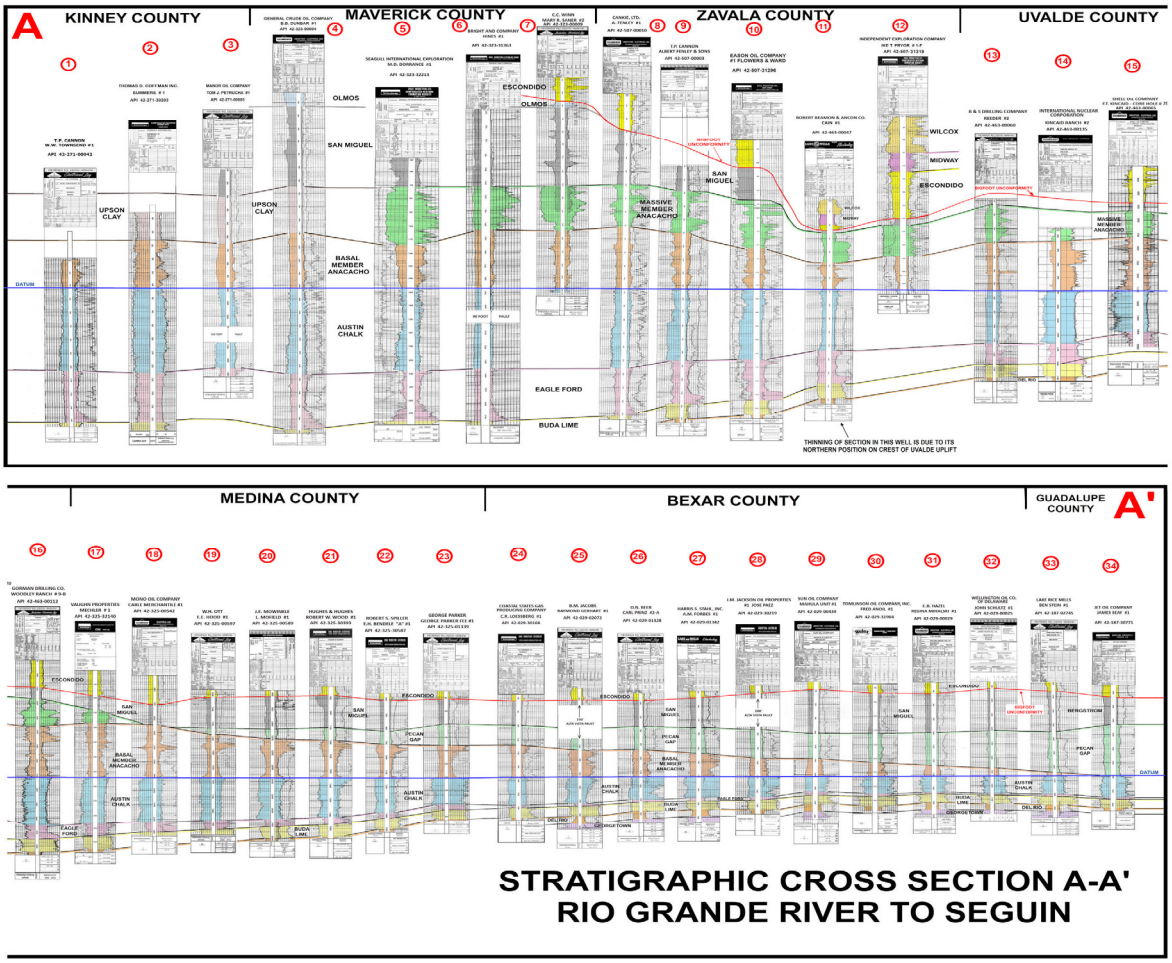


Figure 5. Cross section A–A'. Stratigraphic section covering 160 miles from Seguin to the Rio Grande River, along the south edge of the Balcones Fault Zone, and using top of Austin Chalk as datum. See Figure 4 for location. A high-resolution version is included as a supplement to the digital version of this publication (Plate 1).

late Austin and early Taylor. Tequesquite Creek limestones contain gigantic 5 feet in diameter ammonites (Scott and Moore, 1928) and these rocks have been dated as Big House Chalk–Burditt Chalk equivalent (Adkins, 1932; Durham, 1957; Pessagno, 1969).

The stratigraphic assignment of these limestone exposures between the Rio Grande and the northwest escarpment of the Anacacho Mountains was debated in the geologic literature before a final decision to designate them as Austin was made for the publication of geologic maps by the Texas Bureau in 1933 (Sellards et al., 1933) and the U.S. Geological Survey (USGS) in 1937 (Darton et al.). Recent versions of published geologic maps by the Bureau (1992) and the USGS (Page et al., 2009) continue to designate these exposures in northwestern Maverick County as Austin Chalk.

During the construction of cross section A–A' it was noticed that the Basal Member of the Anacacho Formation continues west from the Anacacho Mountains all the way to the Rio Grande. Electric well logs in southern Kinney and northern Maverick counties indicate the Ana-

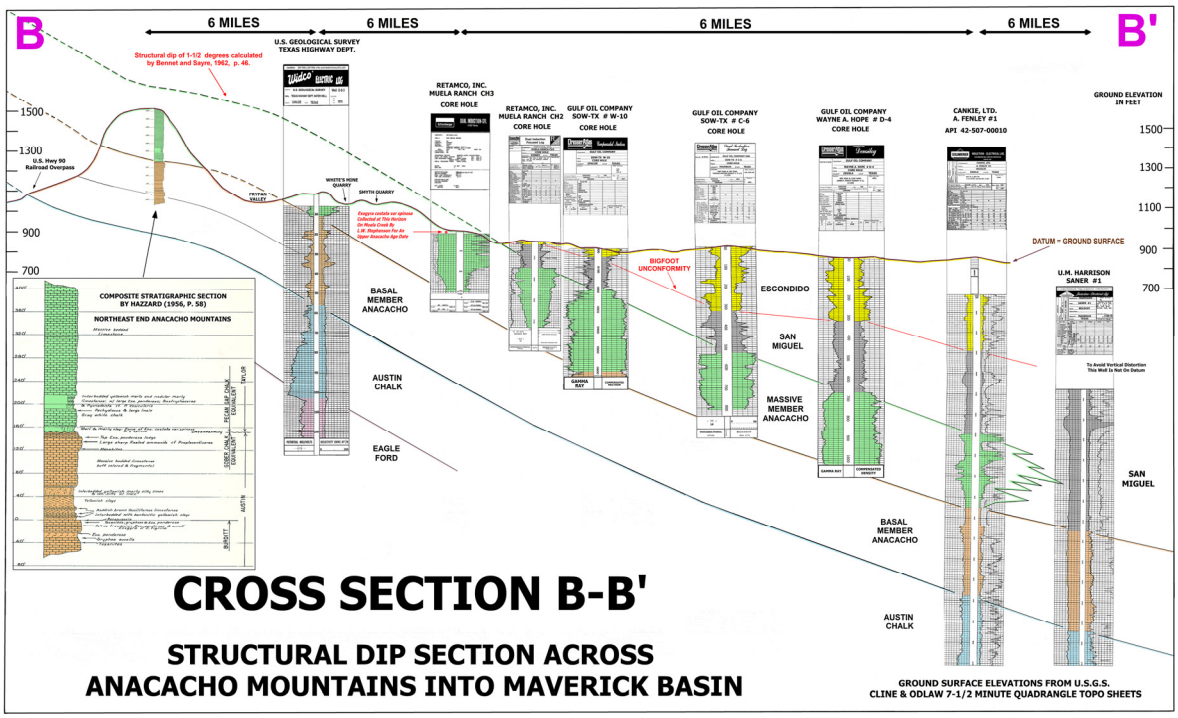


Figure 6. Cross section B–B'. Structural section across the Anacacho Mountains and extending 20 miles southward into the subsurface using the land surface elevation as the datum. See Figure 4 for location. A high-resolution version is included as a supplement to the digital version of this publication (Plate 2).

cacho is exposed at the surface in numerous localities currently mapped as Austin Chalk. The Jack Phillips #1 Tequesquite Ranch well was drilled in 2010 at a location between the Tequesquite Creek and the Las Moras outcrops, and the electric log of this well shows that the actual top of the Austin Chalk is found at a depth of 325 feet below the ground surface; the limestones exposed at the surface must be Anacacho equivalent. Electric logs from wells drilled adjacent to limestone outcrops at Lindsey Creek and along the base of the Anacacho Mountain escarpment indicate that these limestones are actually Basal Anacacho Member and not Austin Chalk as current maps display. Cross section C–C' (Fig. 7) illustrates the continuity of the Anacacho Formation for 80 miles across the Maverick Basin (Tequesquite Creek outcrop area of northwest Maverick County) to Pearsall field (Ewing, 2003, section PS–C) in Frio County. A geological subcrop map (Fig. 8) was prepared using well logs and outcrop descriptions all across southern Kinney and northern Maverick counties. This reveals that the Basal Anacacho Member is present under a thin surface cover of Quaternary alluvial deposits across southern Kinney County from the west edge of the Anacacho Mountains to the Rio Grande River.

SUMMARY AND CONCLUSIONS

(1) The Pecan Gap is present as a westward thinning wedge that extends from Central Texas to western Medina County.

(2) The Upson Clay overlies the Basal Anacacho Member and never is in depositional contact with the Austin Chalk. No substantiated evidence exists for the presence of the Upson Clay

east of the Anacacho Mountains, and the name Upson Clay should be confined to its type area of southern Kinney and northern Maverick counties.

(3) The Anacacho Formation is 850 foot thick in the Anacacho Mountains and is divided into a lower Basal Member and an upper Massive Member. The Massive Member in the shallow subsurface extends from eastern Kinney County to western Medina County and forms the outcrops in the southern Anacacho Mountains and on the highest peaks of the northern Anacacho Mountains. The Basal Member directly overlies the Austin Chalk, occurs in the subsurface as a continuous layer from Seguin to the Rio Grande, and is exposed in small, discontinuous outcrops from San Antonio to the Rio Grande. The Basal Member is late Austin in age (early to middle Campanian) and the Massive Member is early Taylor (middle to late Campanian).

(4) Exposures of limestone in southern Kinney and northern Maverick counties from the Rio Grande to the Anacacho Mountains that have been previously mapped and described as being Upper Austin Chalk are actually Basal Member Anacacho limestones.

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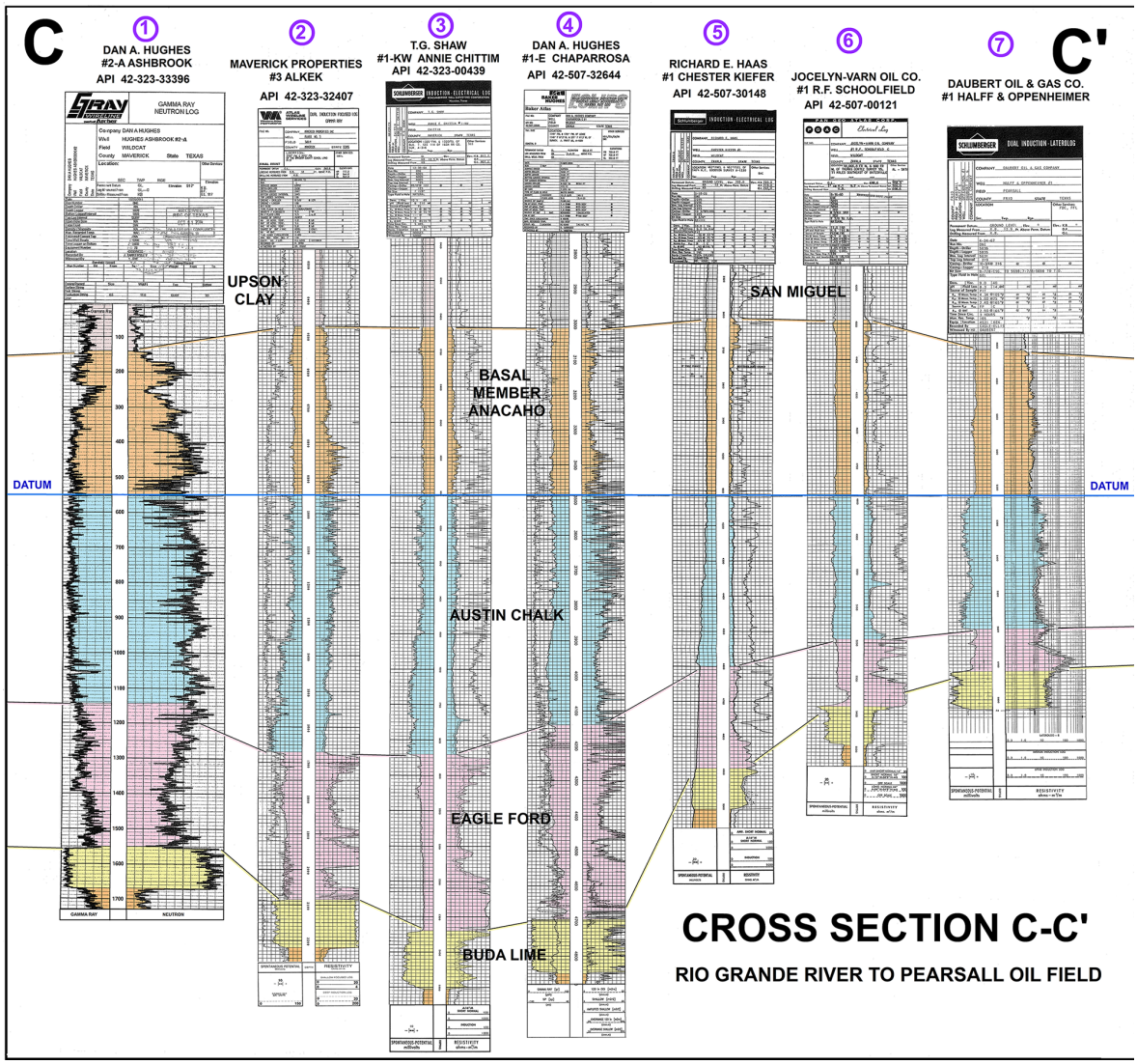

Figure 7. Cross section C–C'. Stratigraphic section covering 80 miles from Pearsall Oil Field in Frio County to the shallow Anacacho Limestone outcrops in northwestern Maverick County, using the top of Austin Chalk as a datum. The continuity of the Basal Anacacho Member across the Maverick Basin is displayed. See Figure 4 for location. A high-resolution version is included as a supplement to the digital version of this publication (Plate 3).

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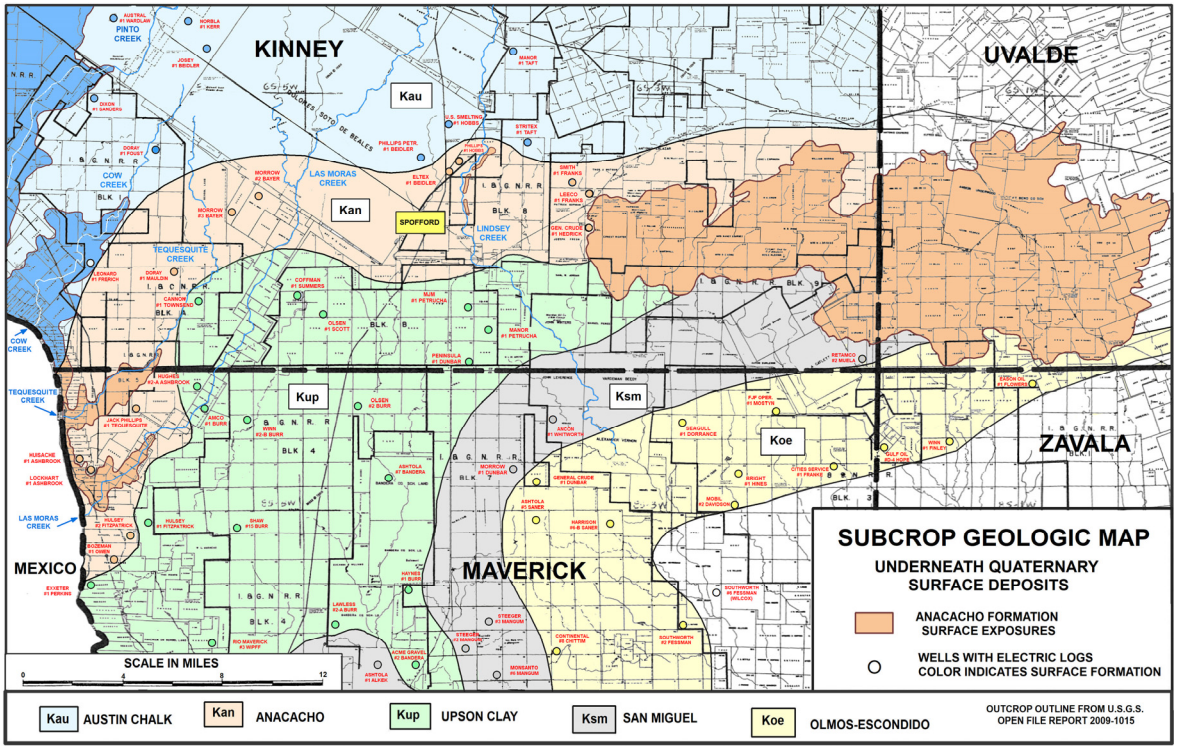

Figure 8. Subcrop geologic map of western part of study area prepared utilizing outcrop and shallow well log data. Igneous exposures are excluded.

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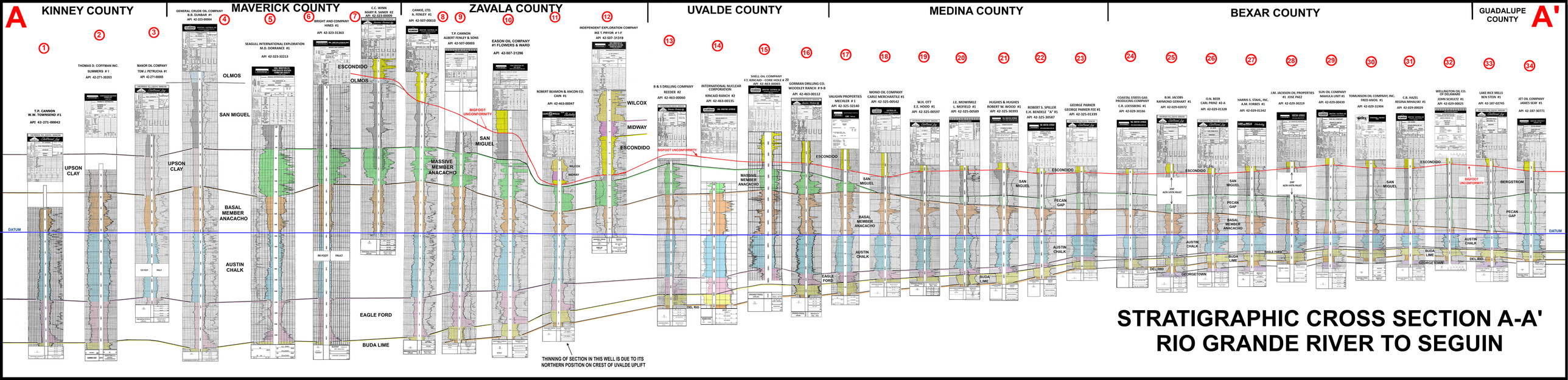
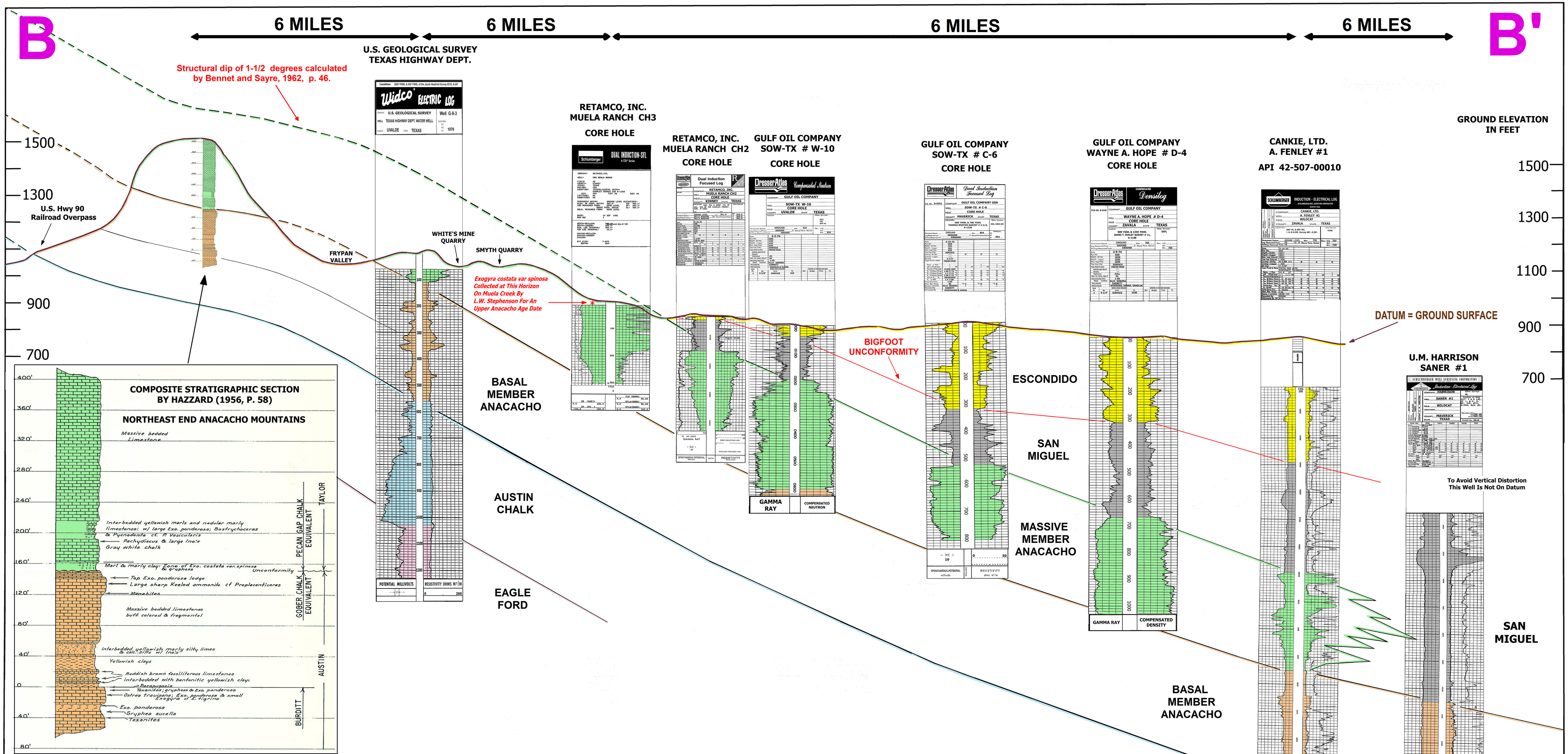


STRATIGRAPHIC CROSS SECTION A-A'
RIO GRANDE RIVER TO SEGUIN



CROSS SECTION B-B'

STRUCTURAL DIP SECTION ACROSS ANACACHO MOUNTAINS INTO MAVERICK BASIN

C

① DAN A. HUGHES #2-A ASHBROOK API 42-323-33396

② MAVERICK PROPERTIES #3 ALKEK API 42-323-32407

③ T.G. SHAW #1-KW ANNIE CHITTIM API 42-323-00439

④ DAN A. HUGHES #1-E CHAPARROSA API 42-507-32644

⑤ RICHARD E. HAAS #1 CHESTER KIEFER API 42-507-30148

⑥ JOCELYN-VARN OIL CO. #1 R.F. SCHOOLFIELD API 42-507-00121

⑦ DAUBERT OIL & GAS CO. #1 HALFF & OPPENHEIMER

C'

DATUM

DATUM

UPSON CLAY

SAN MIGUEL

BASAL MEMBER ANACAHO

AUSTIN CHALK

EAGLE FORD

BUDA LIME

GAMMA RAY

NEUTRON

CROSS SECTION C-C'

RIO GRANDE RIVER TO PEARSALL OIL FIELD

FIGURE 7.