MASTER

A GRAVITY AND SUBSURFACE INVESTIGATION
OF THE PRESIDIO BOLSON AREA, TEXAS

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ABSTRACT

An integrated geophysical-geologic study of the Presidio Bolson area was undertaken primarily using gravity measurements and deep drilling data. Over 2000 gravity readings were used to construct maps of the area and two-dimensional computer modeling of gravity profiles was used to derive earth models. These data outlined the major geologic features of the area and were dominated by Tertiary block faulting and volcanism. The main feature of interest was the Presidio Bolson, which is located in a major graben (Presidio Graben) over 1 km deep in the area near Ruidosa, Texas. These data also suggest that hot springs associated with the Presidio Graben derive their heat from buried Tertiary intrusions associated with this graben or by deep circulation along the boundary faults of the graben.

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INTRODUCTION

This report describes a gravity and subsurface investigation of the Presidio Bolson area of Trans-Pecos, Texas (Figure 1). The Presidio Bolson is a narrow, graben-like feature approximately 90 miles (145 km) long and 20 miles (32 km) wide, trending northwest-southeast along the western edge of Presidio County. The study area (Figure 1) was chosen to include areas adjacent to this bolson which is bounded along the east side by the Sierra Vieja Mountains, the Chinati Mountains, and the Bofecillos Mountains. To the west of the bolson lies the Chihuahua Tectonic Belt in the State of Chihuahua, Mexico. The present course of the Rio Grande runs down the center of the bolson which begins north of Candelaria, Texas and extends to the south of Presidio, Texas.

The purpose of this study was to determine the general subsurface configuration and structural setting of the Presidio Bolson thereby providing a better understanding of the economic and tectonic importance of this feature. Of particular interest were surfacing hot waters found in the bolson which pose an interesting geologic problem with possible economic implications. Without a knowledge of subsurface structure, the heat source and travel paths of the water can only be conjectured.

To provide needed information, a surface gravity and magnetic survey was initiated. Several magnetic profiles were compiled using a Geometrics (model G816) portable proton magnetometer. The prevalence of basaltic and rhyolitic float in the fill along the northeast edge of the bolson (below the Sierra Vieja Rim Rock) masked magnetic anomalies related

to faulting in the bolson gravels. Previous magnetic ground surveys in the Marfa Basin Area (Wilson, 1951) also produced profiles with large magnetic variations over short distances caused by a similar gravel fill composition. Due to this problem magnetic surveying was discontinued in favor of gravity surveying.

Gravity data collected by the author consisted of 443 readings. Additional data was obtained from the Department of Defense Gravity Library, Wiely (1970), and Covert (1976). Incorporating these four sources, a total of 2019 gravity readings, a Regional Bouguer Anomaly Map was produced in order to analyze the regional tectonic setting. A more detailed Bouguer Anomaly map (Plate A) was then produced for the immediate Presidio Bolson Area. A two-dimensional computer modeling scheme (Talwani et al., 1959) and existing subsurface data were used to derive earth models (cross-sections) along two profiles crossing the bolson.

REGIONAL SETTING

In the northern part of Presidio County oil-test wells have penetrated Precambrian granite and arkosic sandstone (Bilbrey, 1957). Underlying the Cambro-Ordovician Bliss sandstone, these Precambrian rocks are correlated with outcrops in the Van Horn area to the north in Culberson County (Figure 1). This area was part of the Van Horn mobile belt that was intensely folded, metamorphosed and intruded during late Precambrian time and thrust eastward against the Texas Craton (Flawn, 1956). Subsequent erosion of these geosynclinal deposits rendered the Precambrian

surface relatively flat, with a gentle slope to the south. Upon this shelf, Paleozoic marine sediments were deposited as the Sauk Sea (Sloss, 1963) transgressed from the south.

The oldest rocks exposed near the Presidio Bolson area are Cambrian through Lower Pennsylvanian units found in the Solitario, a Tertiary intrusive center on the Presidio-Brewster County line. These marine sediments record a history of deposition on a stable continental shelf for most of Paleozoic time. To the northeast of the Solitario, the Marfa Basin was formed in response to upwarping of the Diablo and Coahuila Platforms during Late Paleozoic time. This basin was accentuated during Late Mississippian time by mobilization of the Ouachita geosyncline as it received these Permian deposits. The Ouachita-Marathon Orogenic Belt extended through the Marathon-Solitario region to the southeast of the study area. In the Presidio Bolson area, Upper Pennsylvanian black shales along with Permian sediments of the Marfa Basin are exposed in the Chinati Mountains and Pinto Canyon (Rix, 1952) in Laramide anticlines.

Late Permian evaporite deposition in the Chihuahua Trough, west of the study area, and the Permian Basin, to the northeast, are correlated with fine clastics and reef limestones exposed just east of the bolson in the Pinto Canyon area (Amsbury, 1959). Interpreting these strata as being deposited on a gently sloping shelf implies that throughout most of the Paleozoic the Presidio Bolson area was not tectonically active. The study area was a part of the stable shelf on the west flank of the Diablo Platform and the eastern edge of the Chihuahua Trough during early Paleozoic time. During Late Paleozoic time, the Bolson was downwarped

forming a deep trough, as part of the Marfa Basin, and not deformed again until the close of the Mesozoic.

Comanchean and Gulfian Series Cretaceous sediments are the only Mesozoic rocks found in the Presidio Bolson area. These units consist of fine-grained clastics, limestones, and a basal limestone conglomerate. This also is indicative of a stable shelf area lying between the Diablo Platform and the Chihuahua Trough (Dietrich, 1965). This stability ended with Laramide thrusting and folding which formed the Loma Plata Anticline, north of Pinto Canyon, and other north-northwest trending structures. The mountain ranges bounding the bolson on the west in Mexico were also formed at this time. The thrust sheets of Cretaceous limestone, encountered in oil test wells just north of the bolson (Figure 5, numbers 4 and 5), are a buried extension of the Chihuahua Tectonic Belt (Kopp, 1977). It has been suggested that these thrust faults are used as conduits by heated waters originating deep in the Chihuahua Trough. Following the thrust sheets upward and eastward until normal faults are encountered, the hot waters surface at numerous locations in the Presidio Bolson (Kopp, 1977). Deep circulation and conversion of gypsum to anhydrite in the Chihuahua Trough could be the heat source for the water, rather than a persistent hot Tertiary magma chamber.

Tertiary volcanic rocks originated from numerous eruptive centers on a northwest/southeast trending belt along the boundary between the Diablo Platform and the Chihuahua Trough. The belt contains the Northern Quitman Mountains and the Eagle Mountains in Hudspeth County, the Chinati Mountains, Bofecillos Mountains (McKnight, 1970), and the Solitario in Presidio County, and the Chisos Mountains in Big Bend National Park in

Brewster County (Figure 1). This belt of resurgent cauldrons (McAnulty, 1975) extends southward into Chihuahua and Coahuila, Mexico and northward into New Mexico where similar cauldron structures are known. The Sierra Vieja, north of the Chinati Mountains, is another eruptive center, but is not classified as a cauldron. North of Presidio County lie the northern Davis Mountains where at least two eruptive centers were located. In the area of the Presidio Bolson, eruption began along the northeastern edge in the Sierra Vieja and Chinati Mountains 30 to 40 m.y. ago (Dasch et al., 1959) and spread southward to the Bofecillas Mountains volcanic center. During a second eruptive phase in early Miocene, basin and range block faulting was beginning in the Sierra Vieja and Chinati Mountains. K-Ar dates (Dasch et al., 1959) on these rocks give an age of 22.3 m.y. (basaltic, trachy basaltic, northwest-striking) and 19.2 m.y. (alkalic basaltic, north-striking). This dates the beginning of normal faulting in the bolson area along the Rim Rock Fault as early Miocene.

The eastern boundary fault zone of the Presidio Bolson area consists of the Rim Rock Fault, the Candelaria Fault and the Chinati Fault. The Rim Rock Fault of the Sierra Vieja Mountains can be traced from the Van Horn area (Figure 1) southward to the Chinati Mountains. This high-angle normal fault is downthrown on the west; south of Candelaria, the fault bifurcates with displacement being 300 feet (91.5 m) having decreased from 3000 feet (915 m) near the abandoned town of San Carlos. The Candelaria Fault, also downthrown to the west, extends from the south end of the Sierra Vieja Mountains, southward to Pinto Canyon. Displacement decreases southward from 1800 feet (549 m) to 80 feet (24 m).

The West Chinati Fault Zone, downthrown on the west, separates the Chinati Mountains from the Presidio Bolson.

Infilling of the bolson continued until integration was accomplished by the Rio Grande (Strain, 1970) which has cut approximately 1000 feet (305 m) into lake bed sediments (Groat, 1972). Arroyos have exposed faults in the lake bed gravels that imply some late Cenozoic movement along Basin and Range trends. This movement could be related to the southern extension of the Rio Grande rift into the Chihuahua Trough (Gries, 1977) rather than residual Basin and Range activity. The nature and location of the possible extension of the Rio Grande Rift south of El Paso, Texas is very controversial. However, extension of this rift into the Presidio Bolson area would easily supply heat to circulating ground waters eliminating the need for a gypsum to anhydrite conversion heat source. The flowability of these Permian evaporites in the Chihuahua Trough would greatly reduce any surface expression of rift faulting.

Chapin and Seager (1975) have proposed a tectonic model for the Rio Grande Rift which is outlined below. The plate west of the Rio Grande Rift is moving westward (rotating slightly to the northwest) at a rate slightly greater than the plate to the east. The plate to the east is over-riding the rift, and its associated mantle bulge, resulting in a greater structural relief than exists on the western plate. Basin and Range block faulting resulted from extension forces developed in the western plate. Magmatic centers and hot springs developed along the western edge of the rift (eastern edge of the western plate) due to this extension. However, due to regional compression, faults on the east flank of the rift are tight and free of volcanism and hot springs. Re-

gional extension began during late Oligocene as marked by a change in the composition of igneous rocks from calc-alkalic (30 to 40 m.y.) to basalts and basaltic andesites (5 to 20 m.y.).

DATA COLLECTION AND REDUCTION

Instrument Calibration

Worden gravity meters number 90, 229 and 393 were calibrated by the author for use in the Presidio Bolson study area. The purpose of this procedure is to derive a calibration constant which allows meter dial unit readings to be converted into relative differences in gravity. The gravity unit used is the milligal ($.001 \text{ cm/sec}^2$). The condition of the internal instrument parts, primarily the quartz fibers, can change due to age, temperature, handling and shipment. A calibration check is therefore necessary, periodically, and was conducted about half way through the survey.

Two Department of Defense gravity base stations were used, both located in El Paso, Texas (Appendix A). One was located at the Kidd Seismic Observatory (979107.53 mgals) on the University of Texas at El Paso campus and the other was located at the El Paso International Airport (979066.81 mgals). The procedure used was to create a multiple loop tie between the base stations. Three readings for each instrument were obtained at each base and were averaged and tabulated. The difference between the averaged dial unit value obtained at the two base stations was calculated as was the difference in observed gravity at the two stations ($979107.53 - 979066.81 = 40.67 \text{ mgals}$). The appropriate

value for the number of milligals per dial unit was obtained by division of these values. Calibration constants determined for the three meters in use were, Worden 90 - 0.53808 and Worden 229 - 0.08365 and Worden 393 - 0.48766.

Establishment of Base Stations

A Department of Defense gravity base station is located in the Alpine Post Office, Alpine, Texas (Appendix A). Secondary base stations established at Alpine, Marfa and Shafter by Covert (1976) were located and tied to the Alpine Department of Defense station by averaging dial unit readings from multiple loop occupations. Secondary bases at Van Horn (Covert, 1976 and Wiley, 1970) were both tied to the Department of Defense base station at Van Horn. In this study, secondary bases were established at Presidio and Ruidosa and tied to the Department of Defense station at Alpine. Thus, all existing data in the area were tied to the same system of base stations.

The observed gravity value of the secondary base station was calculated by averaging the multiple dial readings taken at the primary base and at the secondary base. The averages were subtracted, multiplied by the calibration constant for the instrument used, and added to the observed value of the primary base.

Gravity Stations

Gravity stations were collected in a closed loop pattern so that drift corrections could be calculated. The procedure followed was to occupy a base station when beginning a series of readings and then re-occupy the base station upon closing the survey. Linear drift was

assumed, and thus, each station could then be drift corrected according to the length of time that passed from the initial reading of the base station. Drift was calculated as the difference in initial dial reading and closing dial reading (of the base station) divided by the total time in minutes. The drift correction was made in a computer program as a part of the standard correction process.

An individual gravity station was located as accurately as possible both horizontally and vertically. Gravity stations were established as bench marks and spot elevations on topographic maps in order to increase the accuracy of vertical control. Latitude and longitude were measured to the nearest second using a Gerber scale and 7 1/2 minute topographic quadrangle maps in the bolson area. Larger scale (1:250,000) maps were used where 7 1/2 minute sheets were not available. Stations were generally located along jeep trails, ranch roads, paved roads, hill tops, and fence line corners. Only limited backpacking of the instrument was feasible. The spacing of stations was in large part dictated by access and the presence of elevation data.

Gravity Data Reduction

Standard corrections to the gravity data gathered were made by computer. In addition to the drift correction discussed earlier, the standard corrections include a two-part elevation correction and a latitude correction. Terrain corrections, if deemed necessary, are usually calculated separately due to the complex procedure involved. For this report, terrain corrections were calculated using the method of Hammer (1939) and were only made for gravity stations used in constructing the gravity models.

The two part elevation correction includes the Bouguer and Free Air corrections and is designed to reduce all readings to the elevation datum. The Free Air correction accounts for the distance in feet of the station elevation above or below the datum plane elevation. The Bouguer correction removes the effect of the mass of material between the station elevation and the datum plane. The standard value for crustal density of 2.67 gm/cc was used for the Bouguer correction.

Since the gravitational acceleration is approximately 530 milligals greater at the poles than at the equator, a correction for this variation must be made. The reduction computer program used corrected for this variation by computing a theoretical gravity value for each station from the International Gravity Formula, 1967. For a more detailed description of gravity corrections the reader is referred to Chapter 11 of Dobrin (1976).

BOUGUER ANOMALY MAP

Development of Map

The Regional Bouguer Anomaly Map (Figure 2) of the Presidio Bolson area was compiled from 2019 gravity readings. The gravity data was reduced to sea level using an average crustal density of 2.67 gm/cc. The map covers 10,550 square kilometers including all of Presidio County and part of the State of Chihuahua, Mexico. Gravitational relief is 50 milligals with the contour interval being 5 milligals. In the bolson area itself (Plate A) a contour interval of one milligal was used due to the importance of small anomalies to an interpretation of the

FIGURE 2. REGIONAL BOUGUER ANOMALY MAP FOR PRESIDIO BOLSON STUDY AREA

KEY

Redrains and International Boundary County Line Gravity Contour Line, dashed where data lacking

bolson bedrock interface. Inaccuracies in the gravity data, which are nonlinearities in meter drift, earth tides, nonrepeatability of readings, and elevation inaccuracies, are estimated to be no greater than ± 0.3 milligal. Therefore a one milligal contour interval is acceptable.

Regional Geologic Structures

The Presidio Bolson is flanked on the west by the Chihuahua Tectonic Belt (Figure 2) which is represented by a northwest/southeast trending linear gravity maximum. The Presidio Bolson, itself a graben-like feature, is associated with a gravity low approximately centered on the course of the Rio Grande. The gravity low north of the Presidio Bolson, centered on the Presidio-Jeff Davis County Line (Figure 2), is interpreted to represent the Valentine Basin (Covert, 1976). South of the Presidio Bolson along the course of the Rio Grande is a small feature known as the Redford Bolson. This bolson is centered at Redford, Texas but is not very well known. On this map this bolson is outlined on the basis of only 9 data points. Northeast of the Redford Bolson is an extensive gravity high in the area of the Solitario and the Bofecillos Mountains. North of this gravity high is a gravity low that trends east-west across the center of the map. This low probably represents the Paleozoic Marfa Basin that, in the area of the Chinati Mountains, has been obscured by Laramide deformation, Basin and Range faulting, and Tertiary volcanism. The Chinati Mountain gravity high flanks the eastside of the Presidio Bolson and appears to extend northward into the Sierra Vieja gravity high.

Bolson Area

The gravity signature of the Presidio Bolson was interpreted using computer modeling along the two profiles (Figures 3 and 4) discussed in a later section. The bolson is 85 kilometers long and 15-20 kilometers wide with a maximum calculated depth of 1.5 kilometers. Bolson fill begins to thin north of Ruidosa and has died out before reaching Candelaria. The graben which contains the Presidio Bolson extends 15 kilometers north beyond the bolson fill and is represented by a gravity low continuing north of Candelaria (Plate A). In the Ruidosa area the base of the bolson appears to be very complex before reaching its lowest level 10 kilometers to the south of Ruidosa. South of this low the base of the bolson gently shallows before merging into the Redford Bolson 15 kilometers south of Presidio. The west flank of the Presidio Bolson butts against the thrust sheets of the Chihuahua Tectonic Belt. The Bouguer Anomaly Map (Plate A) indicates that the western side (in Mexico) of the bolson is steeper than the eastern side because of the higher gravity gradient on the west side. The east flank of the bolson thins abruptly against the Sierra Viejas, the Chinati Mountains and the Bofecillos Mountains. Figure 3 portrays a computer derived model section crossing the northern edge of the bolson and Figure 4 portrays a computer derived model crossing the southern edge of bolson.

The base of the bolson, as portrayed by the gravity data, rests on an uneven surface in the Ruidosa area. Cretaceous sediments and Tertiary intrusions could account for these small gravity anomalies due to

Figure 3. TALWANI 2-D GRAVITY MODEL, PINTO CANYON HIGHWAY,
PRESIDIO COUNTY, TEXAS

their density differences. On the other hand, if these anomalies are due to faulted and rotated blocks of Paleozoic-Cretaceous sediments, then the graben is structurally complex. This question cannot be settled from the data available without additional drill hole information.

COMPUTER MODELING

Model Parameters

Two profiles were modeled (Figures 3 and 4) using the two-dimensional formulation of Talwani et al. (1959) and an added plot subroutine for the CALCOMP plotter. Well data in the area served as a constraint in the gravity modeling along with surface geologic data. Well data collected for this study is listed in Appendix C and a comprehensive review of previous geologic studies can be found in Kopp (1977). With considerations of data resolution and the lack of geologic control only the following geologic units were modeled: bolson fill (1.9 gm/cc), Tertiary volcanics (2.0 gm/cc), Tertiary intrusives (2.65 gm/cc), Paleozoic sediments (2.6 gm/cc) and the Precambrian basement (2.7 gm/cc). No bulk density logs were available for Presidio County so these density values were chosen on the basis of measurements reported by Healey (1970) (bolson fill and Tertiary volcanics), and Wilson (1951) (Cretaceous and Paleozoic sediments).

Accurate density values are vital for modeling true thickness of geologic units. A small change in density can produce a large difference in the calculated thickness of a unit. As the error in the density contrast between units increases the error in calculated thick-

Figure 4. TALWANI 2-D GRAVITY MODEL, SHAFTER HIGHWAY, PRESIDIO COUNTY, TEXAS
well numbers correspond to Index numbers Appendix C

ness increases. Normal faulting in the Presidio area has down dropped Paleozoics and Cretaceous sediments so that at depth in the bolson these units may be adjacent to higher density rocks. Thus, some of the negative anomaly in the bolson is a result of a negative density contrast associated with these units.

Both earth models extend to a depth of eight kilometers (25,192 ft) below the datum elevation. The datum plane elevation used in both models was the elevation of the lowest gravity station on each profile. For the Shafter Highway Profile an elevation of 2568 feet (783 m) was used as a datum while for the Pinto Canyon Profile an elevation of 2608 feet (795 m) was employed.

Pinto Canyon Model

The Pinto Canyon Profile extends from the Marfa area southwestward along the Pinto Canyon Highway (County Road 2810). At the end of the paved section of the highway, the profile turns due west crossing the Rio Grande into Mexico 6 miles (9.7 km) north of Ruidosa (Figure 1). The total length of the profile is 101.5 kilometers (63 mi) with an overall relief of 3.7 milligals. The Chihuahua Tectonic Belt in Mexico is represented by a gravity high while the Presidio Bolson is a gravity low. The Gulf Oil Test Well (Appendix C, number 6) located 3.5 miles (5.6 km) south of the profile was cased to 3200 feet (975 m) which is interpreted as the depth of bolson fill at this point. Due to the permeability of the fill it was felt that casing would have been necessary in order to prevent caving and hold circulation of drilling mud. Depth of fill is based on this assumption since formation contact depths

were not released for this well. Many of the wells in Presidio County that penetrated the Tertiary volcanics were cased through these tuffaceous rhyolites. It is therefore possible that what has been interpreted as one kilometer of bolson fill could be bolson fill underlain by Tertiary volcanics.

The bedrock surface beneath the fill is uneven on the profile (see also Plate A). Warping or block faulting of the bolson floor prior to or contemporaneous with downdropping could account for the unevenness. Tertiary intrusions similar to those northwest of the Loma Plata Anticline (Amsbury, 1958) could also produce the small gravity anomalies seen in the Presidio Bolson (Plate A).

The Candelaria Fault cuts the east flank of the bolson before the bolson ends against the Loma Plata Anticline. The gravity high in the vicinity of the Sierra Vieja Mountains represents either a shallowing of the Precambrian basement or an intrusion. Linear gravity trends east of this high indicate an eastern boundary fault for the Sierra Viejas. The gravity low, east of the Vieja Mountains, is apparently associated with the Marfa Basin. Northeast of the Marfa Basin, the Valentine Basin (Covert, 1976) is represented by another gravity low. The intervening gravity high represents a ridge in the basement that trends northwest-southeast. In the Marfa area Gulf's H. J. Hubbard well, Phillip's 1-C Mitchell well and Tucker's H. B. Holmes well (Appendix C, numbers 14, 13, and 12) indicate the Tertiary volcanics to be at least a half kilometer thick. The Davis Mountains, the probable source for these volcanics, is represented by a slight gravity low.

Shafter Highway Model

The Shafter Highway Profile extends southwest from Marfa through Shafter to Presidio and south into Mexico (Figure 1). The total length of the profile is 151.7 kilometers (94 mi) with an overall relief of 28.0 milligals. The Paleozoic Marfa Basin is represented by a gravity low south of Marfa, Texas. The basin thins southward toward the Chinati Mountain gravity high near Shafter, Texas. The West-Cockburn's Presidio Trust Well (Appendix C, number 26) 16 miles north of Presidio records at least one kilometer of bolson fill before bottoming in limestone. The West's Presidio Trust (number 25) and the Atlantic Richfield's Presidio State (number 22), 7 and 9 kilometers north of Presidio, record at least one kilometer of bolson fill over Cretaceous sediments. The bolson is deepest (1.2 km) on this profile in the immediate vicinity of Presidio.

South of the Presidio Bolson in Mexico a gravity high representing the Chihuahua Tectonic Belt is encountered.

DISCUSSION

The Presidio Bolson is located in a graben-like feature comparable in size (85 km by 15 km), trend (northwest-southeast), and gravity relief (-30 mgals) to typical Basin and Range grabens of Nevada and Utah (Thompson, 1959). Volcanism in the bolson area came in two pulses, 30 to 40 m.y. and 19 to 22 m.y. ago. As the second phase was ending in the bolson area, Rio Grande Rift associated volcanism was beginning in the Colorado-New Mexico area, 5 to 20 m.y. (Chapin and Seager, 1975). Thus

bolson volcanism, 19 to 22 m.y., is most likely associated with Basin and Range block faulting not the Rio Grande Rift.

There are several possible sources for the heat which is responsible for hot springs in the Presidio Bolson area. The conversion of gypsum to anhydrite has been postulated to be a source but sufficient quantities of these minerals do not seem to be present. Hot springs are associated with both boundary faults (Figures 3 and 4), and circulating ground water rising along thrust faults from the Chihuahua Trough would encounter the western boundary fault and probably come to the surface. It seems unlikely that the hot water would cross the fault plane, travel through the graben and surface along the eastern boundary fault. There is no evidence to suggest that the western boundary fault is tight. If the water entered the bolson gravels, the heat and water would be dispersed and little would reach the eastern boundary fault. A similar argument would apply to a heat source under the Vieja, the Chinati, or the Bofecillos Mountains providing hot waters for springs on the west side of the graben.

Therefore, late Tertiary intrusions located beneath the bolson or near the boundary faults or deep circulation presently seem the most feasible heat sources for the hot springs. The occurrence of all but one hot spring north of Ruidosa shows a relation between the hot springs and graben boundaries as outlined by gravity. Deep circulation along the graben boundary faults is also a feasible explanation for the hot springs. It was previously mentioned that the gravity signature of the north end of the bolson contains local anomalies. If these anomalies are interpreted as late Tertiary intrusions rather than fault block

rotation, then they could be heat sources. The gravity signature of the graben (as discussed previously) north of the bolson, continues the local anomalies from the bolson northward.

Many local anomalies were detected (Plate A) although additional gravity work in remote areas would be helpful. A gravity high trending westward from the Chinati Mountains (south of and parallel to Pinto Canyon) is interpreted as representing a ridge of intrusive rock having a higher density than bolson fill. A small closed gravity low northeast of Ruidosa possibly represents a slight deepening of the bolson that trends northeast-southwest. The linearity of the gravity contours northeast of Candelaria and east of Ruidosa follow Basin and Range trends. This is interpreted as the northwest trending fault paralleling the Rim Rock Boundary Fault. Northeast of this fault are three linear gravity features perpendicular to the fault and parallel to the gravity low north of Ruidosa (discussed above as a slight deepening of the bolson). These three features consist of two gravity lows bracketing a gravity high. The gravity high is centered at Capote Falls on the Capote Ranch, the northern low follows the present course of Capote Creek, and the southern gravity low is centered on Macho Mountain on the Vizcaino Ranch. Step faulting of the Tertiary volcanics into the bolson strikes north-south in this area and cannot be correlated with these three gravity anomalies. Due to the topographic relief near Macho Mountain terrain corrections were calculated for selected gravity stations. The maximum terrain correction value was found to be 11 milligals and does not account for the total anomaly.

Laramide orogenesis produced north-northwest trending features, such as the Sierra Vieja, in the bolson area. Basin and Range block faulting resulted in features of similar trend such as the Rim Rock Fault. Neither of these episodes of deformation can be considered responsible for the northeast trending anomalies. Late Paleozoic folding and thrusting of the Ouachita-Marathon Orogeny produced northeast trending structures along the southeast margin of the county (Kopp, 1977). If these northeast trending anomalies are due to Late Paleozoic features, they could not be a heat source for the hot springs.

CONCLUSIONS

1. The Presidio Bolson is located in a major Basin and Range graben, the Presidio Graben.
2. Hot springs in the area are associated with the boundary faults along the northern half of the Presidio Graben and are not restricted to areas with bolson fill.
3. The northern half of the graben (from Ruidosa northward) is structurally complex with both northeast trending (Late Paleozoic), and northwest trending (Late Mesozoic and Middle Tertiary) structures present.
4. Because of a major structural boundary, the western boundary fault of the graben, the heat source for the hot springs is not likely to be located in the Chihuahua Trough.
5. The fill in the Presidio Bolson is more than 1 kilometer thick in several localities and is thickest in the Ruidosa area where it is

approximately 1.5 kilometer thick.

6. Deep circulation of ground water along the graben boundary faults is a possible explanation for the hot springs.
7. East-west trending gravity features in the northern portion of the graben could be associated with unexposed Tertiary intrusions which could be heat sources for the hot springs.

APPENDIX A

GRAVITY

BASE STATIONS ESTABLISHED
FOR PRESIDIO BOLSON STUDY

UNIVERSITY of TEXAS at EL PASO
GRAVITY BASE STATION DESCRIPTION

Station Identification Code DOD 0595-2 IGB 11903B

City, State Location ALPINE, TEXAS

Latitude 30° 21.30' N

Longitude 103° 34.77' W

Elevation 1371.6

Gravity (mgals) 978975.73

Source Dept. of Defense

Accuracy +/- 0.1

Date 1 July 1973

Description:

U.S. A.F. Gravity Disk set in N-W corner of lobby 5 feet to right of door to Post Master's Office.

Diagram:

UNIVERSITY of TEXAS at EL PASO
GRAVITY BASE STATION DESCRIPTION

Station Identification Code Mraz Presidio

City, State Location Presidio, Texas

Latitude 29° 33' 46"

Longitude 104° 21' 47"

Elevation 2599

Gravity (mgals) 978996.17

Source Mraz

Accuracy

Date February 1977

Description:

Bench mark F 455 is located in the south wall at the south west corner of the Presidio High School and Tax Office Building. School is one block north of the Redford Highway across from the International boundary and Water Commission Offices located south of the Redford Highway.

Diagram:

UNIVERSITY of TEXAS at EL PASO
GRAVITY BASE STATION DESCRIPTION

Station Identification Code- Mraz Ruidosa

City, State Location Ruidosa, Texas

Latitude 29° 58' 42"

Longitude 104° 40' 37"

Elevation 2759

Gravity (mgals) 978998.37

Source Mraz

Accuracy

Date February 1977

Description:

Station is located at the west edge of the highway
just south of the nose of a small ridge.

Diagram:

Drawn to a
1:24,000
Scale
From Ruidosa 1 NW
7.5 minute blue-
sheet

UNIVERSITY of TEXAS at EL PASO
GRAVITY BASE STATION DESCRIPTION

Station Identification Code	<u>Mraz New Ruidosa</u>		
City, State Location	<u>Ruidosa, Texas</u>		
Latitude	<u>29° 59' 45"</u>	Longitude	<u>104° 40' 57"</u>
Elevation	<u>2772</u>	Gravity (mgals)	<u>979000.15</u>
Source	<u>Mraz</u>	Accuracy	<u></u>
Date	<u>February 1977</u>		

Description:

B.M. 732 just north of Ruidosa, Texas, is located on the east side of the Candelaria County Road. The brass pin is set in concrete and marked by a two foot high piece of two inch post approximately twenty-five feet off the road.

Diagram:

Drawn
at 1:24,000
scale
From Ruidosa 1 NW
7.5 minute
blue-sheet

APPENDIX B

PRINCIPAL FACTS

FOR

GRAVITY READINGS

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
TXRUD 1	29.0	59.17	104.0	40.52	2884.0	978.99072	-60.68	-159.09
TXRUD 2	29.0	59.10	104.0	40.23	2977.0	978.98438	-58.20	-159.78
TXRUD 3	29.0	59.35	104.0	39.68	3042.0	978.98071	-56.21	-160.01
TXRUD 4	29.0	59.47	104.0	39.25	3041.0	978.98242	-54.74	-158.51
TXRUD 5	29.0	59.97	104.0	39.00	3058.0	978.98242	-53.86	-158.20
TXRUD 6	29.0	59.63	104.0	38.82	3095.0	978.98022	-51.94	-157.55
TXRUD 7	29.0	59.72	104.0	38.45	3090.0	978.97827	-54.62	-160.06
TXRUD 8	29.0	59.73	104.0	38.07	3167.0	978.97510	-50.58	-158.65
TXRUD 9	30.0	0.15	104.0	36.92	3319.0	978.96997	-41.85	-155.10
TXRUD 10	30.0	0.27	104.0	36.57	3350.0	978.96924	-39.95	-154.26
TXRUD 11	29.0	59.87	104.0	36.00	3481.0	978.96240	-33.95	-152.72
TXRUD 12	29.0	59.85	104.0	34.73	3862.0	978.94165	-18.65	-150.43
TXRUD 13	29.0	59.82	104.0	34.43	3882.0	978.94336	-15.23	-147.69
TXRUD 14	29.0	59.88	104.0	33.67	3974.0	978.93896	-10.92	-146.52
TXRUI 15	30.0	0.17	104.0	33.67	3845.0	978.94678	-15.73	-146.93
TXRUD 16	30.0	0.25	104.0	32.52	4235.0	978.92676	0.87	-143.63
TXRUD 17	29.0	59.37	104.0	32.93	4180.0	978.92822	-1.61	-144.23
TXRUD 18	29.0	59.18	104.0	22.66	4065.0	978.93481	-5.62	-144.33
TXRUD 19	29.0	59.57	104.0	31.97	4060.0	978.93896	-2.35	-140.88
TXRUD 20	29.0	59.47	104.0	31.75	4079.0	978.93750	-2.05	-141.23
TXRUD 21	29.0	59.43	104.0	21.33	4137.0	978.93433	0.43	-140.73
TXRUD 22	29.0	59.88	104.0	30.75	4204.0	978.92944	1.24	-142.21
TXRUD 23	30.0	0.23	104.0	30.05	4286.0	978.92432	3.38	-142.87
TXRUD 24	30.0	0.43	104.0	29.88	4350.0	978.92090	5.73	-142.69
TXRUD 25	29.0	59.33	104.0	33.77	4004.0	978.93652	-9.79	-146.41
TXRUD 26	29.0	59.07	104.0	33.65	4057.0	978.93384	-7.25	-145.68
TXRUD 27	29.0	58.92	104.0	34.02	3962.0	978.93799	-11.80	-146.99
TXRUD 28	29.0	58.88	104.0	35.85	3517.0	978.95850	-33.16	-153.17
TXRUD 29	29.0	58.57	104.0	34.75	3580.0	978.95801	-27.31	-149.46
TXRUD 30	29.0	58.38	104.0	34.48	3796.0	978.94458	-20.20	-149.73
TXRUD 31	29.0	57.56	104.0	34.12	3738.0	978.94922	-19.99	-147.54
TXRUD 32	29.0	57.45	104.0	34.33	3730.0	978.94702	-22.67	-149.94
TXRUD 33	29.0	57.20	104.0	34.58	3610.0	978.95337	-27.28	-150.46
TXRUD 34	30.0	0.52	104.0	35.73	3500.0	978.96460	-30.81	-159.24
TXRUD 35	29.0	59.47	104.0	41.00	2766.0	978.99902	-63.95	-158.33
TXRUD 36	29.0	59.75	104.0	40.93	2772.0	978.99829	-64.56	-159.15
TXRUD 37	29.0	59.77	104.0	40.50	2953.0	978.98706	-58.77	-159.53
TXRUD 38	30.0	0.03	104.0	40.27	2987.0	978.98560	-57.37	-159.29
TXRUD 39	30.0	0.23	104.0	40.05	3024.0	978.98267	-57.27	-160.45
TXRUD 40	30.0	0.73	104.0	39.78	2071.0	978.97852	-57.38	-162.16
TXRUD 41	30.0	1.18	104.0	39.40	3137.0	978.97656	-53.73	-160.77
TXRUD 42	30.0	1.40	104.0	38.85	3185.0	978.97534	-50.72	-159.40
TXRUD 43	30.0	0.88	104.0	37.92	3303.0	978.96753	-46.72	-159.42
TXRUD 44	30.0	0.98	104.0	36.92	3405.0	978.96582	-38.93	-155.11
TXRUD 45	30.0	0.45	104.0	37.53	2290.0	978.96597	-45.04	-157.30
TXRUD 46	30.0	0.08	104.0	37.03	3316.0	978.96802	-43.95	-157.10
TXRUD 47	30.0	1.42	104.0	28.33	3205.0	978.97046	-53.67	-163.03
TXRUD 48	30.0	1.47	104.0	37.08	3377.0	978.96826	-40.57	-155.56
TXRUD 49	30.0	1.80	104.0	36.58	3460.0	978.96484	-35.97	-154.03
TXRUD 50	30.0	2.12	104.0	35.85	3605.0	978.95947	-28.12	-151.13
TXRUD 51	30.0	1.55	104.0	39.08	2104.0	978.98071	-53.20	-159.11
TXRUD 52	30.0	1.50	104.0	39.78	3024.0	978.98462	-56.72	-159.90
TXRUD 53	30.0	1.63	104.0	40.62	2558.0	978.98550	-58.14	-159.07
TXRUD 54	30.0	1.53	104.0	41.22	2885.0	978.99438	-60.08	-158.52
TXRUD 55	30.0	1.28	104.0	41.17	2895.0	978.99365	-54.50	-158.29
TXRUD 56	30.0	0.87	104.0	41.27	2778.0	978.99122	-62.47	-157.26

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
TXRUD 57	30.0	1.25	104.0	41.68	2770.0	579.00122	-63.65	-158.17
TXRUD 58	30.0	0.0	104.0	40.88	2778.0	578.99902	-63.56	-158.35
TXRUD 59	30.0	0.75	104.0	33.67	3919.0	978.94531	-10.93	-144.66
TXRUD 60	30.0	1.52	104.0	33.25	4210.0	578.92847	-1.35	-145.00
TXRUD 61	30.0	1.47	104.0	32.67	4410.0	578.91772	6.84	-143.64
TXRUD 62	30.0	1.62	104.0	32.17	4440.0	978.91602	7.76	-143.74
TXRUD 63	30.0	1.18	104.0	34.10	3772.0	578.95410	-16.56	-145.26
TXRUD 64	30.0	1.98	104.0	34.47	3708.0	578.95532	-22.31	-148.83
TXRUD 65	30.0	2.23	104.0	34.42	3541.0	578.94116	-14.87	-149.35
TXRUD 66	30.0	2.23	104.0	38.88	3095.0	978.98218	-53.55	-159.15
TXRUD 67	30.0	2.68	104.0	38.33	3185.0	978.97876	-49.06	-157.73
TXRUD 68	30.0	3.33	104.0	38.88	3140.0	578.97363	-59.28	-166.42
TXRUD 69	30.0	4.03	104.0	38.05	3241.0	578.97681	-47.44	-158.03
TXRUD 70	30.0	4.35	104.0	37.75	3309.0	978.97266	-45.74	-158.65
TXRUD 71	30.0	4.80	104.0	37.30	3480.0	578.96289	-39.85	-158.60
TXRUD 72	30.0	4.98	104.0	37.17	3579.0	578.96167	-31.95	-154.07
TXRUD 73	30.0	5.42	104.0	36.55	3705.0	578.95898	-23.55	-149.97
TXRUD 74	30.0	6.00	104.0	36.13	3905.0	978.94824	-16.02	-149.27
TXRUD 75	30.0	6.63	104.0	35.77	3677.0	978.96582	-20.89	-146.35
TXRUD 76	30.0	6.98	104.0	35.58	3768.0	578.96582	-12.82	-141.39
TXRUD 77	30.0	7.32	104.0	34.57	3934.0	578.95044	-12.91	-147.15
TXRUD 78	30.0	7.42	104.0	34.42	3865.0	978.95654	-13.53	-145.41
TXRUD 79	30.0	7.25	104.0	33.25	4610.0	578.90894	9.32	-147.98
TXRUD 80	30.0	7.67	104.0	33.13	4435.0	978.92578	9.09	-142.24
TXRUD 81	30.0	6.52	104.0	33.00	4125.0	578.94360	-0.69	-141.44
TXRUD 82	30.0	8.82	104.0	32.83	4766.0	578.89673	9.71	-152.91
TXRUD 83	30.0	10.52	104.0	33.60	5750.0	978.82520	28.38	-167.82
TXRUD 84	30.0	10.13	104.0	33.70	5770.0	978.82544	31.08	-165.80
TXRUD 85	30.0	7.42	104.0	35.68	3759.0	578.96338	-16.61	-144.87
TXRUD 86	30.0	8.00	104.0	36.00	3790.0	978.95923	-18.66	-147.98
TXRUD 87	30.0	8.78	104.0	36.22	3445.0	578.97681	-33.22	-150.90
TXRUD 88	30.0	7.92	104.0	36.62	3337.0	578.99023	-30.14	-144.01
TXRUD 89	30.0	8.40	104.0	36.58	3400.0	578.98511	-29.98	-146.00
TXRUD 90	30.0	8.65	104.0	37.05	2205.0	578.95756	-36.10	-145.46
TXRUD 91	30.0	5.02	104.0	36.83	3239.0	978.99829	-32.74	-143.26
TXRUD 92	30.0	9.32	104.0	36.73	3255.0	578.99927	-30.51	-141.57
TXRUD 93	30.0	9.47	104.0	35.92	3603.0	578.97607	-21.22	-144.16
TXRUD 94	30.0	8.00	104.0	35.35	4767.0	978.89185	5.83	-156.83
TXRUD 95	30.0	8.50	104.0	34.50	5020.0	578.87476	12.90	-158.73
TXRUD 96	30.0	8.55	104.0	34.72	4810.0	978.89038	7.88	-156.24
TXRUD 97	30.0	8.92	104.0	33.80	4647.0	578.91040	11.94	-146.62
TXRUD 98	30.0	7.63	104.0	34.52	3960.0	578.94971	-11.75	-146.87
TXRUD 99	30.0	7.33	104.0	39.63	2996.0	978.99780	-53.86	-156.09
TXRUD100	30.0	10.27	104.0	41.13	2903.0	979.01147	-52.85	-151.91
TXRUD101	30.0	11.48	104.0	41.63	2589.0	579.01465	-43.15	-145.14
TXRUD102	30.0	12.47	104.0	42.07	2942.0	979.01636	-46.94	-147.33
TXRUD103	30.0	12.83	104.0	41.55	2890.0	578.02417	-44.70	-143.31
TXRUD104	30.0	13.49	104.0	42.18	3074.0	579.01416	-38.19	-143.08
TXRUD105	30.0	14.38	104.0	42.73	2527.0	579.02515	-42.15	-142.02
TXRUD106	30.0	14.67	104.0	43.00	2921.0	578.02612	-42.15	-141.82
TXRUD107	29.0	55.50	104.0	38.37	2969.0	978.97632	-62.36	-163.67
TXRUD108	29.0	55.57	104.0	37.78	2029.0	978.97290	-60.22	-163.57
TXRUD109	29.0	55.57	104.0	37.57	3054.0	578.97144	-59.36	-163.56
TXRUD110	29.0	55.85	104.0	37.68	3026.0	578.97412	-59.76	-163.01
TXRUD111	29.0	55.87	104.0	38.62	2940.0	578.97852	-63.47	-163.79
TXRUD112	29.0	55.42	104.0	37.45	3145.0	978.96582	-56.30	-163.62

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
TXRUD113	29.0	55.85	104.0	36.67	3254.0	578.96313	-49.18	-160.21
TXRUD114	29.0	55.75	104.0	36.50	3280.0	578.96143	-48.47	-160.39
TXRUD115	29.0	56.13	104.0	35.43	3414.0	578.96167	-35.95	-152.44
TXRUD116	29.0	56.20	104.0	34.82	3542.0	578.95898	-26.76	-147.62
TXRUD117	29.0	56.28	104.0	34.73	3574.0	578.95728	-25.62	-147.57
TXRUD118	29.0	56.78	104.0	34.68	3610.0	578.95410	-26.03	-149.21
TXRUD119	29.0	56.88	104.0	34.82	3567.0	578.95703	-27.31	-149.02
TXRUD120	29.0	57.00	104.0	35.28	3531.0	578.95850	-29.32	-149.80
TXRUD121	29.0	57.08	104.0	36.33	3262.0	578.96973	-43.54	-154.85
TXRUI125	28.0	59.43	104.0	32.52	4304.0	578.91748	76.54	-70.32
TXRUI126	28.0	59.60	104.0	32.52	4275.0	578.91821	74.33	-71.54
TXRUI127	28.0	59.63	104.0	31.98	4608.0	578.90063	88.11	-69.12
TXRUI128	28.0	59.47	104.0	31.57	4480.0	578.91626	91.85	-61.01
TXRUI129	28.0	59.42	104.0	30.90	4731.0	578.89160	90.85	-70.58
TXRUI130	29.0	47.20	104.0	31.32	2916.0	578.97876	-54.14	-153.64
TXRUI131	29.0	47.40	104.0	29.93	3077.0	578.97217	-45.97	-150.96
TXRUI132	29.0	47.68	104.0	29.95	3102.0	578.97217	-43.87	-149.71
TXRUI133	29.0	48.63	104.0	29.72	3258.0	578.96533	-37.25	-148.42
TXRUI134	29.0	48.88	104.0	28.78	3395.0	578.96216	-27.80	-143.64
TXRUI135	29.0	49.40	104.0	27.90	3635.0	578.94897	-19.07	-143.10
TXRUI136	29.0	49.65	104.0	27.02	4070.0	578.92285	-4.60	-143.48
TXRUI137	29.0	49.27	104.0	29.18	3402.0	578.96045	-29.35	-145.43
TXRUI138	29.0	50.48	104.0	28.27	3718.0	578.94116	-20.61	-147.48
TXRUI139	29.0	50.67	104.0	28.20	3835.0	578.93384	-17.21	-148.07
TXRUI140	29.0	50.77	104.0	28.70	3767.0	578.93799	-19.64	-148.17
TXRUI141	29.0	50.58	104.0	29.78	3733.0	578.93945	-21.60	-148.97
TXRUI142	29.0	51.57	104.0	29.82	3640.0	578.94580	-24.78	-148.99
TXRUI143	29.0	52.77	104.0	29.93	3885.0	578.92773	-21.30	-153.86
TXRUI144	29.0	53.00	104.0	30.08	4035.0	578.92773	-7.11	-144.93
TXRUI145	29.0	53.07	104.0	30.98	3713.0	578.94946	-16.03	-142.72
TXRUI146	29.0	53.30	104.0	31.45	3695.0	578.95093	-16.62	-142.69
TXRUI147	29.0	53.18	104.0	31.87	3657.0	578.95361	-17.45	-142.23
TXRUI148	29.0	53.18	104.0	32.53	3573.0	578.95654	-22.33	-144.25
TXRUI149	29.0	54.12	104.0	32.83	3500.0	578.96436	-22.57	-141.99
TXRUI150	29.0	53.67	104.0	33.77	3646.0	578.96631	-6.41	-130.82
TXRUI151	29.0	53.17	104.0	32.67	3561.0	578.95679	-23.16	-144.67
TXRUI152	29.0	52.70	104.0	33.28	3409.0	578.95996	-33.67	-149.99
TXRUI153	29.0	52.30	104.0	32.90	3310.0	578.96680	-25.66	-148.61
TXRUI154	29.0	52.62	104.0	32.83	3242.0	578.95996	-49.40	-160.03
TXRUI155	29.0	52.85	104.0	23.08	3433.0	578.96143	-30.28	-147.42
TXRUI156	29.0	52.23	104.0	30.95	3868.0	578.93335	-16.57	-148.55
TXRUI157	29.0	51.05	104.0	30.55	3406.0	578.95923	-32.70	-148.92
TXRUI158	29.0	51.68	104.0	31.08	3357.0	578.96265	-33.22	-147.76
TXRUI159	29.0	49.72	104.0	31.05	3228.0	578.96753	-39.35	-149.50
TXRUI160	29.0	49.07	104.0	30.55	3162.0	578.96826	-43.90	-151.80
TXRUI161	29.0	49.13	104.0	30.25	3232.0	578.96826	-37.56	-147.84
TXRUI162	29.0	43.30	104.0	30.05	3204.0	578.96777	-39.47	-148.79
TXRUI163	29.0	47.97	104.0	30.68	3058.0	578.97095	-45.88	-151.58
TXRUI165	29.0	50.28	104.0	36.02	2795.0	578.98706	-61.14	-156.51
TXRUI166	29.0	51.82	104.0	34.65	3160.0	578.96851	-47.51	-155.34
TXRUI167	29.0	52.22	104.0	34.38	3243.0	578.96338	-45.41	-156.07
TXRUI168	29.0	51.30	104.0	35.22	3039.0	578.97534	-51.39	-155.08
TXRUI169	29.0	49.07	104.0	32.37	3040.0	578.97412	-49.51	-153.24
TXRUI170	29.0	49.63	104.0	32.48	3205.0	578.96924	-39.74	-149.10
TXRUI171	29.0	50.30	104.0	32.28	3226.0	578.96509	-42.69	-152.77
TXRUI172	29.0	50.70	104.0	32.77	3254.0	578.96411	-41.58	-152.61

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
TXRUI173	29.0	50.47	104.0	33.42	3155.0	978.96899	-45.66	-153.31
TXRUI174	29.0	50.65	104.0	34.03	3086.C	978.97241	-48.92	-154.22
TXRUI175	29.0	49.90	104.0	35.73	2791.0	978.98755	-60.59	-155.83
TXRUI176	30.0	3.70	104.0	35.40	3585.0	978.96265	-28.90	-151.23
TXRUI177	30.0	3.40	104.0	35.88	3595.C	978.96118	-28.85	-151.51
TXRUI178	30.0	2.73	104.0	36.92	3589.0	978.95703	-32.72	-155.18
TXRUI179	30.0	2.75	104.0	36.27	3621.C	978.95801	-28.81	-152.37
TXRUI180	30.0	2.38	104.0	35.08	3834.C	978.94629	-20.78	-151.60
TXRUI180	30.0	14.63	104.0	37.72	3221.0	979.00488	-35.19	-145.10
TXRUI181	30.0	15.82	104.0	37.42	3388.0	978.95976	-26.20	-141.81
TXRUI182	30.0	16.10	104.0	37.62	3382.0	979.00000	-26.89	-142.29
TXRUI183	30.0	16.48	104.0	27.37	3456.C	978.99658	-23.75	-141.67
TXRUI184	30.0	17.48	104.0	37.90	3609.0	978.98730	-20.03	-143.17
TXRUI185	30.0	17.50	104.0	38.32	3758.0	978.98022	-13.15	-141.38
TXRUI186	30.0	19.12	104.0	38.60	3863.C	978.97461	-10.86	-142.67
TXRUI187	30.0	19.42	104.0	37.87	3889.0	978.97803	-5.57	-138.24
TXRUI188	30.0	19.42	104.0	36.87	4472.0	978.94385	15.28	-137.31
TXRUI189	29.0	44.08	104.0	32.87	2684.0	978.99316	-57.59	-149.18
TXRUI190	29.0	46.30	104.0	29.37	2975.0	978.98364	-42.68	-144.19
TXRUI191	29.0	47.42	104.0	28.15	3233.C	978.97803	-25.33	-135.65
TXRUI192	29.0	47.80	104.0	27.05	3600.C	978.95898	-10.36	-133.19
TXRUI193	29.0	49.88	104.0	24.83	4367.0	978.91064	10.68	-138.33
TXRUI194	29.0	48.53	104.0	24.53	3960.C	978.94312	6.56	-128.57
TXRUI195	29.0	49.17	104.0	25.05	4130.0	978.92896	7.56	-133.36
TXRUI196	29.0	43.90	104.0	26.30	3918.0	978.94214	1.24	-132.45
TXRUI197	29.0	46.47	104.0	28.87	3022.0	978.97900	-43.07	-146.18
WTXPR213	29.0	34.17	104.0	22.23	2612.0	978.99561	-49.09	-138.21
WTXPR204	29.0	34.80	104.0	21.92	2661.C	978.99438	-46.51	-137.31
WTXPR205	29.0	36.67	104.0	21.65	2834.C	978.98828	-38.65	-135.35
WTXPR206	29.0	38.18	104.0	21.48	2933.0	978.98633	-33.35	-133.43
WTXPR207	29.0	39.88	104.0	21.67	3093.C	978.98096	-25.91	-131.45
WTXPR208	29.0	41.25	104.0	21.67	3192.0	978.97925	-20.08	-129.00
WTXPR209	29.0	42.67	104.0	21.47	3391.0	978.97217	-10.27	-125.97
WTXPA210	29.0	43.50	104.0	21.08	3515.C	978.97119	-0.66	-120.60
WTXPB210	29.0	43.50	104.0	21.08	3518.0	978.97119	-0.43	-120.47
WTXPR211	29.0	44.52	104.0	21.15	3716.C	978.96021	6.05	-120.74
WTX.R290	30.0	10.27	104.0	40.82	2881.0	979.01733	-48.71	-147.01
WTX.R291	30.0	10.40	104.0	40.05	2920.0	979.01685	-45.83	-145.46
WTX.R292	30.0	10.70	104.0	39.30	2954.C	979.01514	-44.76	-145.56
WTX.R293	30.0	11.43	104.0	39.08	3000.0	979.01343	-43.29	-145.66
WTX.R294	30.0	12.15	104.0	38.65	3031.C	979.01318	-41.42	-144.85
WTX.R295	30.0	13.13	104.0	37.77	3104.C	979.01050	-38.45	-144.36
WTX.R296	30.0	13.12	104.0	37.38	3133.0	979.00903	-37.27	-144.17
WTX.R297	30.0	14.13	104.0	37.88	3223.C	979.00537	-33.68	-143.65
WTX.R298	30.0	12.28	104.0	35.48	3330.0	979.00562	-20.95	-134.58
WTX.R299	30.0	11.92	104.0	35.70	3263.0	979.00879	-23.60	-134.94
WTX.R200	30.0	10.93	104.0	35.02	3522.C	978.98526	-17.61	-137.78
WTX.R201	30.0	10.97	104.0	35.47	3452.0	978.99463	-18.95	-136.73
WTX.R202	30.0	10.70	104.0	35.48	3499.C	978.99048	-18.17	-137.56
WTX.R203	30.0	12.30	104.0	34.93	3371.0	979.00464	-18.11	-133.14
TXRUI300	30.0	19.25	104.0	38.57	3891.0	978.97900	-4.08	-136.84
TXRUI301	30.0	20.75	104.0	38.73	4555.C	978.94165	18.98	-136.44
TXRUI302	30.0	21.05	104.0	38.65	4592.0	978.94092	21.52	-135.16
TXRUI303	30.0	21.73	104.0	39.50	4525.0	978.93652	9.86	-144.54
TXRUI304	30.0	21.05	104.0	39.33	4435.C	978.94067	6.56	-144.77
TXRUI305	30.0	19.78	104.0	40.05	3816.C	978.97510	-15.80	-146.01

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
TXRUI306	30.0	19.63	104.0	40.20	3719.0	578.98267	-17.16	-144.05
TXRUI307	30.0	20.23	104.0	41.17	3352.0	579.00903	-25.90	-140.27
TXRUI308	30.0	20.03	104.0	41.95	3167.0	579.01782	-32.39	-141.14
TXRUI310	30.0	19.80	4.0	41.73	3211.0	575.01660	-31.06	-140.63
TXRUI311	30.0	19.23	104.0	41.72	3232.0	579.01416	-30.73	-141.01
TXRUI312	30.0	18.33	104.0	40.65	3360.0	579.00513	-26.68	-141.33
TXRUI313	30.0	19.58	104.0	41.17	3332.0	579.01050	-25.49	-139.19
TXRUI314	30.0	20.45	104.0	41.65	3277.0	579.01416	-28.29	-140.11
TXRUI315	30.0	21.17	104.0	41.58	3420.0	575.00635	-23.56	-140.25
TXRUI316	30.0	21.42	104.0	42.08	3516.0	579.00073	-20.40	-140.37
TXRUI317	30.0	21.88	104.0	42.00	3582.0	578.99829	-17.20	-139.42
TXRUI318	30.0	22.28	104.0	42.45	3481.0	579.00488	-20.81	-139.59
TXRUI319	30.0	22.42	104.0	43.13	3496.0	579.00562	-18.80	-138.09
TXRUI320	30.0	22.07	104.0	43.48	3455.0	579.00854	-19.29	-137.18
TXRUI321	30.0	21.30	104.0	44.17	3344.0	579.01196	-25.24	-139.34
TXRUI322	30.0	20.60	104.0	44.50	3267.0	579.01489	-28.63	-140.10
TXRUI323	30.0	19.65	104.0	44.68	3129.0	575.02197	-33.29	-140.05
TXRUI324	30.0	15.27	104.0	43.37	2898.0	579.02710	-44.01	-142.89
TXRUI325	30.0	15.77	104.0	44.67	2941.0	579.02783	-39.97	-140.32
TXRUI326	30.0	16.68	104.0	45.42	2952.0	575.03027	-37.84	-138.56
TXRUI327	30.0	17.60	104.0	45.48	2939.0	579.03149	-38.89	-139.17
TXRUI328	30.0	18.17	104.0	45.27	3002.0	579.02856	-36.79	-139.22
TXRUI329	30.0	18.77	104.0	45.25	2968.0	579.03149	-37.66	-138.93
TXRUI330	30.0	19.65	104.0	46.70	3009.0	579.02832	-38.15	-140.83
TXRUI331	30.0	20.38	104.0	46.83	3071.0	575.02515	-36.44	-141.23
TXRUI333	30.0	22.20	104.0	48.83	2588.0	579.03540	-36.39	-138.34
TXRUI334	30.0	20.87	104.0	47.48	3088.0	579.02466	-36.12	-141.49
TXRUI335	30.0	21.50	104.0	46.17	3155.0	575.02100	-33.96	-141.75
TXRUI336	30.0	21.63	104.0	45.58	3158.0	579.02100	-34.09	-141.85
TXRUI337	30.0	21.97	104.0	45.43	3270.0	579.01538	-29.66	-141.23
TXRUI338	30.0	19.47	104.0	45.10	3003.0	579.02954	-37.39	-139.86
TXRUI339	30.0	19.48	104.0	44.32	3038.0	579.02808	-35.61	-139.27
TXRUI340	30.0	19.60	104.0	43.80	3062.0	575.02588	-35.70	-140.18
TXRUI341	30.0	3.35	104.0	34.13	3860.0	578.95093	-14.16	-145.87
TXRUI342	30.0	3.93	104.0	33.72	3580.0	578.94580	-8.84	-144.65
TXRUI343	30.0	3.20	104.0	33.63	4195.0	578.93091	-2.48	-145.62
TXRUI344	30.0	3.82	104.0	33.02	4170.0	578.93408	-2.42	-144.71
WTXPR345	29.0	34.15	104.0	20.68	2653.0	578.99512	-45.63	-136.15
WTXPR346	29.0	34.35	104.0	20.42	2661.0	578.99316	-47.09	-137.89
WTXPR347	29.0	34.60	104.0	19.88	2679.0	578.99609	-42.86	-134.27
WTXPR348	29.0	34.77	104.0	20.28	2694.0	578.99512	-42.71	-134.64
WTXPR349	29.0	35.07	104.0	20.13	2711.0	578.99463	-41.98	-134.49
WTXPR350	29.0	35.57	104.0	20.27	2765.0	578.99292	-39.21	-133.70
WTXPR351	29.0	36.83	104.0	19.72	2857.0	578.98682	-38.15	-135.63
WTXPR352	29.0	37.55	104.0	19.55	2922.0	578.98340	-36.36	-136.07
WTXPR353	29.0	37.58	104.0	19.07	2947.0	578.98340	-34.09	-134.64
WTXPR354	29.0	38.90	104.0	17.05	3255.0	578.97412	-16.22	-127.28
WTXPR355	29.0	39.17	104.0	16.63	3313.0	578.97461	-10.65	-123.70
WTXPR356	29.0	39.30	104.0	16.35	3352.0	578.97461	-7.15	-121.53
WTXPR357	29.0	38.83	104.0	16.10	3264.0	578.97778	-11.67	-123.04
WTXPR358	29.0	37.92	104.0	15.50	3092.0	578.98535	-18.97	-124.47
WTXPR359	29.0	39.53	104.0	15.42	3186.0	578.98364	-12.71	-121.42
WTXPR360	29.0	39.10	104.0	15.23	3257.0	578.98145	-8.93	-120.07
WTXPR361	29.0	39.68	104.0	15.68	3465.0	578.96875	-2.85	-121.08
WTXPR362	29.0	40.07	104.0	15.73	3478.0	578.96924	-1.66	-120.34
WTXPR363	29.0	41.13	104.0	15.53	3637.0	578.96436	7.18	-116.92

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
WTXPR364	29.0	41.65	104.0	15.68	3765.0	978.95728	11.34	-117.13
WTXPR365	29.0	41.82	104.0	15.48	3756.0	978.95850	11.47	-116.69
WTXPR366	29.0	40.08	104.0	16.35	3418.0	978.57363	-2.86	-119.49
WTXPR367	29.0	40.47	104.0	16.67	3467.0	978.97046	-1.83	-120.13
WTXPR368	29.0	41.13	104.0	17.10	3494.0	978.96997	-0.84	-120.06
WTXPR369	29.0	41.58	104.0	17.17	3674.0	978.95996	5.62	-119.74
WTXPR370	29.0	42.08	104.0	16.95	3761.0	978.95605	9.29	-119.04
WTXPR371	29.0	42.77	104.0	16.08	3868.0	978.95410	16.51	-115.47
WTXPR372	29.0	42.93	104.0	15.73	3892.0	978.95361	18.13	-114.67
WTXPR373	29.0	43.22	104.0	15.27	3950.0	978.95142	20.96	-113.82
WTXPR374	29.0	43.55	104.0	15.27	3954.0	978.95190	21.32	-113.60
WTXPR375	29.0	42.93	104.0	15.32	3936.0	978.95190	20.36	-113.94
WTXPR376	29.0	42.67	104.0	17.13	3742.0	978.95972	10.36	-117.32
WTXPR377	29.0	42.73	104.0	17.60	3660.0	978.97070	13.55	-111.33
WTXPR378	29.0	42.77	104.0	19.07	3187.0	978.99170	-10.02	-118.77
WTXPR379	29.0	41.75	104.0	19.65	3129.0	978.99023	-15.55	-122.32
WTXPR380	29.0	41.08	104.0	19.87	3086.0	978.98901	-20.01	-125.31
WTXPR381	29.0	40.60	104.0	17.88	3428.0	978.96851	-7.65	-124.62
WTXPR382	29.0	40.87	104.0	17.58	3469.0	978.96802	-4.78	-123.15
WTXPR383	29.0	39.93	104.0	17.85	3297.0	978.97510	-12.64	-125.14
WTXPR384	29.0	39.47	104.0	18.42	3195.0	978.97803	-18.63	-127.65
WTXPR385	29.0	38.77	104.0	18.95	3087.0	978.98120	-24.61	-129.94
WTXPR386	29.0	38.03	104.0	19.62	2968.0	978.98315	-33.02	-134.29
WTXPR387	29.0	38.38	104.0	20.00	2982.0	978.98315	-32.22	-133.97
WTXPR388	29.0	33.55	104.0	21.07	2604.0	978.99634	-48.21	-137.07
WTXPR389	29.0	33.37	104.0	20.58	2598.0	978.99707	-47.74	-136.39
WTXPR390	29.0	32.87	104.0	20.75	2594.0	978.99561	-49.18	-137.69
WTXPR391	29.0	32.80	104.0	21.52	2559.0	978.99756	-50.34	-137.66
WTXPR392	29.0	32.63	104.0	22.28	2562.0	978.99390	-53.47	-140.89
WTXPR393	29.0	32.93	104.0	22.67	2569.0	978.99609	-50.94	-138.60
WTXPR394	29.0	32.15	104.0	20.75	2556.0	978.99854	-48.78	-135.99
WTXPR395	29.0	32.50	104.0	19.68	2549.0	979.00073	-47.64	-134.61
WTXPR396	29.0	31.83	104.0	19.48	2547.0	979.00024	-47.42	-134.32
WTXPR397	29.0	31.33	104.0	17.08	2638.0	978.99463	-43.88	-133.90
WTXPR398	29.0	35.97	104.0	21.32	2722.0	978.99414	-41.51	-134.73
WTXPR399	29.0	39.12	104.0	22.75	3005.0	978.98267	-31.31	-133.84
WTXPR400	29.0	39.52	104.0	22.02	3054.0	978.98120	-28.72	-132.93
WTXPR401	29.0	41.15	104.0	20.42	2229.0	978.97998	-15.68	-125.85
WTXPR402	29.0	41.35	104.0	20.70	3219.0	978.97998	-16.80	-126.64
WTXPR403	29.0	41.87	104.0	20.38	3289.0	978.97827	-12.54	-124.77
WTXPR404	29.0	42.73	104.0	20.73	3424.0	978.97437	-5.10	-121.93
XPRE405	29.0	44.10	104.0	32.68	2691.0	978.99194	-58.20	-150.02
XPRE406	29.0	46.13	104.0	27.27	3325.0	978.97290	-20.25	-133.70
XPRE407	29.0	45.67	104.0	28.75	3035.0	978.97485	-44.92	-148.48
XPRE408	29.0	44.97	104.0	28.85	2935.0	978.97485	-53.35	-153.50
XPRE409	29.0	44.97	104.0	28.62	2943.0	978.97974	-47.78	-148.20
XPRE410	29.0	44.60	104.0	28.05	2977.0	978.97925	-44.47	-146.05
XPRE411	29.0	44.55	104.0	27.65	2979.0	978.98169	-41.82	-143.47
XPRE412	29.0	42.77	104.0	33.07	2625.0	978.99829	-56.31	-145.87
XPRE413	29.0	42.08	104.0	32.50	2618.0	978.99854	-55.83	-145.16
XPRE414	29.0	42.40	104.0	31.77	2732.0	978.99927	-44.76	-137.98
XPRE415	29.0	41.88	104.0	31.73	2645.0	978.99609	-55.51	-145.76
XPRE416	29.0	36.68	104.0	26.68	2607.0	978.99634	-51.95	-140.90
TXPRE417	29.0	37.57	104.0	21.50	2891.0	978.98584	-36.89	-135.54
TXPRE418	29.0	37.08	104.0	21.25	2859.0	978.98706	-38.11	-135.67
TXPRE419	29.0	34.75	104.0	23.28	2582.0	978.99756	-50.64	-138.78

STATION	LATITUDE		LONGITUDE		ELEV	OBSERVED	FREE AIR	BOUGUER
	DEG	MIN	DEG	MIN	FT	GRAVITY	ANOMALY	ANOMALY
TXPRE420	29.0	34.77	104.0	24.28	2568.0	978.99829	-51.31	-138.94
TXPRE421	29.0	34.80	104.0	24.82	2571.0	978.99829	-51.11	-138.84
TXPRE422	29.0	37.58	104.0	26.18	2672.0	978.99463	-48.77	-139.94
TXPRE423	29.0	37.95	104.0	25.75	2730.0	978.99365	-44.68	-137.83
TXPRE424	29.0	35.75	104.0	23.33	2652.0	978.99658	-46.36	-136.85
TXPRE425	29.0	36.23	104.0	23.00	2704.0	978.99561	-43.09	-135.35
TXPRE426	29.0	32.32	104.0	17.58	2671.0	978.99463	-41.99	-133.13
TXPRE427	29.0	32.92	104.0	17.22	2693.0	978.99341	-42.05	-133.94
TXPRE428	29.0	33.63	104.0	17.63	2717.0	978.99194	-42.12	-134.83
TXPRE429	29.0	33.18	104.0	18.60	2626.0	978.99878	-43.39	-133.00
TXPRE430	29.0	33.88	104.0	17.17	2736.0	978.99121	-41.47	-134.83
TXPRE431	29.0	34.15	104.0	16.57	2765.0	978.99072	-39.47	-133.81
TXPRE432	29.0	34.45	104.0	16.22	2785.0	978.99072	-37.90	-132.93
TXPRE433	29.0	34.00	104.0	16.65	2751.0	978.99072	-40.56	-134.43
TXPRE434	29.0	31.32	104.0	16.15	2557.0	979.00146	-44.68	-131.92
TXPRE435	29.0	32.67	104.0	15.58	2752.0	978.99023	-39.29	-133.19
TXPRE436	29.0	32.67	104.0	16.58	2620.0	978.99829	-43.57	-132.97
TXPRE437	29.0	31.17	104.0	15.82	2553.0	979.00058	-45.16	-132.28
TXPRE438	29.0	30.83	104.0	15.47	2650.0	978.99463	-42.17	-132.59
TXPRE439	29.0	30.83	104.0	15.12	2575.0	979.00000	-43.70	-131.57
TXPRE440	29.0	29.60	104.0	13.18	2558.0	978.99902	-44.77	-132.06
TXPRE441	29.0	29.18	104.0	12.52	2535.0	978.99976	-45.74	-132.24
TXPRE442	29.0	28.68	104.0	12.32	2530.0	978.99878	-46.58	-132.91
TXPRE443	29.0	28.17	104.0	12.25	2561.0	978.99658	-45.14	-132.53
TXPRE444	29.0	27.93	104.0	12.15	2560.0	978.99609	-45.35	-132.70
TXPRE445	29.0	27.15	104.0	11.55	2522.0	978.99780	-46.24	-132.30
TXPRE448	29.0	27.45	104.0	11.37	2563.0	978.99609	-44.60	-132.05
TXPRE449	29.0	27.45	104.0	10.07	2802.0	978.98291	-35.22	-130.83
TXPRE450	29.0	27.32	104.0	10.42	2713.0	978.98853	-37.85	-130.42
TXPRE451	29.0	28.17	104.0	10.63	2808.0	978.98340	-35.19	-131.00
TXPRE452	29.0	28.47	104.0	11.22	2706.0	978.98975	-38.76	-131.10
TXPRE453	29.0	28.10	104.0	10.07	3038.0	978.96875	-27.90	-131.56
TXPRE454	29.0	26.80	104.0	11.22	2518.0	978.99829	-45.62	-131.54
TXPRE455	29.0	26.08	104.0	11.02	2568.0	978.99292	-45.37	-132.99
TXPRE456	29.0	25.42	104.0	10.65	2529.0	978.99390	-47.16	-133.45
TXPRE457	29.0	24.89	104.0	10.37	2543.0	978.99170	-47.39	-134.16
TXPRE458	29.0	24.47	104.0	10.05	2494.0	978.99341	-49.72	-134.82
TXPRE459	29.0	24.15	104.0	9.63	2507.0	978.99194	-49.71	-135.26
TXPRE460	29.0	23.83	104.0	9.28	2531.0	978.98975	-49.14	-135.50
TXPRE461	29.0	23.63	104.0	8.90	2485.0	978.99414	-48.81	-133.61
TXPRE462	29.0	23.47	104.0	8.53	2496.0	978.99292	-48.75	-133.92
TXPRE463	29.0	23.25	104.0	7.98	2500.0	978.99268	-48.43	-133.73
TXPRE464	29.0	21.77	104.0	5.52	2493.0	978.99658	-43.37	-128.44
TXPRE465	29.0	21.10	104.0	4.58	2461.0	978.99585	-46.23	-130.20
TXPRE466	29.0	20.83	104.0	4.50	2454.0	978.99341	-48.86	-132.59
TXPRE467	29.0	20.47	104.0	3.85	2431.0	978.99487	-49.11	-132.06
TXPRE468	29.0	19.95	104.0	2.87	2458.0	978.99219	-44.97	-130.21
TXPRE469	29.0	19.79	104.0	1.88	2685.0	978.98145	-37.70	-129.32
TXPRE470	29.0	19.33	104.0	0.40	2685.0	978.98120	-37.46	-129.08
TXPRE485	29.0	42.87	104.0	21.82	3367.0	978.97339	-11.45	-127.19
TXPRE486	29.0	43.22	104.0	21.92	3420.0	978.97095	-9.45	-127.02
TXPRE487	29.0	43.30	104.0	22.33	3375.0	978.97314	-11.65	-127.68
TXPRE488	29.0	43.97	104.0	22.63	3473.0	978.96899	-7.38	-126.77
TXPRE489	29.0	43.55	104.0	22.88	3447.0	978.96973	-9.08	-127.58
TXPRE490	29.0	44.20	104.0	23.35	3385.0	978.97388	-11.06	-127.42
TXPRE491	29.0	44.55	104.0	23.15	3451.0	978.97192	-7.33	-125.97

STATION	LATITUDE DEG MIN	LONGITUDE DEG MIN	ELEV FT	OBSERVED GRAVITY	FREE AIR ANOMALY	BOUGUER ANOMALY
XPRES492	29.0 43.13	104.0 24.27	3250.0	578.97607	-20.20	-131.92
XPRES493	29.0 44.02	104.0 26.03	3182.0	578.97900	-24.80	-134.19
XPRES494	29.0 43.43	104.0 26.40	3092.0	578.97803	-33.35	-139.65
XPRES495	29.0 44.50	104.0 26.07	3225.0	578.97778	-22.47	-133.34
XPRES496	29.0 44.22	104.0 26.40	3167.0	578.97900	-26.49	-135.36
XPRES497	29.0 42.25	104.0 22.47	3270.0	578.97583	-17.49	-129.90
TXPRI502	30.0 17.23	104.0 0.80	4678.0	578.92505	18.68	-140.94
TXPRI503	30.0 16.50	104.0 1.10	4656.0	578.92773	20.25	-138.52
TXPRI504	30.0 15.90	104.0 1.70	4629.0	578.92773	18.44	-139.51
TXPRI505	30.0 15.40	104.0 2.00	4614.0	578.92822	18.17	-139.27
TXPRI506	30.0 14.30	104.0 2.60	4588.0	578.93091	19.98	-136.57
TXPRI507	30.0 14.00	104.0 2.80	4583.0	578.93213	21.12	-135.26
TXPRI508	30.0 12.80	104.0 3.40	4564.0	578.93335	22.02	-133.72
TXPRI509	30.0 10.50	104.0 4.20	4445.0	578.93237	12.99	-138.68
TXPRI510	30.0 9.70	104.0 4.50	4445.0	578.92993	11.59	-140.08
TXPRI511	30.0 8.00	104.0 6.20	4203.0	578.92310	-15.86	-159.28
TXPRI512	30.0 5.00	104.0 9.50	4737.0	578.90625	21.39	-140.24
TXPRI514	30.0 1.40	104.0 12.00	5142.0	578.85767	15.61	-159.84
TXPRI515	30.0 0.20	104.0 12.80	5021.0	578.87939	27.53	-143.79
TXPRI516	29.0 58.50	104.0 13.40	4975.0	578.88062	26.63	-143.12
TXPRI517	29.0 57.00	104.0 14.10	4733.0	578.89185	16.98	-144.52
TXPRI519	29.0 53.00	104.0 16.60	4398.0	578.91016	9.19	-140.87
TXPRI520	29.0 52.10	104.0 17.40	4399.0	578.91162	11.91	-138.19
TXPRI521	29.0 51.10	104.0 17.60	4199.0	578.92651	9.21	-134.07
TXPRI522	29.0 49.30	104.0 18.50	3843.0	578.95337	4.87	-126.26
TXPRI524	29.0 48.50	104.0 19.80	4151.0	578.93652	18.13	-123.51
TXPRI525	29.0 46.80	104.0 20.50	3918.0	578.95557	17.48	-116.21
TXPRI526	29.0 46.70	104.0 20.90	3870.0	578.95654	15.02	-117.03
TXPRI527	29.0 57.20	104.0 26.12	4925.0	578.87061	13.72	-154.33
TXPRI528	29.0 57.63	104.0 25.50	4890.0	578.87427	13.36	-153.50
TXPRI529	29.0 57.73	104.0 25.15	4860.0	578.87671	12.88	-152.95
TXPRI530	29.0 57.97	104.0 25.82	4890.0	578.87695	15.62	-151.24
TXPRI531	29.0 54.70	104.0 25.62	4785.0	578.87769	10.70	-152.57
TXPRI532	29.0 54.57	104.0 25.27	4568.0	578.88501	-2.15	-158.02
TXPRI533	29.0 55.50	104.0 23.68	4607.0	578.88330	-1.28	-158.48
TXRUI540	29.0 58.82	104.0 27.50	4915.0	578.88086	20.90	-146.80
TXRUI541	29.0 59.27	104.0 27.68	4785.0	578.89160	18.77	-144.50
TXRUI542	29.0 59.83	104.0 28.27	4620.0	578.90430	15.15	-142.49
TXRUI552	30.0 16.30	104.0 5.50	4715.0	578.91968	18.08	-142.83
TXRUI553	30.0 15.60	104.0 6.60	4692.0	578.91919	16.36	-143.74
TXRUI555	30.0 14.70	104.0 8.90	4644.0	578.91895	12.61	-145.85
TXRUI556	30.0 13.50	104.0 10.90	4811.0	578.90723	18.27	-145.89
TXRUI557	30.0 12.40	104.0 12.90	4565.0	578.89819	25.25	-144.16
TXRUI558	30.0 11.30	104.0 13.30	5035.0	578.89453	29.46	-142.34
TXRUI559	30.0 11.20	104.0 16.10	5174.0	578.88672	34.94	-141.60
TXRUI561	30.0 10.70	104.0 17.80	5308.0	578.87671	38.14	-142.98
TXRUI562	30.0 10.30	104.0 20.10	5551.0	578.85913	43.90	-145.51
TXRUI563	30.0 8.40	104.0 23.80	5902.0	578.83130	51.68	-149.70
TXRUI564	30.0 7.20	104.0 24.40	5719.0	578.84326	47.92	-147.22
TXRUI565	30.0 5.90	104.0 25.70	5386.0	578.86108	36.03	-147.75
TXRUI567	30.0 5.00	104.0 26.50	5368.0	578.86060	35.01	-148.15

APPENDIX C

WELL DATA COLLECTED
FOR PRESIDIO COUNTY

INDEX NUMBER	WELL NAME AND COMPANY	DATE COMPLETED ELEV SPUDDED TOTAL DEPTH	SOURCE	UNIT THICKNESS (in feet)
1	Gulf Oil Corp., #1 Trust Nat'l. Bank of Fort Worth	4-15-64 11,701	Kopp (1977)	
2	Stanolind Oil, Trust #1	8-15-45 3858 8111	Carlisle (1955)	Cret. 5770 Paleo. 2250 Granite 90+
3	N. B. Hunt #1 Toole Trust	7-14-53 3858 8111	Bilbrey (1957) Midland Sample Library	Alluvium 1610 Cret. 4160 Paleo. 2230 Granite 110+
4	Gulf Oil, #1 Swafford NCT-A	1-5-64 3456 8815	Kopp (1977) Midland Sample Library	Tert. Vol. 1455 Cret. 1100 U. Paleo. 5935 Camb-Ord. 320 Granite 5+
5	Gulf Oil Corp. Presidio Trust "3" #1	5-7-64 3239 6208	Kopp (1977)	
6	Gulf Oil Corp., #1 State School Board "LO"	9-13-65 9725	Kopp (1977) Tops picked by Dr. Hills	Bolson Fill 3200 Cret. 2970 Paleo. 3270+
7	Brite Fee #4	11- -38 5255	Carlisle (1955) Midland Sample Library	Tert. Vol. 1390 Cret. 3750+

8	Lewis W. Welch, #1 Jos. Espy	8-2-52 4746 7837	Carlisle (1955) Midland Sample Library	Tert. Vol. 3390 Cret. 1750 U. Paleo. 1130 Ord. 510 Camb. 490 Prec. 100+
9	Brite Fee #1	2-26-53 5156	Carlisle (1955)	Tert. Vol. 2410 Cret. 2746+
10	Sinclair Oil and Gas Co., #1 Evans	10-5-62 4673 9420	Kopp (1977) Midland Sample Library	Tert. Vol. 4780 Cret. 4640+
11	O. N. Beer Inc., #1 Robert R. York "OWDD"	6-1-66 4669 6903	Kopp (1977)	Tert. Vol. 4250 Cret. 0 Paleo. 2650+
12	Tucker Drlg. Co. Inc., #1 H. B. Holmes, Jr.	4-9-68 4744 6020	Kopp (1977)	Tert. Vol. 3960 Cret. 2060+
13	Phillips Pet. Corp. #1-C Mitchell	10-13-71 4550 8584	Petroleum Inf. Corp.	Tert. Vol. 4000 Cret./Paleo. 4585+
14	Gulf Oil Corp., #1 H. J. Hubbard	2-12-61 4587 10,132	Paleo. Lab., Midland (tops)	Tert. Vol. 3970 Cret. 0 Perm. 4040 Miss. 120 Dev. 230 Sil. 600 Ord. 1170

15	Sinclair Oil & Gas Co., #1 Allison	12-18-64 5100 6010	Williams and Lee Scouting Service, Inc.	Tert. Vol. 910 Cret./Paleo. 5100+
16	Socony Mobil Oil Co., Inc., #1 J. E. White & Sons	4-6-61 4596 4570	Geol. Inf. Center, Midland	Tert. Vol. 1445 Cret. 3120 Granite 5+
17	The Pure Oil Co., #1 J. F. Lane	6-24-61 4000 7908	Paleo. Lab., Midland	Tert. Vol. 3460 Cret. 360 Perm. 880 Dev. 70 Sil. 870 Ord. 1290+
18	El Paso Natural Gas Co., #1 Simpson	1-29-72 4917 12,017	Kopp (1977)	Tert. Vol. 2610 Cret. 1540 Perm. 6655 Penn. 365 Miss. 110 Sil./Dev. 735+
19	Gulf Oil Corp., Arco-Mitchell #1	1-9-47 5338 15,996	Carlisle (1955) Midland Sample Library	Tert. Vol. 2250 Cret. 680 Perm. 9700 Miss. 810 Dev. 385 Ord. 1410+
20	Exxon Corp., #1 J. P. Kennedy	9-12-74 19,739	Geol. Inf. Center, Midland	

21	Pan Amer. Pet. Corp., #1 Moody-Hutchings	9-25-62 9256	Kopp (1977)	
22	Atlantic Richfield, #1 Presidio State	11-19-76 8500	Kopp (1977)	Bolson Fill 3385 Cret. 4595 Perm. 520+
23	Linderman Bros. Oil Corp., #1 Bledsoe	507	Kopp (1977)	
24	Linderman Bros. Oil Corp., #1 Bledsoe & Bagley	3312	Kopp (1977)	
25	Wesley W. West, #1 Presidio Trust	11-7-48 2870 8002	Zinn (1935)	Bolson Fill 3225 Cret. 4780+
26	Wesley W. West and Cockburn, #1 Presidio Trust	5-4-50 3469 8774	Zinn (1953)	Bolson Fill 3460 Cret. 5320+
27	Wesley W. West, #1 R. I. Beldsoe	2-11-54 2738 12,499	Geol. Inf. Center, Midland	
28	E. W. Hazelwood/ H. C. Lasley, #1 T. L. Davis	7-1-56 2200	Kopp (1977)	Bolson Fill 1100 Anydrite 1100
29	Fairway Oil & Gas Co., Inc., #1 S. W. Birdsal	4-10-67 3761 6571	Kopp (1977)	Cret. 1500 Paleo. 5020

30	Gulf Oil Corp., CT-1 State Nat'l. Bank of El Paso	3297	Petroleum Inf. Corp., Midland	
31	Phillips Petroleum Co., Tootle #1	4732	Billbrey (1957)	Alluvium 30 Cret. 4700
32	Texas and Pacific Coal, Bagle #1	4665 4290	Carlisle (1955)	Tert. Vol. 2280 Cret. 450 Perm. 1560+
33	Lewis W. Welch, #1 Brite	2-26-53 5058 6135	Carlisle (1955) Midland Sample Library	Tert. Vol. 3170 Cret. 820 U. Paleo. 740 Ord. 1270 Camb. 135+
34	Wilcox-Presidio, Corning #1	4300 8523	Carlisle (1955)	Tert. Vol. 2270
35	Killam Deep Test	8370	Woodward (1954)	Alluvium 587 Tert. Vol. 5970 Cret. 1800

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