**PRELIMINARY STUDY OF URANIUM
FAVORABILITY OF THE WILCOX
AND CLAIBORNE GROUPS (EOCENE)
IN TEXAS**

BENDIX FIELD ENGINEERING CORPORATION

Grand Junction Operations
Grand Junction, Colorado 81501

January 1978

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W. P. Wilbert and C. J. Templain

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SUMMARY

Rocks of the Wilcox and Claiborne Groups crop out in the Texas Gulf Coastal Plain and are represented by a series of sands and shales which reflect oscillation of the strandline. The Wilcox Group (lower Eocene), usually undifferentiated in Texas, consists of very fine sands and clays and abundant lignite. The Claiborne Group (middle Eocene) comprises, in ascending order, Carrizo Sand, Reklaw Formation (clay), Queen City Sand, Weches Formation (clay), Sparta Sand, Cook Mountain Formation (clay), and Yegua Formation (sand).

Fluvial systems of the Wilcox and Claiborne Groups exist in east Texas and trend perpendicular to the present coastline. In central Texas, sand bodies are parallel to the present coastline and are strand-plain, barrier-bar systems. Since the time of deposition of the Queen City Sand, a significant fluvial sand buildup occurred in the area of the present Rio Grande embayment where the marine clays pinch out.

Known occurrences of mineral matter in the Wilcox and Claiborne (up to the Yegua) are limited to lignite (particularly in the Wilcox), cannel coal in the upper Claiborne, and hydrocarbons throughout. No uranium mineralization is known, and no uranium is likely to be discovered in the Claiborne and Wilcox. Approximately 50 surface samples and many gamma-ray logs showed no significant anomalies. The sands are very good potential host rocks, but no uranium source was discovered. During deposition of the Wilcox and Claiborne Groups, there was no volcanism to serve as a source of uranium (as with the prolific occurrences in the younger rocks of south Texas); also, Precambrian crystalline rocks in the Llano uplift were not exposed.

INTRODUCTION

This report presents the results of a preliminary study of the uranium favorability of lower and middle Eocene rocks in the Wilcox and Claiborne Groups in the Texas Gulf Coastal Plain. The project began October 1, 1976, and was completed March 1, 1977, by personnel of Bendix Field Engineering Corporation (BFEC) under the auspices of the U.S. Energy Research and Development Administration (ERDA).

PURPOSE

The purpose of this project was to determine (1) whether the area under investigation is sufficiently favorable for the occurrence of commercially significant concentrations of uranium to warrant further investigation, and (2) if it is, what methods can best be employed to further evaluate the area.

AREA INVESTIGATED

Rocks of the Wilcox and Claiborne Groups (Eocene) crop out in areas covered in the Laredo, Crystal City, San Antonio, Seguin, Austin, Waco, Palestine, Dallas, Tyler, and Texarkana 2° quadrangles (Bureau of Economic Geology). The project area extends downdip to the approximate position of the -5,000 ft msl structure contour on the top of the Claiborne Group; some regions shown on the McAllen, Corpus Christi, Beeville, Houston, and Beaumont quadrangles are included in the project area (Fig. 1). The entire project area includes parts or all of 91 counties and encompasses about 200,000 sq mi.

PROCEDURES

Relevant literature and maps were reviewed. Outcrop samples (Pl. 1) were collected and analyzed by BFEC for both fixed and leachable U_3O_8 ; these values are listed in Appendix A and are graphically shown by stratigraphic unit in Figure 2. Available logs of radioactivity were examined; anomalies are listed in Appendix B. Samples that showed anomalously high uranium content were analyzed for pathfinder elements. Also, several thin sections were prepared and examined. Selected clay samples were examined by x-ray diffraction.

Data for subsurface sand maps were taken from Fischer and McGowen (1967), Jones and others (1976), and Payne (1968, 1972, 1975). The maps are based on loose well spacing (approximately one well for every 5 sq mi). Only the stratigraphic units that are mainly sand were mapped by these authors. An arbitrary depth limit of -5,000 ft msl was used in the subsurface mapping. Surface samples were collected from all units, but mostly from the more sandy units.

Figure 1. Index map.

FORMATION	1	2	3	4	5	6	7	8	
Cook Mountain			3.0	(1)					CLAIBORNE
Sparta & Laredo		1.5	(9)						
Weches & El Pico			2.7	(1)					
¹ Queen City & Bigford				4.2	(12)				
Reklaw		1.75	(4)						
Carrizo			1.8	(12)					
² Simsboro (Wilcox)						6.3	(3)		WILCOX
Wilcox (undiff.) & Indio			1.86	(7)					

Mean ppm U_3O_8 (number of samples in parentheses)

¹ If one anomalously high Queen City sample is ignored, mean total U_3O_8 is 2.27.

² If one anomalously high Simsboro sample is ignored, mean total U_3O_8 is 1.0.

Figure 2. Average cU_3O_8 content of surface samples.

GEOLOGY

GEOLOGIC HISTORY

Geologic history of the Gulf Coastal Plain has been reviewed by numerous authors. Detailed tectonic studies by Bornhauser (1958) and a regional compilation by Murray (1961) are the most comprehensive. The sediments of the Wilcox and Claiborne Groups (Eocene) represent several cycles of transgression and regression (Lowman, 1949). Coarser clastic sediments (sands) were deposited during the regressions and are generally of continental origin. These progradational sand units are separated by marine clay. The clay/sand cyclicity of the lithologies of the stratigraphic units are described in Table 1. Volcanic rocks and shallow intrusions along the Balcones fault zone are of Cretaceous and earliest Tertiary age. Volcanism apparently ceased near the beginning of Wilcox deposition and began again near the end of Claiborne deposition to continue through the Miocene Epoch and act as a source for uranium deposits in south Texas (Eargle and others, 1975). The source of the later volcanism is believed by most workers to have been in West Texas and (or) northern Mexico (W. E. Galloway, 1976, personal communi.).

There are few lithologically pure rocks in either the Wilcox or the Claiborne. Most sands contain some clay, and most clays contain minor amounts of sand and silt.

STRUCTURE

Major structural features of the Texas Gulf Coastal Plain are shown on Figure 1. Rocks that crop out in the coastal plain generally dip homoclinally coastward less than 1° . The East Texas and Rio Grande embayments are separated by the San Marcos arch, which trends southeastward from the Llano uplift through Guadalupe and Caldwell Counties. Presence of the embayments and the arch have affected lithologies and thicknesses of sediments.

Sedimentary units are generally thicker in the embayments. Thickening is especially evident in Cretaceous rocks, and Tertiary rocks are less affected. The embayments and the Sabine uplift at the eastern edge of the project area predate the Wilcox and Claiborne strata, although the Sabine uplift may have been rejuvenated during the Tertiary Period. Large areas of Precambrian crystalline rocks are exposed on the Llano uplift, about 70 mi northwest of Austin, but there is no evidence that the crystalline rocks were exposed prior to Miocene time, when there was major movement along the Balcones fault zone (Young, 1962, p. 104). Thus, the Precambrian rocks were not a source for the clastic sediments in the Wilcox and Claiborne Groups.

The project area is transected by numerous faults. The faults are mostly normal, down-to-the-coast, growth faults that form hydrocarbon traps and disrupt the ground-water flow. They are generally aligned parallel to the present coastline, except in Anderson and the surrounding counties where they are associated with salt domes in the East Texas salt basin. Few of these faults are exposed at the surface; they are recognized, in most cases, by loss of section in the many hydrocarbon and water wells and, in a few cases, by disruption of vegetation belts.

TABLE 1. STRATIGRAPHIC COLUMN AND LITHOLOGIC DESCRIPTIONS OF THE CLAIBORNE AND WILCOX GROUPS (Descriptions and thicknesses based on section exposed in central Texas and augmented where necessary; adapted from Bur. Econ. Geology Geol. Atlas of Texas sheets)

Group	Formation	Lithology and thickness
CLAIBORNE	Yegua	Sandstone, clay, and lignite, 750-1,000 ft thick (not studied in this project).
	Cook Mountain	Mostly clay, variably glauconitic and (or) sandy, small concretions common, marine megafossils and microfossils abundant; near Brazos River, a very richly fossiliferous glauconite tongue is called the Stone City Formation; thickness of Cook Mountain near Austin is 200-300 ft thick.
	Sparta	Quartz sand, very fine- to fine-grained, well sorted, micaceous; silty clay partings; locally carbonaceous, laminated; 150-200 ft thick.
	Weches	Clay and sand, in part marly; quartz sand common; interbedded silty glauconitic clay; brown to dark green, weathers red; locally forms layers of ironstone; marine megafossils and microfossils abundant; approximately 50 ft thick.
	Queen City	Fine-grained quartz sand, locally carbonaceous; thin interbeds of sandy, glauconitic clay; outcrops usually show prominent cross-bedding; weathers red and white mottled; approximately 200 ft thick.
	Reklaw	Clay and sand, glauconitic, carbonaceous in upper part; ironstone lentils and marine megafossils in east Texas; muscovite in Gregg County; 35 ft thick near Louisiana boundary but thickens slightly to southwest and is 80 ft thick south in Austin; in the Rio Grande embayment, merges with Bigford Formation a terrigenous sand and silt.
	Carrizo	Sandstone, fine to coarse grained, poorly sorted, friable, noncalcareous, thickly bedded to cross-bedded; contains carbonaceous trash; 100 ft thick; forms ridges (particularly in East Texas) covered with oak; pinches out near the boundary between Morris and Titus Counties.

TABLE 1 (continued)

Group	Formation	Lithology and thickness
WILCOX	(usually undifferentiated)	<p>Sandstone and mudstone, brown to yellowish-brown, locally lignitic and cross-bedded; sandstone, both lenticular and in thin beds, very fine- to medium-grained sand, moderately well sorted, undivided in most places; divided in places north of Colorado River into Hooper clay, Simsboro sand, Calvert Bluff clay, in ascending order; Simsboro, where recognized, is mostly sand with some mudstone and mudstone conglomerate, fine to coarse grained, generally well sorted and cross-bedded; Calvert Bluff contains most commercial lignite deposits (Kaiser, 1974); entire group is about 2,000 ft thick in the Austin area; maintains comparable thickness to the east (within Texas) and has abundant carbonaceous trash and some marine megafossils; called the Indio Formation in Rio Grande embayment where it is fine-grained sand, shale, siltstone, and lignite and 440 ft thick; the Simsboro, which pinches out in Freestone County (Bur. Econ. Geology, 1968), is as much as 300 ft thick.</p>

Jurassic salt is thick enough to have formed domes only in the East Texas salt basin, where piercement of the Wilcox and Claiborne strata is common (Pl. 2). Salt tectonics are not important elsewhere in the project area.

The Sabine uplift is present at the eastern margin of the project area (Fig. 1). Basement rocks are located in this area at shallow depths as indicated by well data in eastern Texas and southern Arkansas and by regional gravity maxima. The uplift appears to have been a positive feature since late Paleozoic time, although it was intermittently inundated during the Mesozoic and Cenozoic Eras (Murray, 1961). There is little topographic expression of the uplift; it is marked by an inlier of Wilcox strata, mostly in Panola County (Pl. 1).

STRATIGRAPHY

The stratigraphic nomenclature used in outcrop mapping by the Texas Bureau of Economic Geology is shown on Figure 3 and is used in this report. Characteristic electric log (E-log) curves of the same units in the subsurface are shown on Figure 4 for the section northeast and southeast of the San Marcos arch.

Wilcox Group

The Wilcox Group represents deposition during the first major cycle of alluviation and delta formation in the Gulf province (Lowman, 1949, p. 1987). The Wilcox sands are divided downdip by a wedge of marine shale into a lower sand, a middle shale, and an upper sand. Structure contours on the top of the Wilcox Group are shown on Plate 2. Depositional systems of the lower Wilcox have been studied, mainly in the subsurface, using E-logs by Fisher and McGowen (1967). Their net-sand map, which is reproduced here as Plate 3, shows an extensive fluvial-deltaic system northeast of the San Marcos arch, and lagoons and barrier bars southeast of the arch. The middle Wilcox shale is continuous along strike (Jones and others, 1976), but it does not crop out. Thus the term "Wilcox undivided" is usually used for describing rocks at and near the outcrop.

The upper Wilcox is a fluvial-deltaic sand that differs from the lower Wilcox in detail only. The upper Wilcox has been less studied than the lower Wilcox. Net-sand isoliths (Pl. 4) show that the thickest sands are southwest of the San Marcos arch.

The Wilcox Group on outcrop thickens northeastward from about 500 ft in Zavala County, near the Rio Grande, to 3,000 ft in Milam County. From Milam County northeastward, it thins to about 2,000 ft in Nacogdoches County (Jones and others, 1976). Southeastward (downdip), the group thickens to more than 5,000 ft at the downdip limit of the project area. This thickening is evidenced (1) by normal thickening into the Gulf basin and (2) by inclusion of the middle Wilcox marine shale wedge. A similar pattern is present in all sands of the Claiborne Group.

Figure 3. Stratigraphic nomenclature used by Texas Bureau of Economic Geology in outcrop mapping.

NOTE: Different depth & electrical scales on each well.

Figure 4. Typical electrical characteristics of subsurface units (Poth well modified after Eargle, 1968; Bastrop County oil well modified after Follett, 1970).

Carrizo Sand

The Carrizo Sand is a massive to cross-bedded quartzose sand. It is one of the most prolific aquifers of the Gulf Coastal Plain and is also one of the most lithologically consistent units in the Claiborne Group. It consists of 80 to 100 percent sand-sized particles. It can be traced for several hundred miles from a feather edge north of the Sabine uplift southwest into the Rio Grande embayment, where it is more than 1,000 ft thick on outcrop (Pl. 6), thence across the Rio Grande (Eargle, 1968, p. D7) with little lithologic change. Structure contours on the top of the Carrizo are shown on Plate 5. The Carrizo can be traced 40 to 50 mi downdip from the outcrop. The authors believe the thick sands in south Texas, shown on Plate 8, are longshore bars. Sand, thick in other units in south Texas, trends perpendicular to the coast and is believed to represent fluvial-deltaic systems. Guevara and Garcia (1972) interpreted some sands in the Queen City Formation to be longshore bars downcoast from fluvial-deltaic sediments in east Texas; the coastline-parallel thick sands in the Carrizo Formation are analogous to the Queen City sands.

There is a fairly well-developed fluvial-deltaic system in northeast Texas that centers around Leon County. It consists of thin carbonaceous clays (probably representing interdistributary bays) interbedded with extensive channel facies (Pls. 7, 8). Sands of the channel facies also contain some carbonaceous trash. The trash has apparently been leached from the outcrop because none was observed.

An interval of erosion may have occurred after deposition of the Wilcox and before deposition of the Carrizo. The basal Carrizo contains small chert gravel and quartz sand in Bastrop County (site of surface samples MAC-027 and MAC-028; Pl. 1; App. A). Eargle (1968) traced the Carrizo-Wilcox unconformity through Texas from the Carrizo pinchout in east Texas to the Rio Grande and beyond. However, downdip the Carrizo cannot be distinguished from the Wilcox. In this report, the Carrizo is considered to be the basal unit of the Claiborne Group, as it is in most of the literature (Murray, 1961).

Average outcrop thickness of the Carrizo in the Freestone County area is 95 ft (Guyton and others, 1972). Southwestward to Bastrop County, it thickens to 250 ft and to a maximum of about 300 ft near its type locality near Carrizo Springs in Dimmit County.

On outcrop, the Carrizo is easily distinguished from the underlying Wilcox by red oxidation of iron minerals in the Carrizo. The red coloration, in fact, is a characteristic of all sands of the Claiborne Group.

Reklaw Formation

The Reklaw Formation is dominantly marine clay that is glauconitic in many places (Pl. 9). Although dominantly clay, it contains lenses of sand as much as 175 ft thick (Pl. 12) in the subsurface near the Wilson-Karnes county line (Pls. 10, 11).

Southwestward along strike, the clayey lithology and marine character of the Reklaw persist to about the Frio River in Frio County. Southwest from there, the clays are thinner and interfinger with sands (Eargle, 1968, p. D10). In the Rio Grande embayment, the marine clay of the Reklaw wedges into the fluvial sands of the Bigford Formation.

Thickness of the Reklaw on the outcrop ranges from 30 to 130 ft in eastern Texas, from 30 to 300 ft in Wilson County, and from 600 to 800 ft downdip in Webb County. Here, the Reklaw and the overlying Queen City Sand are mapped as the Bigford Formation (Bur. Econ. Geology, 1976).

Queen City Sand

The Queen City Sand is a sandy, sparsely fossiliferous section between the Reklaw and the Weches (Table 1). According to Calendar (1957), the Queen City, in central Texas, contains the same metamorphic suite as the Carrizo but is less abundant.

The isopach map (Pl. 13) shows the maximum thickness of the Queen City Sand to be in extreme southwest Texas. Depositional systems of the Queen City were studied by Guevara and Garcia (1972). Their sand isolith map (1972, Figs. 12a, 12b) reflects a sand dispersal pattern similar to that shown in the Wilcox by Fisher and McGowen (1967), with the exception that a major buildup of sand for the Queen City was deposited by the paleo-Rio Grande in extreme southwest Texas. This sand buildup in Zavala and Webb Counties is also reflected in Payne's (1972) sand percentage map, reproduced here as Plate 14. Plate 15 shows the trend and maximum thickness of Queen City Sand units. As a result of the sand buildup in southwest Texas, the strand-plain, barrier-bar facies of the Queen City is restricted to central Texas (Guevara and Garcia, 1972), basically near the crest of and on either side of the San Marcos arch.

Fluvial-deltaic sands in the Queen City reflect the earliest sand deposition of the paleo-Rio Grande river system. The influence of the paleo-Rio Grande may be seen on sand percentage maps of the Queen City and subsequent Claiborne units. The influx of sand reflects uplift in central Arizona and New Mexico. Volcaniclastics did not appear in Texas sediments until late Eocene time (Jackson Group).

Weches Formation

In Texas, the Weches Formation is a thin marine unit. It is composed mostly of clay with some siltstones and is characterized throughout Texas by much glauconite. Locally in outcrop, the Weches contains some sandy lenses but not as much as the Reklaw Formation. Most outcrops east of the San Marcos arch contain marine fossils, dominantly mollusks. Plate 16 shows that no salt diapirism affects the Weches Formation.

The Weches thickens to the southwest from about 50 ft in Cherokee County (Guyton and others, 1972) to about 100 ft in Bastrop County (Follett, 1970). At the east margin of the Rio Grande embayment, the formation becomes

gypsiferous and carbonaceous. Southwest of the Frio River, the Weches is generally nonmarine and cannot be distinguished from the Queen City on well logs because the two formations merge laterally into the El Pico Clay (Eargle, 1968). In Dimmitt County, the El Pico Clay is 700 ft thick, and it thickens toward the Rio Grande to a reported thickness of more than 1,100 ft (Eargle, 1968). Six cannel coal mines are near the contact between the El Pico and Bigford in Webb County just north of Laredo. Sands in the El Pico are rare and thin.

Sparta Sand

The Sparta Sand in the subsurface is one of the most easily recognized units in the Claiborne Group (Eargle, 1968). On outcrop, the Sparta is easily mistaken for the Queen City or Carrizo, and it is virtually identical to other Claiborne sands in terms of petrography and sedimentary structures. The Sparta Sand is quartzose, hematitic, and commonly cross-bedded.

In east Texas, the Sparta consists mostly of very fine- to fine-grained quartz sand, clay, and silty clay that contains some lignite beds (Guyton and others, 1972). In central Texas it consists of fine- to medium-grained, loose to lightly cemented stratified sand beds that are separated by thin layers of clay and silt (Follett, 1970).

The Sparta thins southwestward across the state, from about 325 ft in deltaic(?) lobes in southern Cherokee County to 200 ft in Lee County and to less than 100 ft in Webb County (Pl. 17). In southern Webb County and southward, the upper part of the Claiborne Group (Laredo Formation) is mostly sand. This increased sand content reflects the increasing dominance of the paleo-Rio Grande depositional system (Pl. 18).

The Sparta can be traced on E-logs as far as the Rio Grande (J. V. Quick, 1976, personal commun.), and Payne (1968) has mapped it. However, the clayey Cook Mountain Formation above the Sparta begins to reflect paleo-Rio Grande drainage and picks up sand and lignite. This formation is called the Laredo by the Texas Bureau of Economic Geology on its Laredo (1976) and Crystal City-Eagle Pass sheets (1977). Thick sands in the Sparta Formation in east Texas (Pl. 19) reflect fluvial-deltaic conditions similar to those in the Wilcox Group.

Cook Mountain Formation

The Cook Mountain Formation consists mostly of marine clay with a few beds of very fine sand (Eargle, 1968, p. D21). It is from 125 to 450 ft thick across the state. The Laredo is formed southwest of where the Cook Mountain Formation interfingers with the Sparta. Although it was deposited nearshore, as evidenced by highly glauconitic sands (Eargle, 1968), the Cook Mountain retains its marine character.

The Cook Mountain does not crop out throughout most of Texas. Where it does crop out, it is one of the most distinctive units in the Claiborne Group; it is buff to brown and resembles the marine clays of the Wilcox. The Cook Mountain Formation is overlain by the sandy and lignitic Yegua Formation.

URANIUM FAVORABILITY

Although suitable uranium host rocks exist at many places in the Wilcox and Claiborne Groups in Texas, there is no uranium source rock. In addition, there is no known uranium mineralization in the Wilcox or Claiborne Groups. Grutt (1972) has shown that tuffaceous sediments are often present in the section above the host sandstone or in the host rock itself. No such tuffaceous beds were found in the Wilcox and Claiborne section. G. D. Stanton (1976, personal commun.) noted small but measurable amounts of volcanic rock fragments in the lower Wilcox in Karnes County (subsurface). However, no sanidine, shards, or high-temperature mineralogic polymorphs were noted. Folk (1961) reported some evidence of volcanic material in the Wilcox and the Queen City. A possible volcanic source for the Wilcox is indicated by subhexagonal biotite, sphene, and apatite. Evidence for a possible volcanic source for the Queen City is the presence of subhexagonal biotite and apatite. However, this mineralogic suite does not preclude a plutonic source. Recent in-depth studies (Kaiser, 1974; Jones and others, 1976; Fisher and McGowen, 1967) of the Wilcox Group in Texas do not mention volcanism.

No evidence of volcanism contemporaneous with Wilcox or Claiborne sedimentation was detected during this study. Modal analysis of a sample representative of the Wilcox sandstone (Table 2) showed that most minerals could have had a plutonic or a sedimentary source. Thin-section studies and photomicrographs of several samples from the Wilcox did not reveal any sign of volcanic rocks, although the interstitial clay matrix comprises a fairly high percentage of the rock and could obscure some grains. The samples contain many unidentifiable rock fragments.

Past industry activity in the Wilcox and Claiborne Groups has failed to produce any reported uranium shows. However, there have been many exploration test wells.

Several surface samples of the undivided Wilcox and the prominent Simshoro sand in Falls and Limestone Counties contain abundant lignitic material. Uranium assay of these samples, however, showed an average of only 1.0 ppm uranium.

Twenty-eight gamma-ray logs (App. C) showed anomalies of at least 2X background. These are all minor and most are less than 3X background. No definite 5X background anomalies, an arbitrary cutoff point used by Grutt (1972), are known.

CONCLUSIONS

In summary, many units of the Wilcox and Claiborne Groups in Texas seem to be excellent host rocks for uranium. However, no source of uranium is known.

A few radioactivity anomalies appear on gamma-ray logs, but all are of low magnitude and indicate small anomalies at the same horizon. No outcrop samples contained anomalous amounts of uranium.

TABLE 2. MODAL ANALYSIS OF SAMPLE MAC-191 (QUARTZ WACKE)* FROM THE WILCOX UNDIFFERENTIATED, SELBY COUNTY (LAB NO. 21896)

Mineral or component	Estimated percent
Clay matrix	44
Quartz	37
Chert	7
Clay clasts	5
Metamorphic rock fragments	3
Muscovite	1
K-feldspar	1
Opaque minerals	1
Plagioclase	tr
Tourmaline ^b	tr

*Quartz wacke as defined by Williams and others, 1954.

None of the sediments contain a significant percentage of volcanic material, which is generally believed to be the source of uranium in sedimentary deposits. More important perhaps, favorable loci for deposits, such as lignitic concentrations, are barren in the Claiborne and Wilcox Groups. Lignite samples from the Wilcox Group should be periodically checked for anomalous radioactivity and the occurrence of uranium minerals.

Mapping of sand trends in the Cook Mountain - Laredo - Sparta interval in the Rio Grande embayment was beyond the scope of a preliminary investigation, but it could be fruitful for the uranium prospector.

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APPENDIX A

TOTAL AND EXTRACTABLE U_3O_8 ANALYTICAL
DATA FROM SURFACE SAMPLES

APPENDIX A. TOTAL AND EXTRACTABLE U₃O₈ ANALYTICAL DATA FROM SURFACE SAMPLES

Sample no.		Stratigraphic unit	County	Total U ₃ O ₈ (ppm)	Extractable U ₃ O ₈ (ppm)
Field (Pl. 2)	Lab				
MAC 027	20502	Carrizo	Bastrop	3	1*
028	20503	Carrizo	Bastrop	1	1*
029	20504	Reklaw	Bastrop	1	1*
030	20505	Queen City	Bastrop	6	2*
031	20506	Queen City	Bastrop	4	1*
033	20508	El Pico	Frio	3	3**
034	20509	El Pico	Frio	2	----
035	20510	El Pico	Dimmit	3	2**
036	20511	Bigford	Dimmit	2	----
037	20512	Laredo	Webb	3	----
038	20513	Laredo	Webb	2	----
039	20514	Laredo	LaSalle	2	----
040	20515	El Pico	Dimmit	5	3**
041	20516	Laredo	Dimmit	1	----
042	20517	Laredo	Frio	1	----
043	20518	Carrizo	Frio	1	----
044	20519	Carrizo	Zavala	2	----
045	20520	Indio (Wilcox Group)	Uvalde	1	----
046	20521	Wilcox Group	Medina	2	----
047	20522	Wilcox Group	Medina	1	----
048	20523	Wilcox Group	Medina	2	----
049	20524	Carrizo	Medina	1	----
050	20525	Carrizo	Medina	2	----
176	20526	Reklaw	Frio	1	----
177	20527	Queen City	Frio	1	----
178	20528	Carrizo	Bexar	4	2**
179	20529	Carrizo	Bexar	3	1**
180	20530	Cook Mtn.	Atascosa	3	3**
181	20531	Queen City	Wilson	3	1**
182	20532	Reklaw	Wilson	4	2**
183	21888	Carrizo	Bastrop	2	----
184	21889	Weches	Lee	2	----
185	21890	Simsboro (Wilcox)	Limestone	17	10**
186	21891	Simsboro (Wilcox)	Limestone	1	----
187	21892	Carrizo	Leon	1	----
188	21893	Queen City	Leon	1	----
189	21894	Sparta	Leon	2	----
190	21895	Sparta	Leon	1	----
191	21896	Wilcox Group	Shelby	3	----
192	21897	Wilcox Group	Shelby	2	----
193	21898	Wilcox Group	Shelby	2	----
194	21899	Carrizo	Rusk	1	----
195	21900	Queen City	Upshur	25	24**

APPENDIX A (continued)

Sample no.		Stratigraphic unit	County	Total U ₃ O ₈ (ppm)	Extractable U ₃ O ₈ (ppm)
Field (Pl. 2)	Lab				
MAC 196	21901	Weches	Wood	2	----
197	21902	Queen City	Wood	3	----
198	21903	Queen City	Wood	2	----
199	21904	Queen City	Wood	1	----
200	21905	Queen City	Henderson	1	----
MAI 501	21906	Sparta	Anderson	<1	----
502	21907	Sparta	Anderson	1	----
503	21908	Weches	Anderson	2	----
504	21909	Queen City or Reklaw	Freestone	1	----
505	21910	Carrizo	Freestone	<1	----
506	21911	Simsboro	Falls	1	----
(Wilcox Group)					

---- = Extractable U₃O₈ not determined

* = Cold extractable

** = Extractable in hot 4N HNO₃

NOTES:

1. Sample MAI-504 (21909) was used in computing averages of both Queen City and Reklaw Formations for Figure 2.

2. Resampling of MAC-185 (21890) and MAC-195 (21900) showed no U₃O₈ anomaly. Values shown in this appendix may be contaminated, MAC-185 by pesticides and MAC-195 by hydrocarbons.

APPENDIX B

PATHFINDER ELEMENT ANALYSES
OF ANOMALOUS SAMPLES

APPENDIX B. PATHFINDER ELEMENT ANALYSES OF ANOMALOUS SAMPLES

Sample no.		Stratigraphic unit	County	Total U ₃ O ₈	Extractable U ₃ O ₈	V ₂ O ₅	Se	Mo	As	Pb
Field	Lab			(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
MAC 185	21890	Simsboro	Limestone	17	10	123	1	1	248	46
MAC 195	21900	Queen City	Upshur	25	24	89	1	1	0	79

APPENDIX C
GAMMA-RAY LOGS
WITH ANOMALOUS RADIOACTIVITY
FROM CLAIBORNE OR WILCOX STRATA

APPENDIX C. GAMMA-RAY LOGS WITH ANOMALOUS RADIOACTIVITY (AT LEAST 2X BACKGROUND)
FROM CLAIBORNE OR WILCOX STRATA

Location no. (Pl. 1)	Well name	Field	County	Log depth (ft)	Lithology	Stratigraphic interval
1	Chevron, #1 Mary Withers	Nevis	Anderson	2,842-2,863	shale	Wx?
2	J.E. Anderson #1 Leary	Salt Flat	Caldwell	770-785	-	Wx
3	Colorado Oil #11 Cora Malone	Salt Flat	Caldwell	160-165 168-180 960-970	sand sand shale	Wx Wx Wx
4	Colorado Oil #15 Merriweather	Salt Flat	Caldwell	705-710	shale	Wx
5	Ellang Oil #1 Dunlap	Dunlap	Caldwell	200-225	sand	C or Wx
6	F.C. Lattner #7 W.T. Davis	Spiller	Caldwell	565-572 625-635	sand sand	Wx Wx
7	F.C. Lattner #7 Garland Harris	Spiller	Caldwell	438-442 495-505	sand sand	Wx Wx
8	F.C. Lattner #14 Greenwood	Spiller	Caldwell	495-505 550-560	shale sand	Wx Wx
9	F.C. Lattner #14 O'Banion	Spiller	Caldwell	506-508 564-568	shale shale	Wx Wx
10	F.C. Lattner #16 O'Banion	Spiller	Caldwell	540-545 602-610	shale shale	Wx Wx
11	Luling Oil #A-1 Floy Gay	Salt Flat	Caldwell	495-500	sand	Wx
12	Luling Oil #1 C.F. Dye	Salt Flat	Caldwell	370-380	-	Wx

APPENDIX C (continued)

Location no. (Pl. 1)	Well name	Field	County	Log depth (ft)	Lithology	Stratigraphic interval
13	Luling Oil #9 Tiller	Salt Flat	Caldwell	510-520	shale	Wx
14	Luling Oil #7 Tiller	Salt Flat	Caldwell	280-285	sand	Wx
15	Luling Oil #10 Tiller	Salt Flat	Caldwell	540-550	sand	Wx
16	Magnolia #1 Tabor	Luling	Caldwell	930-960	shale	Wx
17	Stan-Band #A-1 A.B. Fowler	Wildcat well	Caldwell	350-365	sand	Wx
18	Frank Gravis #1 Frank Gravis	Wildcat well	Guadalupe	230-250	-	Wx?
19	Long & Johnson #1 Masterson	LaVernia	Guadalupe	245-255	-	<u>Wx</u>
20	Long & Johnson #2 Masterson	LaVernia	Guadalupe	244-254	-	<u>Wx</u>
21	D.O. Wade #1 Dinner	LaVernia	Guadalupe	282-287	-	<u>Wx</u>
22	Shell #1 D.J. Hamilton	Wildcat well	Robertson	1,680-1,760 1,810-1,820	- -	Wx Wx
23	Union Oil #412 Carroll Waterford	Van	Titus	2,112-2,115	-	Wx?
24	Frank Cambell #A-1 Kirkpatrick	Tal Vez	Webb	1,724-1,728	sand	C?
25	Keg Oil #6 C.E. Benavides	Carolina Tex-W.	Webb	1,180-1,190 2,600-2,607	sand shale	C C

APPENDIX C (continued)

Location no. (Pl. 1)	Well name	Field	County	Log depth (ft)	Lithology	Stratigraphic interval
27	Tower Prod. Co. #4 Victoria Nal. Bank	Kaye	Wilson	1,592-1,600	-	Wx
28	Wise Drlg. #4 Higgins	Higgins	Wilson	240-242	shale	C
				250-260	shale	C
				420-440	shale	C
				670-710	shale	C
				760-1,030	shale	C
				1,170-1,230	shale	C
				1,580-1,595	shale	Wx
				2,010-2,020	shale	Wx
				2,300-2,310	sand	Wx
				2,410-2,420	sand	Wx
				2,550-2,560	sand	Wx
				2,630-2,650	sand	Wx
				2,780-2,800	shale	Wx

Wx - Wilcox, anomaly determined from test well log.

Wx - Wilcox, anomaly determined from structure map.

C - Claiborne, anomaly determined from structure map.

C? - Claiborne(?) (Yegua?), anomaly determined from structure map.