# PRELIMINARY GEOLOGIC DESCRIPTION

PRAIRIE
#1-A MAST

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## INTRODUCTION

Three intervals of the Travis Peak Formation were cored in the Prairie #1 - A Mast well, Nacogdoches County, Texas. Core was recovered from 8,623.0 to 8,681.2 ft, 9,143.0 to 9,237.0 ft, and 9,930.0 to 9,991.5 ft. The top of the Travis Peak in this well is at 8,043 ft, so the core begins about 580 ft below the contact with the Sligo Formation.

## MACROSCOPIC CORE DESCRIPTION

The Travis Peak cores were described using a hand lens and binocular microscope, and graphic logs of the cores were made at a scale of 1 in = 5 ft (fig. 1). The following features of the cores were noted on the descriptive logs: depth; rock type; accessories such as pyrite, organic matter, and burrows; sedimentary structures; texture (sorting); presence of mudstone interbeds; grain size; relative amount of carbonate cement; color; and special features such as dead oil and calcareous nodules (fig. 1). Porosity and permeability values reported by Petrophysical Services, Incorporated, are noted on the graphic logs, as are the depths from which thin sections were made.

The cores consist of intervals of medium to very fine sandstone and mudstone. In general, intervals of clean sandstone are thicker (up to 40 ft) in the two lower cored intervals than in the upper interval, and mudstone beds are both thinner and less common in the two lower intervals (fig. 1). The thickest mudstone bed in the lower cores is 3.5 ft. A nine-foot-thick mudstone occurs in the upper cored interval (fig. 1).

Two types of sandstone that have been recognized in other Travis Peak cores (Dutton and Finley, 1984) also occur in the Prairie #1-A Mast cores. Most of the sandstones in the lower two cores intervals (9,143.0 to 9,237.0 and 9,930.0 to 9,991.5 ft) are Type II sandstones. These sandstones are characterized by a sharp base and a relatively sharp upper contact (fig. 1). Cross beds and planar laminations are the most common sedimentary structures throughout the entire interval; ripple marks are of secondary importance and may occur at the top of the interval. Thin clay partings may occur within the sandstone, and ripped-up mud clasts are found along some higher angle cross beds (fig. 1). A few of these Type II sandstones are burrowed at the top. The sandstones generally have uniform grain size and good sorting throughout. The Type II sandstones in the Prairie #1-Mast core are interpreted as being longitudinal- and transverse-bar deposits and channel fill from a sand-rich braided stream system.

The thicker mudstones interbedded with the Type II sandstones in the middle cored interval are red. Thin mudstones in both the middle and lower cored intervals are gray, probably because of reducing fluids in the overlying sandstones and the presence of abundant organic matter. These red and gray mudstones are interpreted as overbank flood plain deposits.

The shallowest occurrence of red mudstone is in the upper cored interval at 8,671 ft (fig. 1). Above this depth, the Travis Peak sediments probably were increasingly influenced by the marine transgression that finally resulted in deposition of the Sligo carbonate section. Sandstones in the upper interval contain lower energy sedimentary structures than do the deeper sandstones, with ripples and horizontal laminations the most common structures. The sandstone at 8,623 to 8,633 ft is an example of a Type III sandstone (Dutton and Finley, 1984). It has a gradational, upward-coarsening base, and it is burrowed throughout. The top of the sandstone was not cored, but logs indicate it has a gradational, upward-fining top. This sandstone was probably deposited in a moderate energy, marginal marine setting such as a sandy tidal flat. Mudstones interbedded with the upper sandstones probably were deposited in muddy tidal flats and low-energy bays or estuaries.

## PETROGRAPHIC DESCRIPTION

Detailed study of the core is being conducted with the scanning election microscope (SEM) and petrographic microscope.

### Grain Size

Analysis of grain size was accomplished by making grain-size point counts of thin sections. Fifty grains per slide were measured along their long dimension, excluding cement overgrowths in order to determine the size of the detrital grains. Mean diameter of sand- and silt-sized grains was calculated for each sample (Table 1); detrital and authigenic clays were not included in the calculation of mean grain diameter.

Most sand grains are fine or very fine (.062 to .25 mm), but the sample from 9,595.9 ft has an average grain size of .3 mm, which is a medium sandstone (Table 1). Most silt is coarse silt, between .031 and .062 mm. Both detrital and authigenic clay particles are smaller than .004 mm.

### Mineral Composition

Five samples have been point counted for a preliminary description of mineral composition (Table 2). The sandstones are mineralogically mature and are classified as quartz arenites and subarkoses, with quartz comprising 93 to 98 percent of the essential framework constituents (quartz, feldspar, and rock fragments). Plagioclase and orthoclase feldspars together comprise 1 to 6 percent of the framework grains. Rock fragments, mainly chert and low-rank metamorphic rock fragments, constitute between 0 and 3 percent of the framework

**Table 1. Grain-size distribution in Prairie #1-A Mast core**

| Depth (ft) | Mean (mm) | Sand (%) | Silt (%) | Detrital Clay (%) | Authigenic Clay (%) | Textural Class* |
|---|---|---|---|---|---|---|
| 8,624 | .071 | 62.1 | 32.0 | 1.0 | 4.9 | Silty sandstone |
| 8,639.1 | .127 | 86.2 | 4.0 | 0 | 9.8 | Sandstone |
| 8,646.5 | .103 | 92.0 | 6.0 | 0 | 2.0 | Sandstone |
| 8,669.0 | .147 | 94.1 | 3.9 | 0 | 2.0 | Sandstone |
| 9,172.0 | .111 | 77.7 | 19.4 | 0 | 2.9 | Silty sandstone |
| 9,959.9 | .297 | 99.0 | 0 | 0 | 1.0 | Sandstone |

*Textural class determined only by detrital grains.

Table 2. **Petrographic analyses of Prairie #1-A Mast core, measured in percent.**

| | Depth = 8,628.0 ft | 8,669.0 ft | 9,161.0 ft | 9,172.0 ft | 9,959.9 ft |
|---|---|---|---|---|---|
| **Framework Grains** | | | | | |
| Quartz | 70.3 | 60.6 | 63.3 | 64.2 | 76.4 |
| Plagioclase | 4.0 | 3.4 | 1.0 | 4.4 | 1.0 |
| Orthoclase | 0.5 | 0.5 | 1.9 | 0 | 0 |
| MRF* | 0 | 0 | 1.0 | 0.5 | 0.5 |
| Chert | 0 | 0 | 1.0 | 0 | 0 |
| Clay clasts | 0 | 0 | 0.5 | 0.5 | 0 |
| Heavy minerals | 0 | 0 | 0.5 | 1.0 | 0 |
| Other | 0 | 0 | 0 | 0. | 0 |
| **Matrix** | | | | | |
| Clay-sized fines | 15.3 | 0 | 0 | 0 | 0 |
| **Cements** | | | | | |
| Quartz | 2.0 | 19.7 | 19.0 | 15.7 | 18.2 |
| Dolomite | 3.5 | 0 | 0 | 2.5 | 0 |
| Ankerite | 1.0 | 10.8 | 4.3 | 6.4 | 0 |
| Authigenic clay | 1.0 | 2.5 | 1.4 | 4.9 | 1.0 |
| Feldspar | 0 | 0 | 0.5 | 0 | 0 |
| Solid organic matter | 0 | 0 | 0 | 0 | 0 |
| **Porosity** | | | | | |
| Primary porosity | 0 | 1.5 | 1.9 | 0 | 1.0 |
| Secondary porosity | 2.5 | 1.0 | 3.8 | 0 | 2.0 |
| Porosimeter porosity | 12.0 | 3.9 | no data | no data | no data |

* Metamorphic rock fragments

grains. Zircon and tourmaline are the only heavy minerals, and they are another indication of the mineralogic maturity of the Travis Peak sandstones.

Authigenic cements constitute between 7 and 33 percent of the sandstone volume in these five samples (Table 2). Illite occurs as rims of tangentially oriented crystals around detrital grains, and illite and chlorite (fig. 2) both occur as pore-filling cement. The tangentially-oriented illite was the earlier authigenic cement to precipitate. Authigenic illite and chlorite have a combined volume of 1 to 5 percent.

Quartz cement is the most abundant authigenic mineral in the Prairie #1-A Mast cores (Table 2). Quartz overgrowths fill 2 to 20 percent of the volume, and precipitation of authigenic quartz occluded much of the primary porosity (fig. 2). The sample from 8,628.0 ft has the lowest amount of quartz cement because of the abundant detrital matrix (Table 2). In clean sandstones, the average volume of authigenic quartz is 18.2 percent, which is approximately the same as in clean sandstones in the Clayton Williams #1 Hughes, ARCO #1 Phillips, and Ashland #1 S.F.O.T. cores.

Dolomite cement is common only in the upper cored interval. Minor dolomite cement is present in the middle interval, but it is absent from the lowest cored interval (Table 2). Dolomite rhombs commonly occur within clay clasts or areas of detrital clay matrix. Much of the dolomite cement apparently was an early diagenetic phase that precipitated in marginal marine deposits. Magnesium for the dolomite was derived from seawater. The lack of early dolomite cement in fluvial deposits is probably due to a lack of a magnesium source.

Ankerite cement also decreases in abundance with depth (Table 2). It is common for crystals to be dolomite in the center and ankerite around the edges. Ankerite was a late-stage cement that precipitated after quartz overgrowths; in places it replaces quartz cement and fills secondary pores.

Solid organic matter (also known as reservoir bitumen or "dead oil") was observed in just two small zones in the core (fig. 1), and it was not present in any of the preliminary thin sections (Table 2). A sample from 8,632.4 ft contains 2.4 percent dead oil that occurs in primary pores and coats quartz overgrowths. Solid organic matter is less abundant in the Prairie #1-A Mast core than in the Clayton Williams #1 Hughes or ARCO #1 Phillips cores, possibly because the Prairie core is from deeper in the Travis Peak section. Preliminary studies of the solid organic matter suggest it occurs mainly in the upper Travis Peak (Dutton, 1985). It appears to have formed by deasphalting of pooled oil after solution of gas into the oil (Rogers and Stuler, 1974).

Pyrite is abundant in several sandstone intervals (figs. 1, 3). It is difficult to determine petrographically when the pyrite formed, but it appears to replace quartz overgrowths so it must have been a later phase. Pyrite also replaces detrital grains (fig. 3).

## Porosity

Porosity observed in thin section in the five samples varies from 0 to 5.7 percent (Table 2). Both primary and secondary pores are present. Secondary pores, which are caused by dissolution of framework grains, are approximately the same size as detrital grains. They may contain fragments of dissolved framework grains, probably feldspar. Primary pores commonly are elongated slits that remain open between quartz overgrowths (figs. 2, 4).

In samples with values for both thin-section and porosimeter porosity, thin-section porosity is lower (Table 2). The difference between thin section and porosimeter porosity is probably caused by microporosity in detrital and authigenic clays (fig. 5); such porosity generally cannot be seen in thin section, but it is measured by the porosimeter.

## REFERENCES

Dutton S. P., 1985, Travis Peak core studies, in Finley, R. J., and others, The Travis Peak (Hosston) Formation: geologic framework, core studies, and engineering field analysis: The University of Texas at Austin, Bureau of Economic Geology, topical report prepared for the Gas Research Institute under contract no. 5082-211-0708, p. 75-123.

Dutton, S. P., and Finley, R. J., 1984, Preliminary geologic description, ARCO #1 B. F. Phillips: The University of Texas at Austin, Bureau of Economic Geology, topical report prepared for the Gas Research Institute under contract no. 5082-211-0708, 10 p.

Rogers, M. A., McAlary, J. D., and Bailey, N. J. L., 1974, Significance of reservoir bitumens to thermal-maturation studies, western Canada Basin: American Association of Petroleum Geologists Bulletin : v. 58, no. 9, p. 1806-1824.

## FIGURE CAPTION

Figure 1. Descriptive log of core of the Travis Peak Formation from the Prairie Producing Company #1-A Mast well, Nacogdoches County, Texas. Core depths are from 8,623.0 to 8,681.2 ft, 9,143.0 to 9,237.0 ft, and 9,930.0 to 9,991.5 ft.

Insert foldout pages 1-4 here

# EXPLANATION OF SYMBOLS

## CONTACT

Gradational G

Upward fining

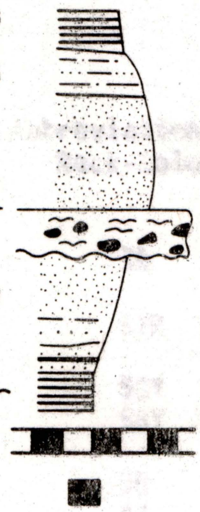
Planar

Erosive E

Upward coarsening

Slightly irregular

## ROCK TYPE (%)



Mudstone

Siltstone and sandy siltstone (—···—)

Sandstone

Mud clast and mud flake (~~~) conglomerate

Interbedded sandstone (····), siltstone (—···—), and

Mudstone

Coal

Porosity

## ACCESSORIES

Vertical and horizontal burrows

Organic fragments

Rootlets

Shells

Mica flakes

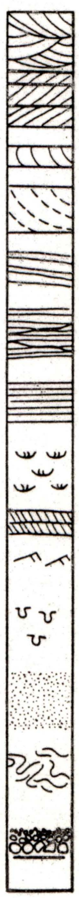
P Pyrite

Callianassa burrows

## TEXTURE

| Sorting | Rounding |
|---|---|
| vp-s Very poor | a Angular |
| p-s Poor | s-a Subangular |
| m-s Moderately well | s-r Subrounded |
| w-s Well | r Rounded |

## STRUCTURES



Trough crossbedding

Planar crossbedding

Crossbeds with oversteepened foresets

Indistinct cross-stratification

Gently inclined lamination = GI

Gently inclined lamination separated by low-angle discordances

Horizontal lamination

Ripple trough lamination

Planar ripple lamination

Climbing-ripple lamination

Heavily bioturbated sandstone

"Massive" sandstone = M

Contorted bedding

Graded bedding

## INDURATION

| | |
|---|---|
| WI | Well indurated |
| I | Indurated |
| IF | Indurated but friable |
| IS | Indurated but shaly |

## RELATIVE CALCITE CONTENT

| | |
|---|---|
| 1 | Slight effervescence |
| 3 | Moderate effervescence |
| 5 | Strong effervescence |
| 10 | Very strong effervescence |

## COLOR

Abbreviations from Rock-Color Chart, Geological Society of America

## FIGURE 2.

SEM photograph of abundant quartz cement (Q). Primary pores are elongated slits (arrow) between quartz overgrowths. Depth is 9,226.7 ft. Bar length is 100 $\mu$m; magnification is 350x.

## FIGURE 3.

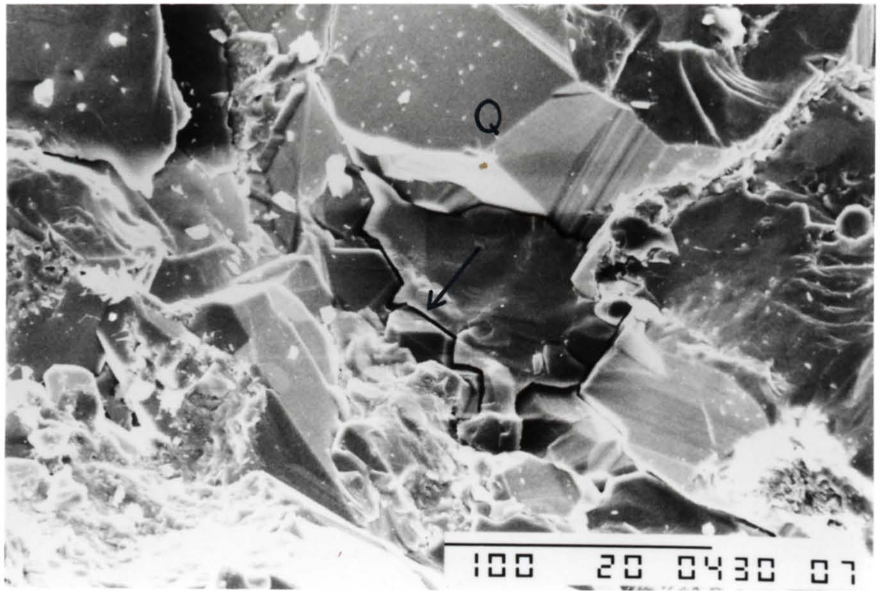
Photomicrograph of pyrite (black) replacing both detrital grains and quartz cement at a depth of 9,991.1 ft. Long dimension of photo = 2.6 mm; plane polarized light.

## FIGURE 4.

Photomicrograph of elongate primary pores (P) between quartz overgrowths. Ankerite cement is dark material at the left. Depth is 9,161.0 ft. Long dimension of photo = 0.65 mm; plane polarized light.

## FIGURE 5.

SEM photograph of pore-filling chlorite cement at a depth of 8,639.1 ft. The abundant microporosity between chlorite crystals would not be distinguished in thin section. Bar length is 10 $\mu$m; magnification is 1500x.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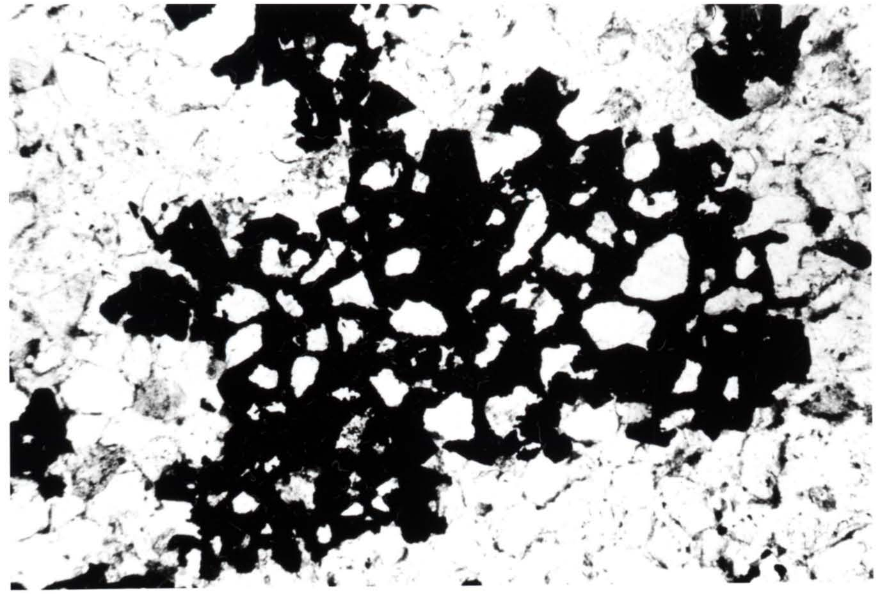

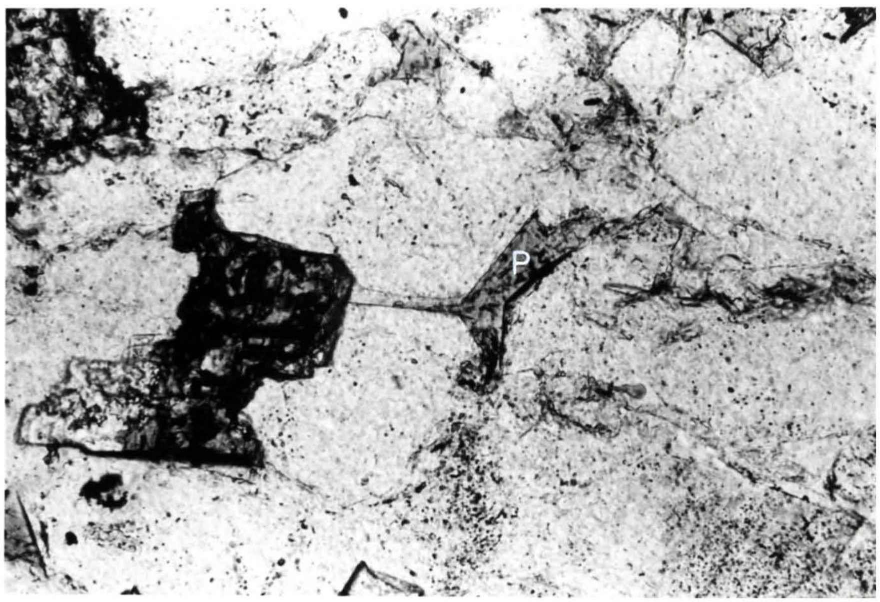
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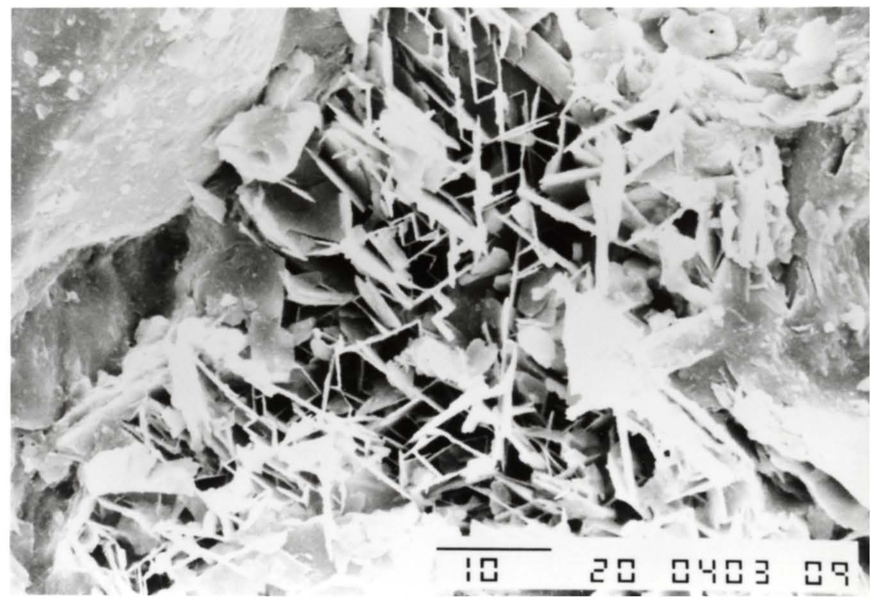
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