

PRELIMINARY RESULTS OF MINERALOGY AND PETROLOGY  
OF THE CORCORAN (8105-8128 ft) AND COZZETTE (7832-7898 ft)  
INTERVALS DRILL CORE MWX-2

by

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## INTRODUCTION

Sandia National Laboratories is conducting and directing the Multi-Well Experiment (MWX) core analysis program as part of the Western Gas Sands Project for the Department of Energy's Unconventional Gas Sands Program. Sandia National Laboratories will carry out sample selection, sample distribution, prioritization of analyses, distribution of data, and coordination of interagency analyses. The U.S.G.S., along with Sandia, will provide interpretation of analytical results. A sedimentological model of the Mesaverde Group at the Multi-Well site will be published by J.C. Lorenze (Sandia).

The Petrology Laboratory of Bendix Field Engineering Corporation is providing routine mineralogic and petrologic analyses of MWX core samples and interpretations, as detailed in this report. These are preliminary results to be used primarily for characterization of the general mineralogy and textures of an interval so that variations in mineralogic trends can be delineated. This report is the third of fifteen which will present the results of petrologic analyses of the fifteen intervals to be submitted from drill holes MWX-1 and 2. Included here are mineralogic and petrologic data from the Corcoran and Cozzette Intervals of drill hole MWX-2.

## PROCEDURES

### Sample Preparation

Seventeen samples were submitted from the Corcoran Interval and twenty-three samples from the Cozzette Interval which extend from hole depths of 8105 ft to 8128 ft and 7832 ft to 7898 ft respectively. The samples were received on May 10, 1982 and consisted entirely of end-chips of core plugs

which were sent to Core Laboratories, Inc., Denver, Colorado, for routine core analysis.

Thin section preparation, thin section analysis, clay mineral analysis and other X-ray diffraction analyses were done as described for the Coastal Interval, MWX-1. Samples from the Cozzette Interval from hole MWX-2 were compared with those which were previously described for the Cozzette Interval from hole MWX-1.

## RESULTS

Since these results pertain to two different intervals they will be discussed separately beginning with the up-hole Interval, Cozzette, followed by the down-hole Interval, Corcoran.

### Cozzette Interval

The samples submitted for the Cozzette Interval from hole MWX-1 extended from core depths of 7871 ft to 7957 ft. Those submitted from hole MWX-2 extended from core depths 7832 ft to 7898 ft. This represents an upper Cozzette zone, MWX-2, a central overlap zone, MWX-1 and MWX-2, and a lower Cozzette zone, MWX-1, according to hole depths. The overlap zone showed a close petrologic correlation at similar hole depths inferring a horizontal relationship between the two holes.

### Lithology - Cozzette Interval

In general the rocks of the Cozzette Interval are feldspar- and lithic-rich quartz sandstones. Therefore the rock types are: Subarkose, sublitharenite, lithic arenite and feldspathic litharenite, according to the classification by Folk, (1980). Subarkose is the dominant rock type. Detrital grains are well-sorted, angular to subrounded and very fine sand-sized grading to fine sand-sized at the top of the interval. These sandstones are well indurated with concavo-convex and sutured grain contacts.

The Cozzette Interval consists of four slightly different lithologic zones: An upper organic-rich zone, a fairly clean very fine sand-sized zone, a calcareous zone, and a lower clean very fine sand-sized zone.

7832.2 to 7849.8 ft - Organic-Rich Zone

The top two samples are fine sand-sized and moderately sorted. Organic material which fills fractures and intergranular pore space gives the sample a dirty appearance. Dolomite is the predominant carbonate mineral. Calcite occurs in very small amounts.

7853.8 to 7858.2 - Upper Clean Sand Zone

This zone is very fine sand-sized and well sorted. This sandstone contains very little of the organic material found in the organic-rich zone giving it a much cleaner appearance. The only carbonate mineral is dolomite. The characteristics of this "clean zone" are very similar to those in the lower "clean zone".

7859.8 to 7868.4 ft - Calcareous Zone

This zone is very fine sand-sized and well sorted. The zone is characterized by significant amounts of calcite. The calcite occurs as cement sometimes supporting detrital grains, especially at the top of the zone. The calcite to dolomite ratio at the top of the zone is approximately 3:1 and total carbonate comprises almost thirty percent of the entire rock. Total carbonate decreases to about seven percent of the rock in the center of the zone and the calcite to dolomite ratio decreases steadily to about 1:6. At 7868.4 ft the total carbonate content increases to over thirty percent with an approximate 1:2 calcite to dolomite ratio.

7870.8 to 7898.1 - Lower Clean Sand Zone

From 7870.8 through the bottom of the Cozzette Interval the sandstone is very similar to the upper clean zone as well as the corresponding zone described for the Cozzette Interval, MWX-1. The bottom sample in this zone (7898.1 ft)

has a large oval-shaped structure (3 mm minimum diameter) surrounded by ferruginous clay and organic material similar to that in the organic zone (Photo 1). Stringers of the organic material encircle and radiate from this structure. The interior of the structure is filled by detritus similar to the rest of the rock. Since this feature does not extend through the width of the core plug end-chip it is difficult to identify. It does extend several millimeters into the end-chip with its axis horizontal to the bedding. This implies that it may be the end of a worm burrow or similar structure.

#### Mineralogy - Cozzette Interval

As expected the detrital mineralogy of the Cozzette Interval in hole MWX-2 is very similar to that which was reported for MWX-1. The authigenic minerals are also very similar. Exceptions to this generality occur in the calcareous zone previously mentioned.

Calcite occurs in significant amounts throughout the calcareous zone. The calcite in this zone occurs as cement which is being dolomitized (Photo 2). Calcite and dolomite partially replace detrital grains in this zone. Dolomite also partially replaces detrital grains throughout the Cozzette Interval. The dolomite texture in the bottom sample of the calcareous zone is unique in relationship to the other samples in that it generally occurs as aggregates of minute rhombs surrounding many of the detrital grains. The dolomite appears to have replaced the edges of these detrital grains. A portion of a suspected shell fragment is also present in this sample (Photo 3).

Small clusters of pyrite framboids are common in the calcite throughout the calcareous zone (Photo 4). The presence of framboidal pyrite and shell fragments implies a biogenic origin for the calcite in this zone. Pyrite is also commonly associated with the organic material in the organic zone as well as the organic material associated with the suspected "worm burrow" at 7898.1 ft

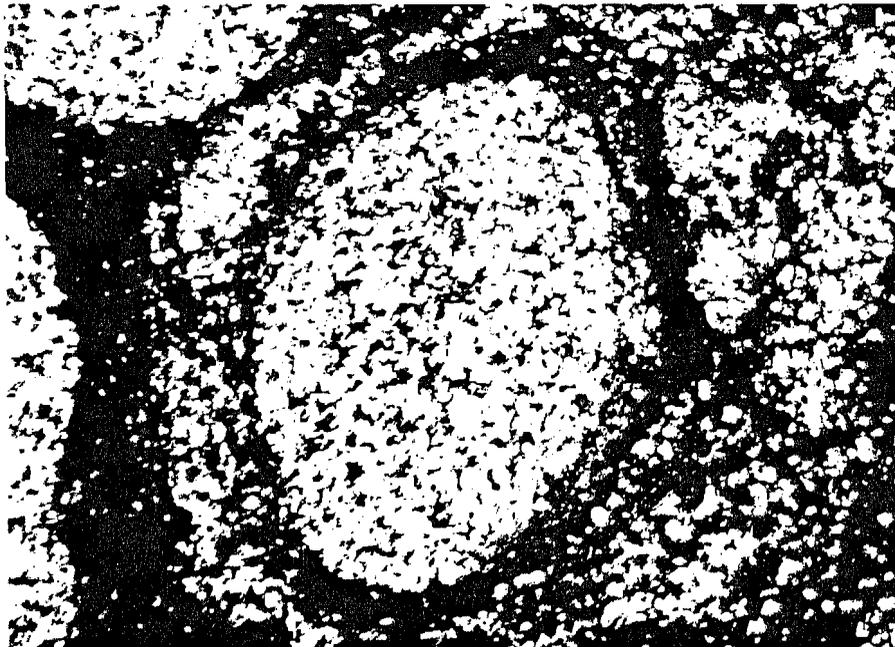


Photo 1. Worm burrow-type structure encircled with ferruginous clay and organic material. 7898.1 ft. Crossed polarizers. 16x.

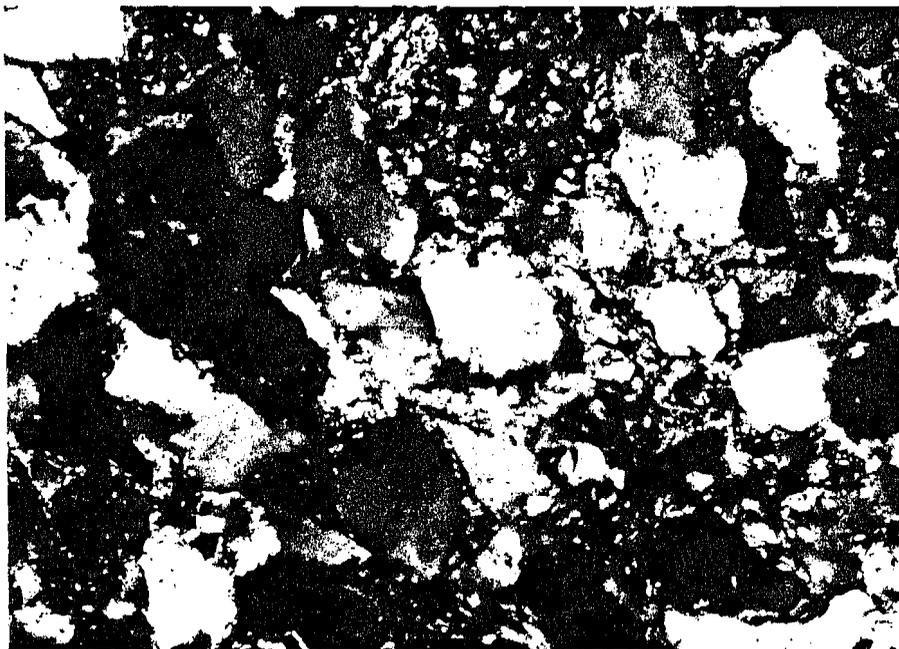


Photo 2. Calcite cement (red stain) being dolomitized. 7859.8 ft. Crossed polarizers. 160x.



Photo 3. Portion of a shell(?) fragment. 7868.4 ft. Crossed polarizers. 200x.

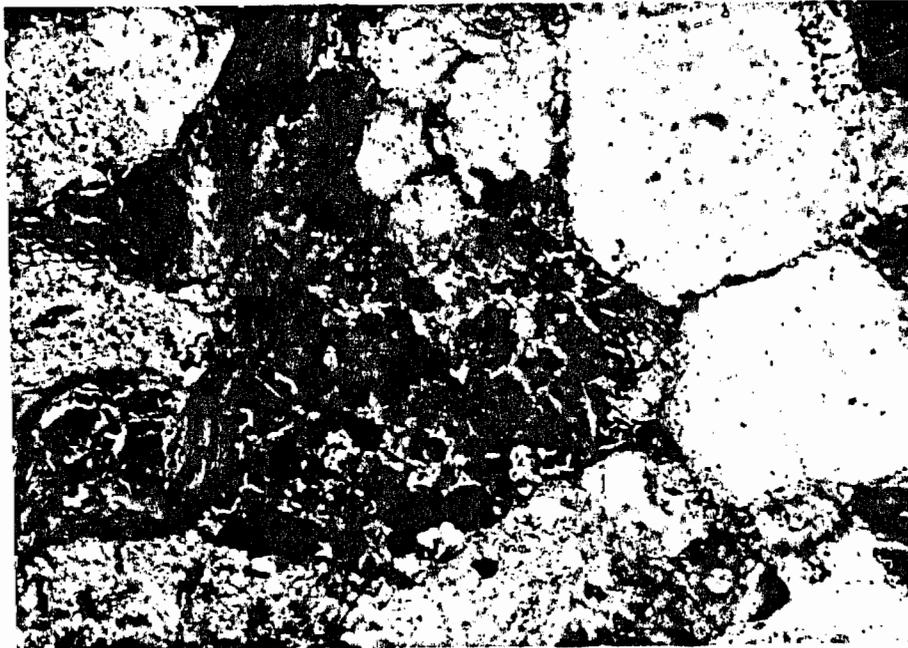


Photo 4. Clusters of framboidal pyrite within calcite (red stain). 7859.8 ft. Plane polarized light. 400x.

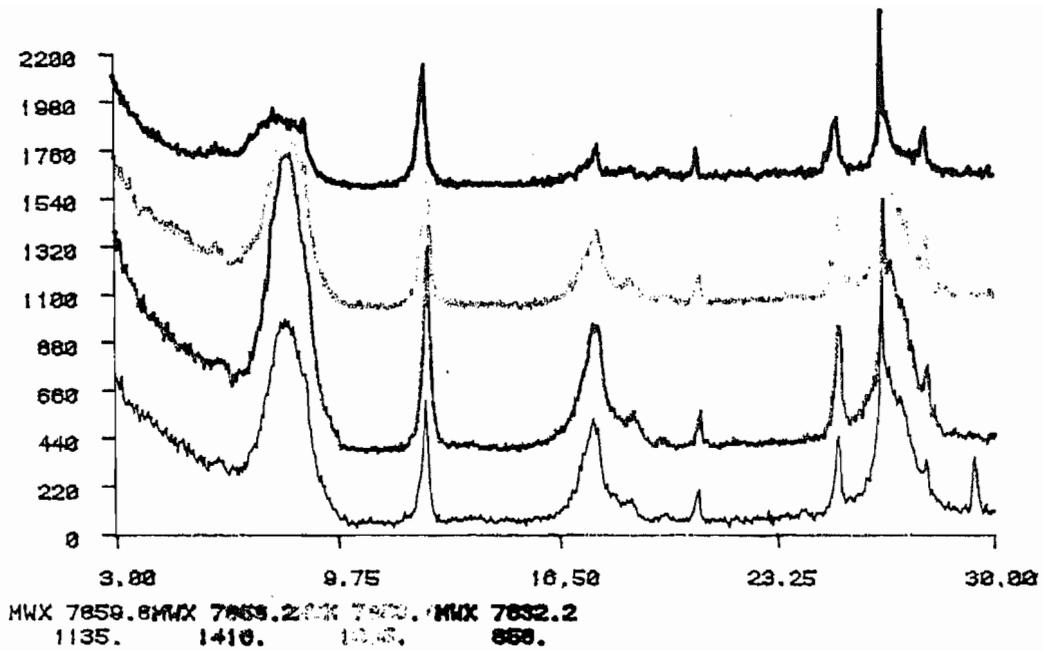
(described previously). This pyrite occurs as minute euhedra and more massive patches. Some clusters of euhedral pyrite fill pore space in this sample.

#### Clay Mineralogy - Cozzette Interval

Clay minerals identified by X-ray diffraction in the MWX-2 Cozzette Interval are very similar to those in the MWX-1 Cozzette Interval. These include an illite/montmorillonite mixed-layer clay, kaolinite, and chlorite.

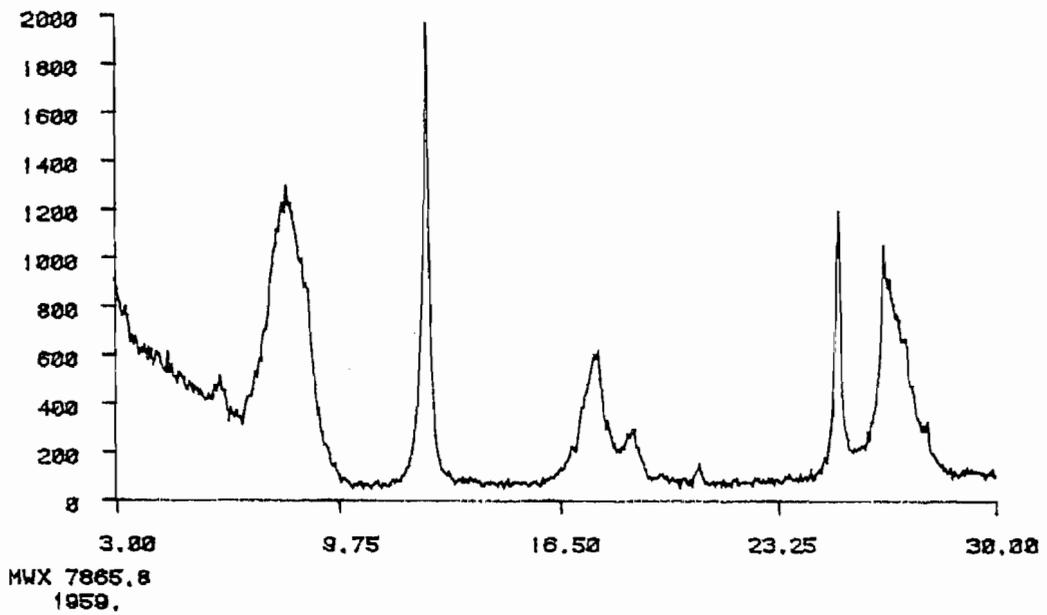
At the top of the "organic zone" (7832.2 ft) kaolinite is the dominant clay mineral with the illite/montmorillonite mixed-layer clay representing a major portion of the clay fraction. Chlorite occurs in trace amounts in this sample as well as throughout the Cozzette Interval. From the top of the Cozzette Interval down-hole through the upper "clean sand zone" and into the top of the "calcareous zone" (7859.8 ft), the amount of kaolinite tends to decrease steadily as the illite/montmorillonite mixed-layer clay becomes dominant (Chart 1). Toward the lower calcareous zone (7865.8 ft) kaolinite is the dominant clay mineral (Chart 2), whereas, at the bottom of the "calcareous zone" illite/montmorillonite is the dominant clay and kaolinite is only a minor constituent of the clay fraction (Chart 3).

Further down-hole, at the top of the lower "clean sand zone" (7870.8 ft) kaolinite and illite/montmorillonite mixed-layer clay occur in a near 1:1 ratio. Except for a high kaolinite zone at 7877.2 ft, kaolinite content tends to decrease steadily through the bottom of the Cozzette Interval (Chart 4). This trend is very similar to that of the corresponding zone in hole MWX-1. Chlorite was not detected by X-ray diffraction analysis of the bottom two samples of the Cozzette Interval, but was observed in thin section. The chlorite content in these samples is probably below the detection limits of X-ray diffraction (approximately five percent).



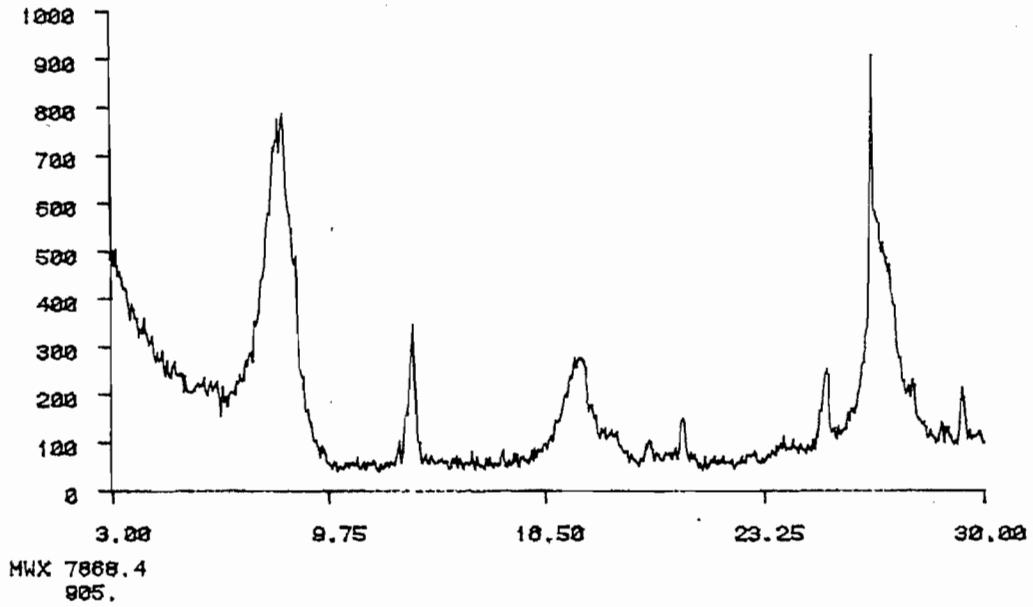
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Chart 1. General decrease of kaolinite in relationship to the illite/montmorillonite from the top of the Cozzette Interval downhole through the top of the calcareous zone. 7832.2 ft through 7859.8 ft.



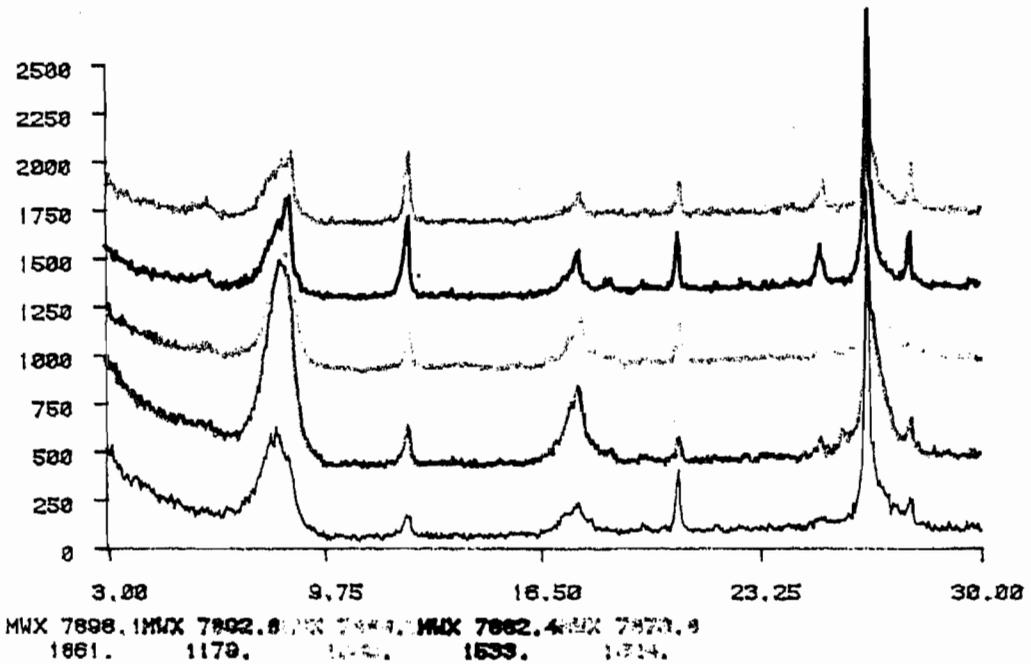
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Chart 2. Dominant kaolinite in the lower middle of the calcareous zone. 7865.8 ft.



BENDIX

Chart 3. Dominant illite/montmorillonite at the bottom of the calcareous zone. 7868.4 ft.



BENDIX

Chart 4. Decrease of kaolinite in relation to the illite/montmorillonite mixed-layer clay in the lower clean sand zone. 7870.8 ft through 7898.1 ft.

Clay minerals occur predominantly as intergranular mats, many of which may be totally altered feldspars or contorted clay clasts. Kaolinite and chlorite also occur as authigenic intergranular pore filling. A chlorite coating on quartz grains, which inhibits secondary quartz overgrowths, was observed in MWX-1, however, this feature was not observed in MWX-2.

#### Pore Space - Cozzette Interval

Porosity in the Cozzette Interval is dominated by microporosity in clay-filled intergranular pore space, as was the case in the Cozzette Interval, MWX-1. Clay-filled pore throats, secondary porosity in altered feldspars, and dissolved carbonate also contribute to the porosity, but to a lesser degree. Very few open pores are present.

At the top of the Cozzette Interval ("organic zone") organic material, which appears to have been injected through fractures, clogs much of the pore space and pore throats (Photo 5). Migration of this organic material has been locally inhibited by chloritized biotite in pores and pore throats (Photo 6). This organic material is not prevalent in samples down-hole except for the bottom sample in the interval (7898.1 ft) where it fills fractures encircling the "worm burrow".

Intergranular pores are generally small, irregular-shaped and randomly spaced, whereas, pore throats are generally long and narrow. The clay which fills the pores, is usually loosely matted allowing for easy impregnation. Tightly packed or oriented clay totally clogging pores was minor in most samples. The bottom sample of the Cozzette Interval is more tightly compacted than other samples resulting in lower porosity. Open pores commonly contain authigenic quartz (Photo 7).

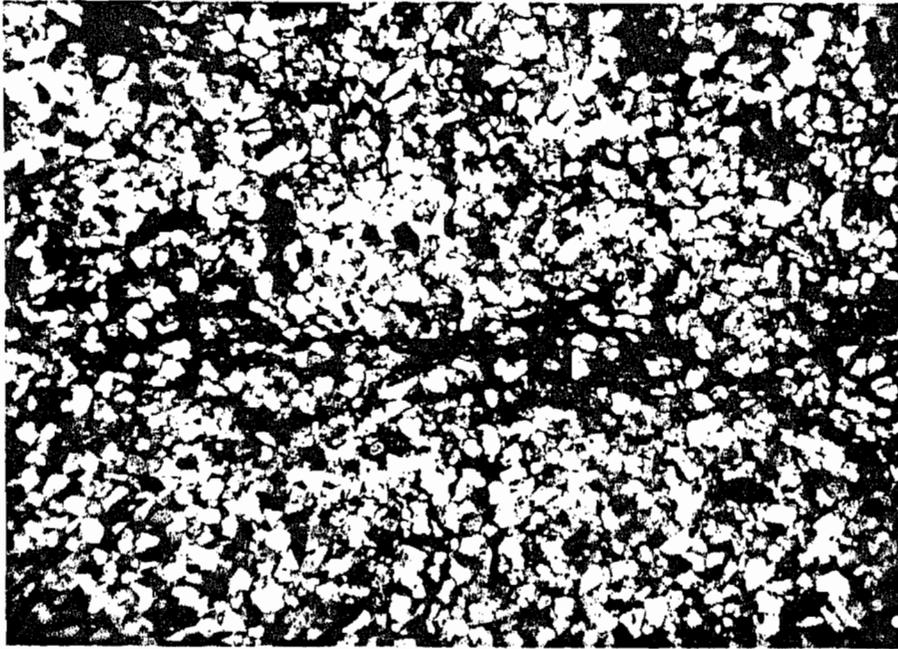


Photo 5. Organic material which migrates along fractures clogs pores and pore throats. 7832.2 ft. Plane polarized light. 16x.

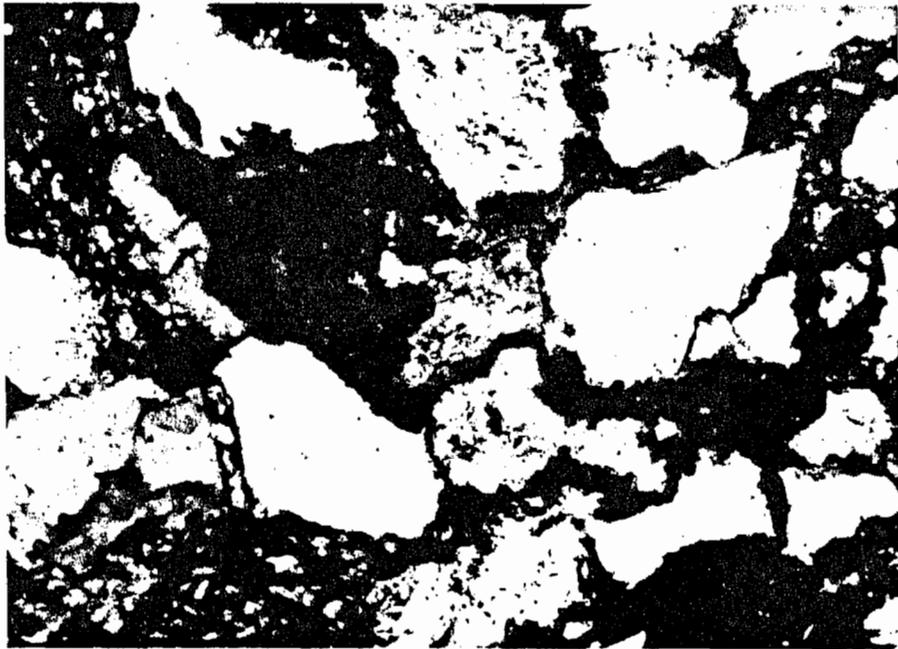


Photo 6. Contorted chloritized biotite (brown) which has inhibited the migration of the organic material (black). 7832.2 ft. Plane polarized light. 160x.



Photo 7. Authigenic quartz euhedra within open pore. 7879.8 ft.  
Plane polarized light. 400x.

Dissolution of calcite in the "calcareous zone" is common. Authigenic chlorite partially fills some of the voids in the calcite (Photo 8). In the bottom sample of the calcareous zone (7868.4 ft) some porosity occurs around grains surrounded by and partially replaced by the minute dolomite rhombs.

Paragenesis - Cozzette Interval

In general the diagenetic sequence for this Cozzette Interval is the same as that reported for hole MWX-1, with few modifications. A comparison of the sequence reported previously with the modified sequence is as follows:

MWX-1

early carbonate(?)  
feldspar alteration  
chlorite formation  
authigenic quartz overgrowths  
authigenic clays  
calcite(?)  
dolomitization

MWX-2

early carbonate(?)  
feldspar alteration  
chlorite formation  
authigenic quartz overgrowths  
later calcite and framboidal pyrite  
authigenic clays  
secondary porosity in later calcite  
later chlorite(?)  
dolomitization  
injection of organic material  
pyrite

This paragenetic sequence implies the commencement order of the diagenetic processes. Most of the processes are contemporaneous and many continue throughout the remainder of the sequence. Evidence for features common to both sequences is as described for hole MWX-1.

The position of the later stage calcite in the diagenetic sequence was more clearly defined in hole MWX-2. The presence of calcite around quartz overgrowths (Photo 9) and as partial replacement of them implies that this later stage calcite



Photo 8. Calcite (red stain) with dissolution cavities which contain authigenic chlorite (green blades). 7859.8 ft. Plane polarized light. 400x.

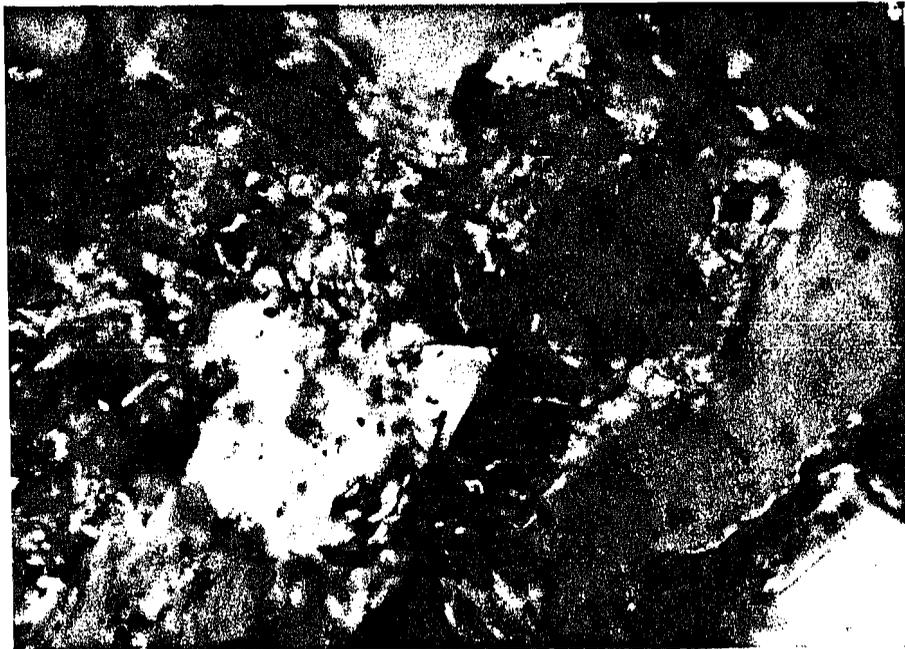


Photo 9. Calcite (red stain) which has developed around authigenic quartz. 7859.8 ft. Crossed polarizers. 635x.

occurred after or during formation of the overgrowths. Framboidal pyrite suspended within the calcite formed contemporaneously. Dissolution of this calcite stage probably occurred shortly after its formation. Some dissolution cavities in the calcite are filled with chlorite(?) which implies that chlorite also occurs later in the diagenetic sequence than previously reported.

There is evidence in the MWX-2 core that shortly after dolomitization started, organic material migrated into the upper portion of the Cozzette. The dispersement of this organic material caused engulfment of some of the dolomite which was forming in zones open to fluid migration (Photo, 10). Other zones not engulfed by organic material are left as open systems where dolomitization could continue. Pyrite was formed in the localized reducing environment provided by this organic material.

#### Lithology - Corcoran Interval

Except for several mudstones the general rock types are very similar to those reported for the Cozzette Interval. The Corcoran Interval can be divided into three separate lithologic zones: An upper sandy mudstone zone, a sandstone zone, and a lower mudstone zone.

#### 8105.9 ft - Upper Sandy Mudstone

This is a mudstone with lenses of fine sand-sized detritus which are probably derived from the underlying sandstones. Some of the lenses are fairly continuous, but most are contorted, possibly by the deformation of the softer sediment around them (Photo 11). Small stringers of carbonaceous material follow the bedding. Dolomite is the predominant carbonate mineral with calcite occurring in very small amounts.

#### 8107.9 to 8122.2 ft - Sandstone Zone

The sandstones in this zone are very fine sand-sized and the predominant rock type is sublitharenite (Folk, 1980). In general these sandstones appear to



Photo 10. Authigenic dolomite which has been engulfed by the migrating organic material. 7849.8 ft. Crossed polarizers. 160x.

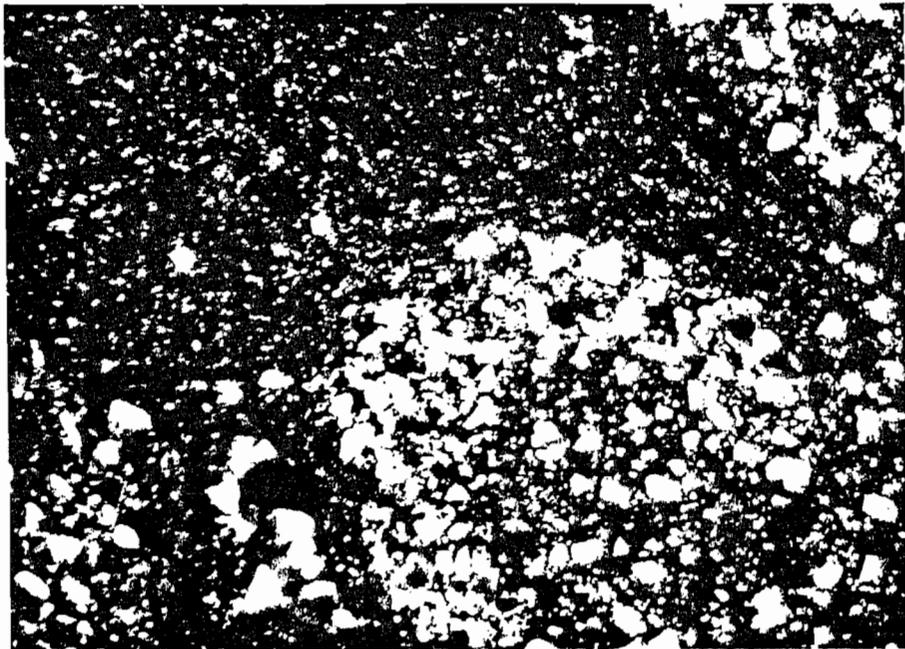


Photo 11. Soft sediment deformation in the sandy mudstone. 8105.9 ft. Crossed polarizers. 16x.

be less compacted than those of the Cozzette and Coastal Intervals. Mudstone lenses are ubiquitous throughout this zone. These lenses are often contorted (Photo 12) and are probably derived from the underlying or nearby mudstones. The mudstone lenses in the bottom sample (8122.2 ft) are thin and fairly continuous giving a bedded appearance to the sandstone, probably representing a transition environment.

Dolomite is the dominant carbonate mineral throughout this zone. Calcite is present at the top of the zone, but disappears completely at 8111.9 ft and is absent through the bottom of the zone. Carbonaceous stringers with associated pyrite are common along the mud lenses. Thin veinlets of chlorite follow these thin lenses in the bottom sample (8122.2 ft).

#### 8124.2 to 8128.1 ft - Lower Mudstone Zone

The top sample of this zone contains alternating beds of sand, silt and clay. These alternating sizes occur in nearly equal amounts. Clumps of silt and sand are common within the clayey lenses.

Chlorite veins cut across the bedding planes in this sample (Photo 13). Microfaults are common along these veins. Dolomite and possibly a small amount of siderite are the only carbonate minerals present. Carbonaceous stringers compacted along bedding planes are common.

The bottom two samples (8125.9 and 8128.1 ft) are mudstones with some floating sand-sized detritus. Detrital sand-sized grains are more abundant in the upper sample. These two mudstones are somewhat bedded with bedding planes strongly contorted.

No carbonate minerals are present in either sample. The 8125.8.9 ft sample contains a finger-shaped lens or vein of pyrite and authigenic clay. The central portion of this lens appears to have a shell-like structure (Photo 14).

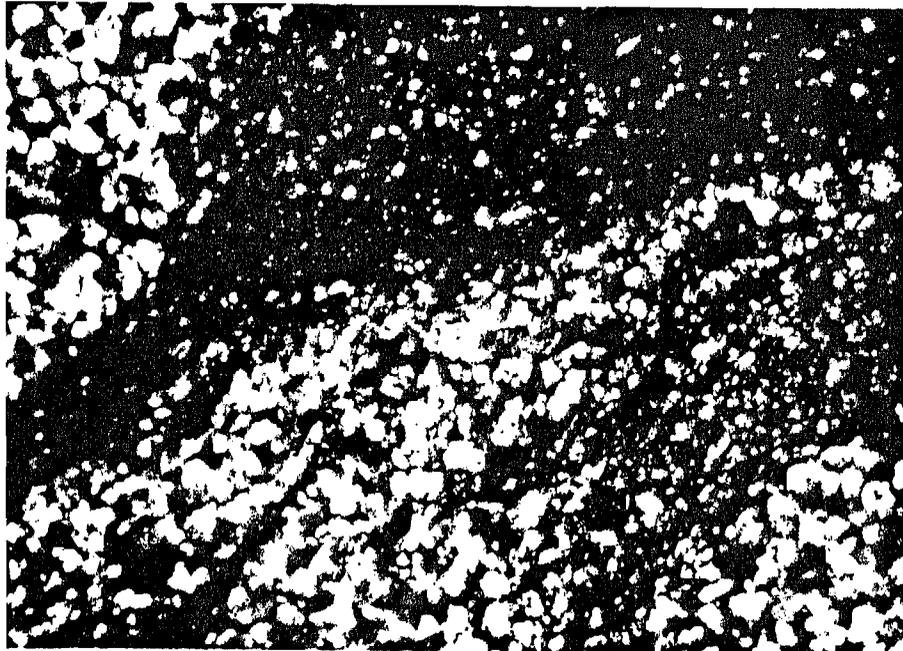


Photo 12. Contorted mudstone lenses within the sandstone zone. 8111.1 ft.  
Crossed polarizers. 16x.



Photo 13. Discordant chlorite veins within the mudstone zone. 8124.2 ft.  
Crossed polarizers. 160x.

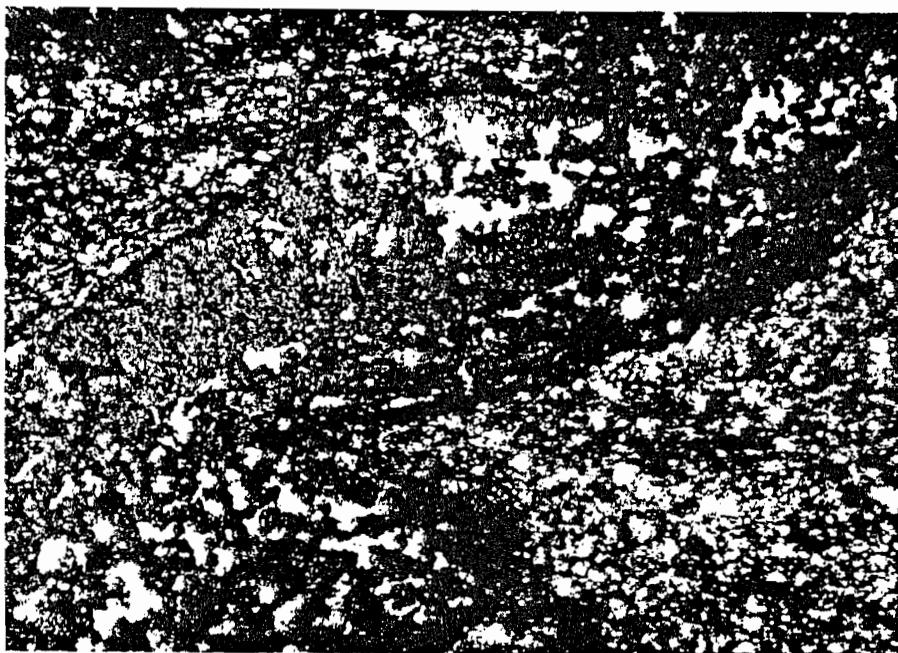


Photo 14. Lens of pyrite with authigenic clay. Note the unusual shell-like structure. 8125.9 ft. Crossed polarizers with oblique light. 40x.

### Mineralogy - Corcoran Interval

The mineralogy of the detritus in Corcoran Interval is very similar to that of the Cozzette Interval. The major detrital framework consists of quartz, feldspars and rock fragments, including chert. Other detrital minerals include biotite, muscovite, opaques and tourmaline. Mudstone lenses and carbonaceous material are probably also detrital. Carbonate minerals, clays and pyrite are also common.

The general texture, form and alteration of the detrital minerals are also very similar to those of the Cozzette Interval. K-feldspar minerals (microcline and perthite) are less abundant in the Corcoran Interval than in the Cozzette Interval.

As in the Cozzette Interval, dolomite is the predominant carbonate mineral and is present throughout, except for the bottom two samples. In addition to the dolomite, calcite is present at the top of the interval, but decreases through 8111.1 ft and disappears entirely below that level. Siderite may be present with the dolomite at 8124.2 ft.

Carbonate minerals occur as intergranular patches, rhombs and irregular shaped grains. Some carbonate grains which are nearly the same size as the detrital framework may also be detrital. Dolomite rhombs occasionally have brownish rims which may be ankerite.

Small fractures in the sample at 8107.9 ft are filled with dolomite and some ferruginous clay (Photo 15). The dolomite tends to migrate into the detrital framework from these fractures and replaces some of the detrital grains (Photo 16).

Pyrite is fairly common in all the samples. It usually occurs as framboidal aggregates or as clusters of minute euhedra, except in sample 8125.9 ft where it is more massive. In this sample open voids within the pyrite masses are filled with authigenic clay. Usually pyrite is contained within or in close proximity to mudstone lenses, as shown in Photo 17. The sample from 8113.5 ft contains

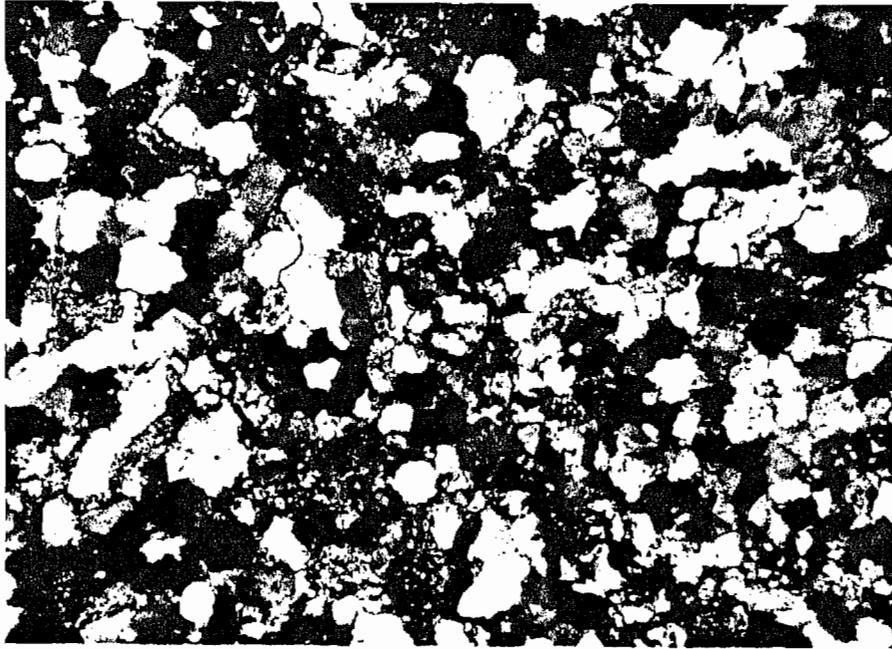


Photo 15. Fracture filled with dolomite and ferruginous clay. 8107.9 ft. Crossed polarizers. 40x.

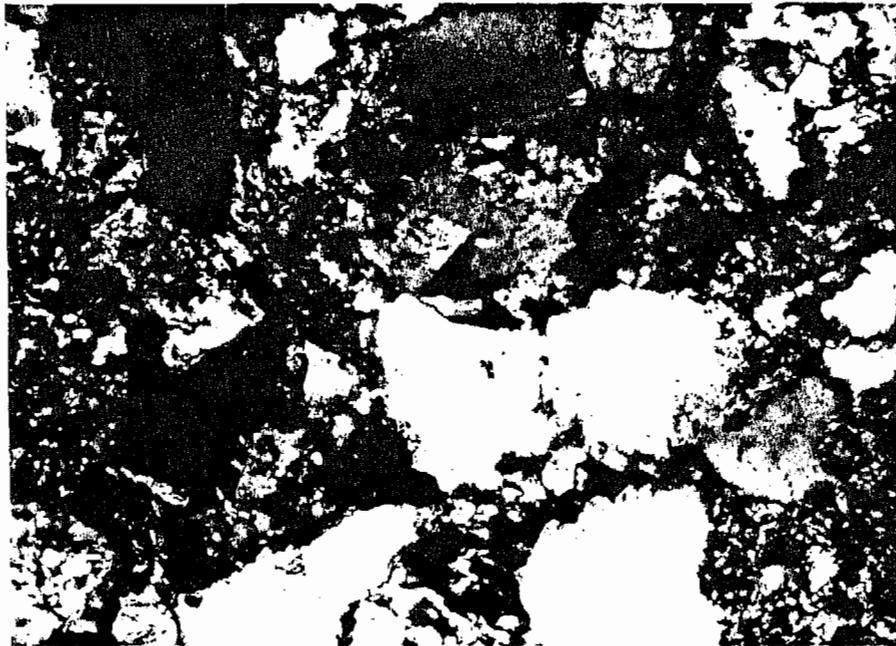


Photo 16. Dolomite replacing detrital grains. 8107.9 ft. Crossed polarizers. 160x.

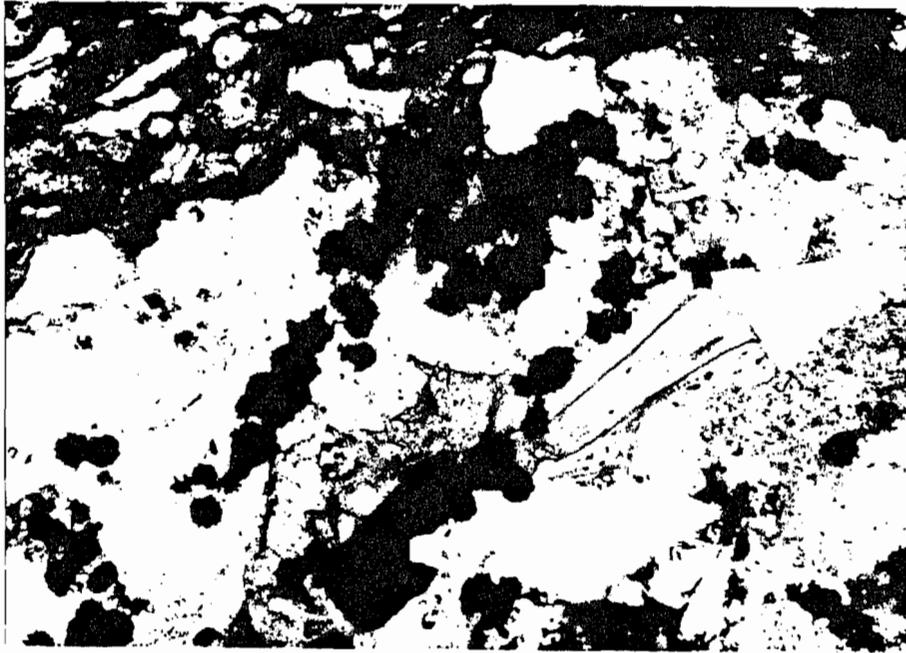


Photo 17. Clusters of pyrite adjacent to a mudstone lens. 8111.1 ft.  
Plane polarized light. 160x.

pyrite as an infilling of cellular structure(?) in a fragment of carbonaceous material (Photo 18).

#### Clay Mineralogy - Corcoran Interval

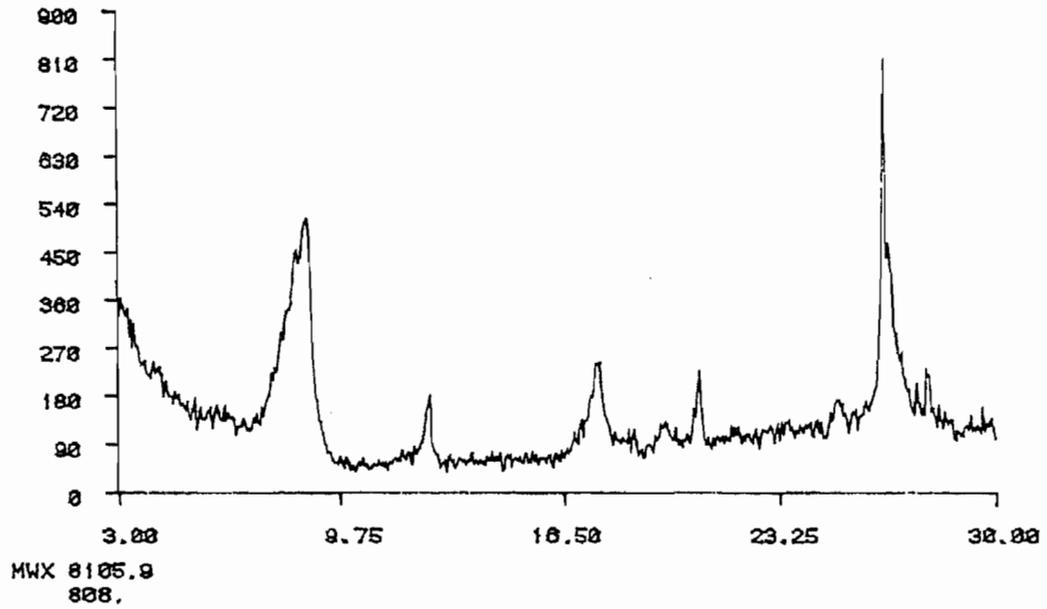
An illite/montmorillonite mixed-layer clay is the predominant clay mineral throughout the Corcoran Interval with kaolinite generally as a minor constituent (Chart 5). Kaolinite does become a major constituent of the clay fraction at 8122.2 ft and 8124.2 ft, but decreases significantly at 8125.9 ft and nearly disappears at the bottom of the Interval (Chart 6).

The general texture and occurrence of the clay minerals are very similar to those in the Cozzette Interval, except that the Corcoran Interval contains very little kaolinite and chlorite. In the samples at 8122.2 ft and 8124.2 ft chlorite occurs in thin veinlets. In the upper sample the chlorite veins follow the bedding, while in the lower sample the veins cut across the bedding. These chlorite veins contain small amounts of vein quartz which probably formed contemporaneously with the chlorite (Photo 19). This vein quartz is more abundant in sandy areas than in clayey zones.

A very small amount of analcime may be present at 8122.2. Analcime peaks were present in the X-ray diffraction pattern of the air-dried clay-sized fraction, however, the match was not very precise because of the oriented nature of the sample.

#### Pore Space - Corcoran Interval

The sandstone zone in the Corcoran Interval is relatively less tightly compacted than those of the Cozzette and Coastal Intervals. Many point contacts are present in this zone and pores are fairly close together with short pore throats. This intergranular pore space, as well as the pore throats are filled with clay. The clay is loosely matted and was impregnated easily. Photo 20 shows the general texture of the pore space in one of the less compacted samples.



BENDIX

Chart 5. Illite/montmorillonite mixed-layer clay is the dominant clay mineral. 8105.9 ft.

Chart 6. General decrease of kaolinite in relation to the illite/montmorillonite mixed-layer clay. 8122.2 ft through 8128.1 ft.

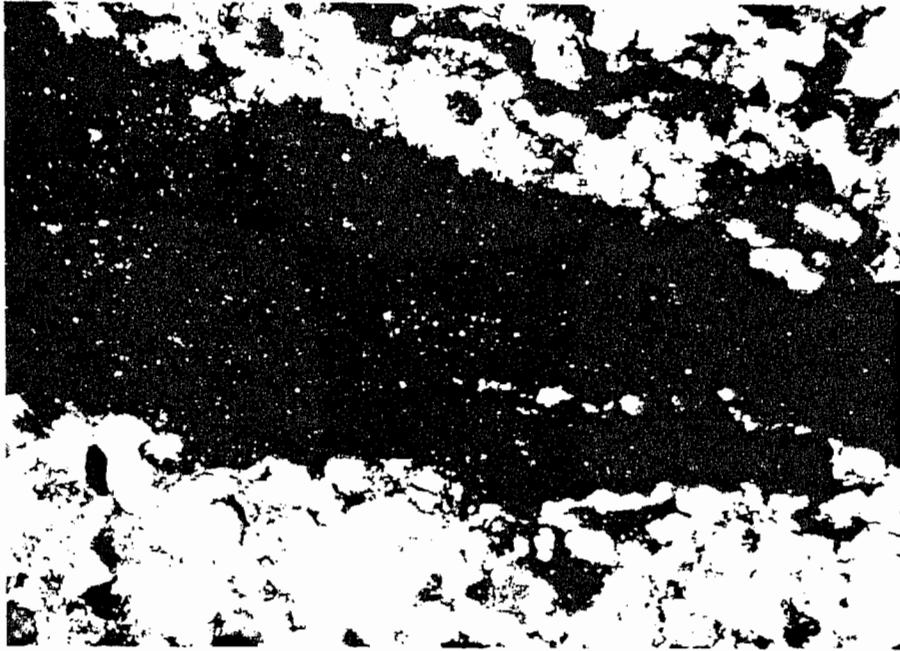


Photo 18. Pyrite as an infilling of cellular structure(?) in a fragment of carbonaceous material. 8113.5 ft. Crossed polarizers with oblique light. 40x.

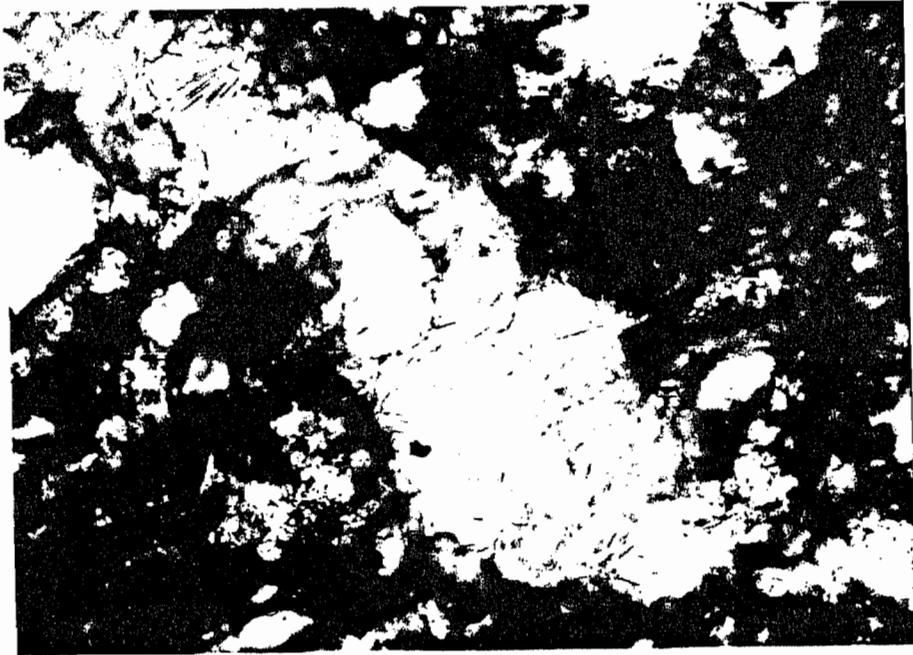


Photo 19. Vein with contemporaneous fine chlorite blades and quartz. 8124.2 ft. Plane polarized light. 400x.

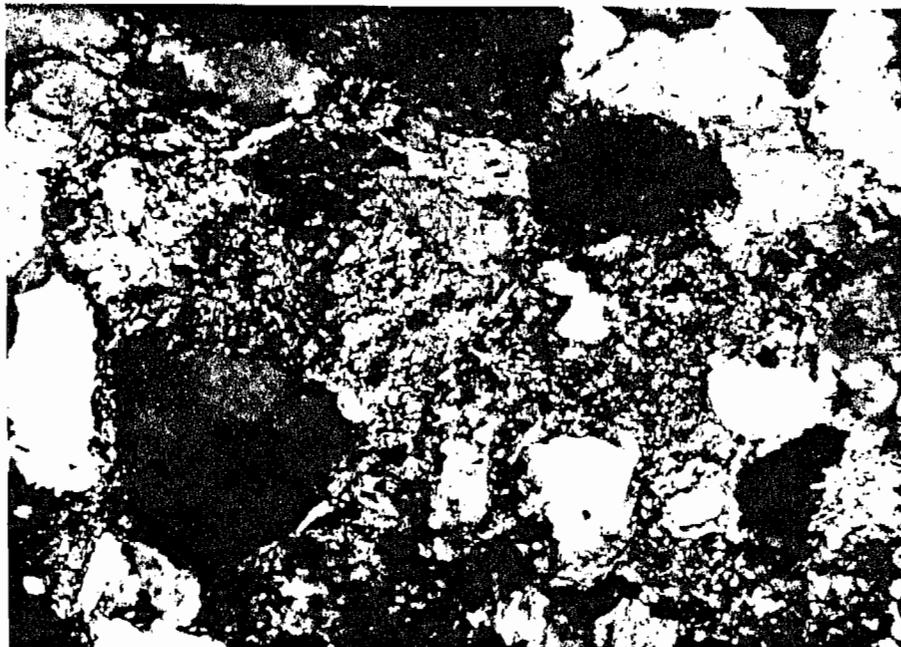


Photo 20. Open fabric with clay-filled pores and many grains with point contacts. 8107.9 ft. Crossed polarizers. 160x.

Although the porosity reported for sand zone samples varies from 9 to 18 percent it should be understood that this variation is not due to the inherent characteristics of the sand but rather it seems to be a reciprocal function of the amount of mudstone lenses in each sample. The mudstone portion significantly reduces the reported porosity because it displaces the more porous sand. The mudstone units at the top and bottom of the Interval probably have a minor amount of internal microporosity, but this is not visible due to the 30 micron depth of the thin sections.

Other factors contributing to the porosity in this Interval are secondary porosity in the altered feldspars and carbonate (from dissolution), and also open pore space (intergranular pores not filled with clay).

#### Paragenesis - Corcoran Interval

The general diagenetic sequence for the Corcoran Interval is very similar to that interpreted for the Cozzette Interval. This sequence is interpreted as follows: Early calcite(?); feldspar alteration; authigenic pyrite, authigenic quartz overgrowths; authigenic clays (including chlorite?); later calcite; dolomitization of calcite; vein chlorite and vein quartz. As is usually the case, most of these events overlap, with many being contemporaneous.

Evidence for an early stage of calcite is the same as previously reported. Calcite is found trapped under authigenic quartz overgrowths (Photo 21). Some feldspar alteration probably occurred prior to deposition, but much of this alteration occurred following deposition and continued throughout the sequence.

Since the mudstone lenses in this Interval are detrital and pyrite may have been present within them prior to deposition, some of the pyrite may also be detrital. The formation of authigenic pyrite could not be adequately positioned in the diagenetic sequence. This authigenic pyrite may have formed early as shown, or sometime later.

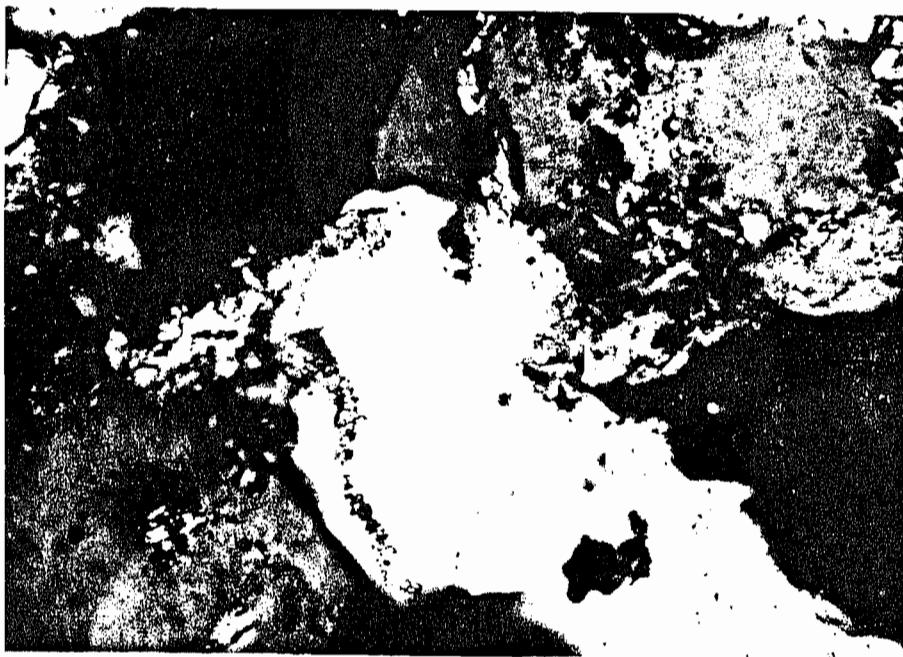


Photo 21. Calcite trapped under authigenic quartz overgrowth.  
8114.9 ft. Crossed polarizers. 400x.

The formation of authigenic quartz overgrowths, authigenic clay and intergranular chlorite, also commenced early in the diagenetic sequence and continued throughout the sequence. Characteristics of the later calcite stage and dolomitization of the calcite is very similar to that reported for the Coastal Interval.

The formation of the chlorite veins with associated vein quartz, occurred late in the sequence. Factors contributing to this formation are: this is a high pressure/low temperature feature; water was liberated from the clays at high pressure; magnesium and aluminum were available in the clay-rich zone forming chlorite along fractures; and silica was available from pressure solution in the sandy zones. Consequently vein quartz concentrated with the chlorite in the sandy areas.

#### SUMMARY

The sandstones in the Cozzette and Corcoran Intervals are generally very fine-grained, with minimal mineralogic variations between these intervals and the previously described intervals (Coastal, Cozzette [MWX-1]). The overlap zone of the Cozzette Interval between cores MWX-1 and MWX-2, showed a very good correlation at similar hole depths.

Pore space in the Cozzette Interval is characterized by small, randomly spaced, clay-filled pores, as is the case with the Coastal Interval. In the Corcoran Interval, however, the pores, though filled with clay, are relatively larger and more closely spaced than in the Cozzette Interval. This characteristic may be controlled by compaction differences and the relatively coarser sands in the Corcoran Interval (even though the sands of both intervals are within the same size range classification). The permeability of these samples is probably controlled by clay mineral morphology in the pores and pore throats. Very few open pores are present in any of these Intervals.

Organic material clogging pore space at the top of the Cozzette Interval also significantly influences the porosity characteristics of this zone. This organic material may be the pyrobytumins referred to by Chuck Spencer (U.S.G.S.) in his letter to Dave Northrop (Sandia National Laboratories), dated August 18, 1982.

Since this is a preliminary and general petrologic investigation, further study may be necessary to better understand the relationships between clay morphology and porosity/permeability controls in these samples. It may also be interesting to see if the upper organic zone found in the Cozzette Interval MWX-2 is also present in the MWX-1 Core.

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APPENDIX A  
SUMMARY OF RESULTS  
COZZETTE INTERVAL MWX-2

| DEPTH<br>(ft) | ROCK NAME            | MEAN GRAIN<br>SIZE (mm) | % PORE<br>SPACE | % CARBONATE<br>CALCITE/DOLOMITE | CLAY ANALYSES<br>(BY XRD) |
|---------------|----------------------|-------------------------|-----------------|---------------------------------|---------------------------|
| 7832.2        | Lithic Arenite       | 0.13                    | 2               | tr/7                            | X                         |
| 7849.8        | Feld. Litharenite    | 0.13                    | 5               | tr/4                            | -                         |
| 7853.8        | Sublitharenite       | 0.08                    | 13              | -/7                             | X                         |
| 7855.2        | Lithic Arenite       | 0.11                    | 13              | -/4                             | -                         |
| 7856.2        | Subarkose            | 0.09                    | 10              | -/5                             | -                         |
| 7857.2        | Subarkose            | 0.08                    | 12              | -/6                             | -                         |
| 7858.2        | Subarkose            | 0.08                    | 11              | -/7                             | X                         |
| 7859.8        | Calc. Sublitharenite | 0.08                    | 11              | 21/8                            | X                         |
| 7861.8        | Subarkose            | 0.09                    | 13              | 4/3                             | -                         |
| 7863.8        | Subarkose            | 0.08                    | 8               | 3/4                             | -                         |
| 7865.8        | Subarkose            | 0.07                    | 11              | 1/6                             | X                         |
| 7868.4        | Calc. Subarkose      | 0.08                    | 7               | 10/23                           | X                         |
| 7870.8        | Subarkose            | 0.07                    | 14              | -/5                             | X                         |
| 7872.9        | Subarkose            | 0.08                    | 16              | tr/5                            | -                         |
| 7874.2        | Subarkose            | 0.07                    | 18              | -/6                             | -                         |
| 7877.2        | Subarkose            | 0.07                    | 17              | -/3                             | X                         |
| 7879.8        | Subarkose            | 0.07                    | 7               | -/10                            | -                         |
| 7882.4        | Subarkose            | 0.07                    | 6               | tr/9                            | X                         |
| 7884.8        | Subarkose            | 0.07                    | 14              | -/9                             | -                         |
| 7889.2        | Subarkose            | 0.07                    | 13              | -/14                            | X                         |
| 7890.9        | Subarkose            | 0.06                    | 7               | -/9                             | -                         |
| 7892.8        | Subarkose            | 0.06                    | 14              | -/11                            | X                         |
| 7898.1        | Subarkose            | 0.06                    | 3               | -/9                             | X                         |

APPENDIX B  
SUMMARY OF RESULTS  
CORCORAN INTERVAL MWX-2

| DEPTH<br>(ft) | ROCK NAME      | MEAN GRAIN<br>SIZE (mm) | % PORE<br>SPACE | % CARBONATE<br>CALCITE/DOLOMITE | CLAY ANALYSES<br>(BY XRD) |
|---------------|----------------|-------------------------|-----------------|---------------------------------|---------------------------|
| 8105.9        | Sandy Mudstone | 0.13*                   | -               | tr/Dom**                        | X                         |
| 8107.9        | Sublitharenite | 0.11                    | 18              | 1/6                             | X                         |
| 8108.7        | Subarkose      | 0.11                    | 9               | 1/6                             | -                         |
| 8110.2        | Lithic Arenite | 0.11                    | 11              | tr/1                            | -                         |
| 8111.1        | Sublitharenite | 0.11                    | 17              | tr/4                            | -                         |
| 8111.9        | Sublitharenite | 0.10                    | 15              | -/7                             | X                         |
| 8113.5        | Subarkose      | 0.10                    | 16              | -/5                             | -                         |
| 8114.2        | Sublitharenite | 0.10                    | 18              | -/6                             | -                         |
| 8114.9        | Sublitharenite | 0.11                    | 16              | -/5                             | X                         |
| 8116.2        | Sublitharenite | 0.11                    | 12              | -/6                             | -                         |
| 8116.9        | Sublitharenite | 0.12                    | 15              | -/5                             | -                         |
| 8119.8        | Sublitharenite | 0.10                    | 14              | -/4                             | X                         |
| 8121.2        | Sublitharenite | 0.09                    | 13              | -/7                             | -                         |
| 8122.2        | Sublitharenite | 0.11                    | 15              | -/6                             | X                         |
| 8124.2        | Sandy Mudstone | -                       | -               | -/Dom**                         | X                         |
| 8125.9        | Mudstone       | -                       | -               | -/-                             | X                         |
| 8128.1        | Mudstone       | -                       | -               | -/-                             | X                         |

\*Sand-sized detritus  
\*\*By X-ray diffraction

APPENDIX C  
 PRIORITY INTERVALS AND  
 THE TENTATIVE DATES OF COMPLETION  
 (IN ORDER OF PRIORITY) FOR  
 MINERALOGY AND PETROLOGY ANALYSES

| <u>Priority</u> | <u>Depth</u> | <u>Well</u> | <u>Interval</u>     | <u>Tentative<br/>Completion<br/>Date</u> |
|-----------------|--------------|-------------|---------------------|--|
| 1               | 6345-6580    | MWX-1       | Coastal             | 06/30/82                                 |
| 2               | 7817-7900    | MWX-1       | Cozlette            | 06/30/82                                 |
| 3               | 7832-8141    | MWX-2       | Corcoran & Cozlette | 08/15/82                                 |
| 4               | 5690-5870    | MWX-1       | Fracture Zone       | 09/15/82                                 |
| 5               | 7080-7390    | MWX-2       | Paludal             | 11/05/82                                 |
| 6               | 6400-6580    | MWX-2       | Coastal             | 11/28/82                                 |
| 7               | 4840-4960    | MWX-1       | High Fluvial I      | 12/31/82                                 |
| 8               | 4180-4400    | MWX-1       | Top                 | 02/07/83                                 |
| 9               | 5690-5870    | MWX-2       | Fracture Zone       | 02/28/83                                 |
| 10              | 4490-4840    | MWX-1       | High Fluvial II     | 04/28/83                                 |
| 11              | 4690-5300    | MWX-1       | Mid Fluvial I       | 06/13/83                                 |
| 12              | 5300-5690    | MWX-1       | Mid Fluvial II      | 08/08/83                                 |
| 13              | 5870-6345    | MWX-1       | Low Fluvial         | 09/23/83                                 |
| 14              | 6580-6830    | MWX-1       | Bottom Fluvial      | 10/18/83                                 |
| 15              | 4880-4950    | MWX-2       | High Fluvial I      | 11/18/83                                 |

APPENDIX D  
PETROGRAPHIC DATA SHEETS  
COZZETTE INTERVAL MWX-2









MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7856.2  
 INTERVAL: Cozette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 27, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.09  
 Grain Size Range (mm): 0.02 to 0.16

% Pore Space: 10  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples, porosity is also similar; pore throats may be more prominent in this sample.

| <u>COMPOSITION</u>       | <u>%</u>   | <u>COMMENTS</u> |
|--------------------------|------------|-----------------|
| Quartz                   | 65         |                 |
| K-feldspar               | 1          |                 |
| Plagioclase              | 10         |                 |
| Chert                    | 1          |                 |
| Lithics                  | 4          |                 |
| Authigenic Minerals      |            |                 |
| Silica O. gr.            | 4          |                 |
| Calcite                  | -          |                 |
| Dolomite                 | 5          | (Twinned)       |
| Muscovite                | tr         |                 |
| Biotite                  | tr         |                 |
| Opagues                  | tr         |                 |
| Accessory Minerals       |            |                 |
| Zircon                   | tr         |                 |
| Voids w/o Clay           | tr         |                 |
| Voids w/Clay             | 10         |                 |
| Clay Minerals            | tr         |                 |
| Kaolinite<br>(Assumed)   | Sub<br>dom |                 |
| Chlorite<br>(Assumed)    | tr         |                 |
| Mixed Layer<br>(Assumed) | dom        |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7857.2  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 27, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.08  
 Grain Size Range (mm): 0.02 to 0.16

% Pore Space: 12  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples.

| <u>COMPOSITION</u>       | <u>%</u>   | <u>COMMENTS</u>                    |
|--------------------------|------------|------------------------------------|
| Quartz                   | 65         |                                    |
| K-feldspar               | 1          |                                    |
| Plagioclase              | 6          |                                    |
| Chert                    | 1          |                                    |
| Lithics                  | 5          |                                    |
| Authigenic Minerals      |            |                                    |
| Silica 0. gr.            | 3          |                                    |
| Calcite                  | -          |                                    |
| Dolomite                 | 6          | (Twinned)                          |
| Muscovite                | tr         |                                    |
| Biotite                  | tr         |                                    |
| Opaques                  | tr         |                                    |
| Accessory Minerals       |            |                                    |
| Tourmaline               | tr         |                                    |
| Zircon                   | tr         |                                    |
| Other                    | tr         | Detrital chalcedony                |
| Voids w/o Clay           | tr         |                                    |
| Voids w/Clay             | 12         |                                    |
| Clay Minerals            | 1          | Did not impregnate with blue epoxy |
| Kaolinite<br>(Assumed)   | Sub<br>dom |                                    |
| Chlorite<br>(Assumed)    | tr         |                                    |
| Mixed Layer<br>(Assumed) | Dom        |                                    |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7852.2  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 27, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.08  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 11  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples.

| <u>COMPOSITION</u>     | <u>%</u>   | <u>COMMENTS</u> |
|------------------------|------------|-----------------|
| Quartz                 | 62         |                 |
| K-feldspar             | 1          |                 |
| Plagioclase            | 8          |                 |
| Chert                  | 2          |                 |
| Lithics                | 5          |                 |
| Authigenic Minerals    |            |                 |
| Silica 0. gr.          | 2          |                 |
| Calcite                | -          |                 |
| Dolomite               | 7          | Twinned         |
| Muscovite              | tr         |                 |
| Biotite                | tr         |                 |
| Opaques                | tr         |                 |
| Accessory Minerals     |            |                 |
| Zircon                 | tr         |                 |
| Voids w/o Clay         | tr         |                 |
| Voids w/Clay           | 11         |                 |
| Clay Minerals          | 2          |                 |
| Kaolinite<br>(X-ray)   | Sub<br>dom |                 |
| Chlorite<br>(X-ray)    | tr         |                 |
| Mixed Layer<br>(X-ray) | Dom        |                 |



MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7861.8  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 27, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.09  
 Grain Size Range (mm): 0.02 to 0.16

% Pore Space: 13  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous sample except for distinct decrease in carbonate content. Porosity is dominated by clay-filled voids and pore throats. Lesser secondary porosity caused by dissolution of calcite.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>                       |
|--------------------------|----------|---------------------------------------|
| Quartz                   | 63       |                                       |
| K-feldspar               | tr       |                                       |
| Plagioclase              | 9        |                                       |
| Chert                    | 1        |                                       |
| Lithics                  | 3        |                                       |
| Authigenic Minerals      |          |                                       |
| Silica 0. gr.            | 3        |                                       |
| Calcite                  | 4        | (Twinned)                             |
| Dolomite                 | 3        | (Twinned)                             |
| Muscovite                | tr       |                                       |
| Biotite                  | tr       |                                       |
| Opaques                  | tr       | Some patches could be altered lithics |
| Accessory Minerals       |          |                                       |
| Zircon                   | tr       |                                       |
| Voids w/o Clay           | tr       |                                       |
| Voids w/Clay             | 13       |                                       |
| Clay Minerals            | 1        |                                       |
| Kaolinite<br>(Assumed)   | Mod      |                                       |
| Chlorite<br>(Optically)  | tr       |                                       |
| Mixed Layer<br>(Assumed) | Dom      |                                       |



MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7865.8  
 INTERVAL: Cozzette (MWX-2)  
 Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.16

Petrologist: M. O. Eatough  
 Date: July 28, 1982  
 % Pore Space: 11  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples. Pores appear to be somewhat smaller in this sample. Kaolinite content also increases significantly.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>        |
|------------------------|----------|------------------------|
| Quartz                 | 61       |                        |
| K-feldspar             | 1        |                        |
| Plagioclase            | 10       |                        |
| Chert                  | tr       |                        |
| Lithics                | 3        |                        |
| Authigenic Minerals    |          |                        |
| Silica O. gr.          | 3        |                        |
| Calcite                | 1        |                        |
| Dolomite               | 6        |                        |
| Muscovite              | 1        |                        |
| Biotite                | tr       |                        |
| Opaques                | tr       |                        |
| Accessory Minerals     |          |                        |
| Zircon                 | tr       |                        |
| Voids w/o Clay         | tr       |                        |
| Voids w/Clay           | 11       |                        |
| Clay Minerals          | 2        |                        |
| Kaolinite<br>(X-ray)   | Dom      |                        |
| Chlorite<br>(X-ray)    | tr       |                        |
| Mixed Layer<br>(X-ray) | Mod      | Illite/montmorillonite |



MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7870.8  
 INTERVAL: Cozzette (MWX-2)  
 Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.15

Petrologist: M. O. Eatough  
 Date: July 28, 1982  
 % Pore Space: 14  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy in this sample is very similar to the samples from 7853.8 ft to 7858.2 ft and the samples in the upper part of the Cozzette Interval of MWX-1 (787.12 to 7896.7). Porosity is dominated by clay-filled pores and pore throats. A few open voids are also present.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u> |
|------------------------|----------|-----------------|
| Quartz                 | 65       |                 |
| K-feldspar             | tr       |                 |
| Plagioclase            | 7        |                 |
| Chert                  | 1        |                 |
| Lithics                | 2        |                 |
| Authigenic Minerals    |          |                 |
| Silica 0. gr.          | 5        |                 |
| Calcite                | -        |                 |
| Dolomite               | 5        |                 |
| Muscovite              | tr       |                 |
| Biotite                | tr       |                 |
| Opaques                | tr       |                 |
| Accessory Minerals     |          |                 |
| Zircon                 | tr       |                 |
| Voids w/o Clay         | 1        |                 |
| Voids w/Clay           | 13       |                 |
| Clay Minerals          | 1        |                 |
| Kaolinite<br>(X-ray)   | Dom      |                 |
| Chlorite<br>(X-ray)    | tr       |                 |
| Mixed Layer<br>(X-ray) | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7872.9  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 28, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.08  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 16  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy is very similar to previous sample. Porosity is also similar, but may contain more large clay-filled pores.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u> |
|--------------------------|----------|-----------------|
| Quartz                   | 60       |                 |
| K-feldspar               | tr       |                 |
| Plagioclase              | 6        |                 |
| Chert                    | 1        |                 |
| Lithics                  | 3        |                 |
| Authigenic Minerals      |          |                 |
| Silica 0. gr.            | 7        |                 |
| Calcite                  | tr       |                 |
| Dolomite                 | 5        |                 |
| Muscovite                | 1        |                 |
| Biotite                  | tr       |                 |
| Opaques                  | tr       |                 |
| Accessory Minerals       |          |                 |
| Zircon                   | tr       |                 |
| Voids w/o Clay           | 1        |                 |
| Voids w/Clay             | 15       |                 |
| Clay Minerals            |          |                 |
| Kaolinite<br>(Assumed)   | Dom      |                 |
| Chlorite<br>(Assumed)    | tr       |                 |
| Mixed Layer<br>(Assumed) | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7874.2  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 28, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 18  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy is very similar to previous samples. Porosity is also very similar.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u> |
|--------------------------|----------|-----------------|
| Quartz                   | 62       |                 |
| K-feldspar               | tr       |                 |
| Plagioclase              | 7        |                 |
| Chert                    | 1        |                 |
| Lithics                  | 1        |                 |
| Authigenic Minerals      |          |                 |
| Silica 0. gr.            | 3        |                 |
| Calcite                  | -        |                 |
| Dolomite                 | 6        |                 |
| Muscovite                | tr       |                 |
| Biotite                  | tr       |                 |
| Opaques                  | tr       |                 |
| Accessory Minerals       |          |                 |
| Zircon                   | tr       |                 |
| Voids w/o Clay           | 1        |                 |
| Voids w/Clay             | 17       |                 |
| Clay Minerals            | 2        |                 |
| Kaolinite<br>(Assumed)   | Dom      |                 |
| Chlorite<br>(Assumed)    | tr       |                 |
| Mixed Layer<br>(Assumed) | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: 7877.2  
 INTERVAL: Cozzette (MWX-2)  
 Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.15

Petrologist: M. O. Eatough  
 Date: July 28, 1982  
 % Pore Space: 17  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy and porosity is very similar to previous samples.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>        |
|------------------------|----------|------------------------|
| Quartz                 | 63       |                        |
| K-feldspar             | tr       |                        |
| Plagioclase            | 7        |                        |
| Chert                  | tr       |                        |
| Lithics                | 5        |                        |
| Authigenic Minerals    |          |                        |
| Silica 0. gr.          | 3        |                        |
| Calcite                | -        |                        |
| Dolomite               | 3        |                        |
| Muscovite              | tr       |                        |
| Biotite                | tr       |                        |
| Opaques                | tr       |                        |
| Accessory Minerals     |          |                        |
| Zircon                 | tr       |                        |
| Voids w/o Clay         | 1        |                        |
| Voids w/Clay           | 16       |                        |
| Clay Minerals          |          |                        |
| Kaolinite<br>(X-ray)   | Dom      |                        |
| Chlorite<br>(X-ray)    | tr       |                        |
| Mixed Layer<br>(X-ray) | Mod      | Illite/montmorillonite |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7879.8

Petrologist: M. O. Eatough

INTERVAL: Cozzette (MWX-2)

Date: July 28, 1982

Rock Type: Subarkose

% Pore Space: 7

Mean Grain Size (um): 0.07

Sorting (est.): Well

Grain Size Range (um): 0.02 to 0.15

Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples. Fewer pore throats were observed in this sample.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u> |
|--------------------------|----------|-----------------|
| Quartz                   | 62       |                 |
| K-feldspar               | tr       |                 |
| Plagioclase              | 11       |                 |
| Chert                    | 1        |                 |
| Lithics                  | 3        |                 |
| Authigenic Minerals      |          |                 |
| Silica 0. gr.            | 5        |                 |
| Calcite                  | -        |                 |
| Dolomite                 | 10       |                 |
| Muscovite                | tr       |                 |
| Biotite                  | tr       |                 |
| Opaques                  | tr       |                 |
| Accessory Minerals       |          |                 |
| Zircon                   | tr       |                 |
| Voids w/c Clay           | 2        |                 |
| Voids w/Clay             | 5        |                 |
| Clay Minerals            | 3        |                 |
| Kaolinite<br>(Assumed)   | Dom      |                 |
| Chlorite<br>(Assumed)    | tr       |                 |
| Mixed Layer<br>(Assumed) | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7882.4  
 INTERVAL; Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 28, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 6  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples. Pores are generally smaller than in previous samples. Few pore throats observed.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>                |
|------------------------|----------|--------------------------------|
| Quartz                 | 69       |                                |
| K-feldspar             | tr       |                                |
| Plagioclase            | 8        |                                |
| Chert                  | 1        |                                |
| Lithics                | 2        |                                |
| Authigenic Minerals    |          |                                |
| Silica 0. gr.          | 3        |                                |
| Calcite                | tr       | Very few globs of microsparite |
| Dolomite               | 9        |                                |
| Muscovite              | tr       |                                |
| Biotite                | tr       |                                |
| Opaques                | tr       |                                |
| Accessory Minerals     |          |                                |
| Zircon                 | tr       |                                |
| Voids w/o Clay         | 1        |                                |
| Voids w/Clay           | 5        |                                |
| Clay Minerals          |          |                                |
| Kaolinite<br>(X-ray)   | Dom      |                                |
| Chlorite<br>(X-ray)    | tr       |                                |
| Mixed Layer<br>(X-ray) | Dom      | Illite/montmorillonite         |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7884.8  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 28, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 14  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples. Porosity increases to previous levels.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u> |
|--------------------------|----------|-----------------|
| Quartz                   | 62       |                 |
| K-feldspar               | 1        |                 |
| Plagioclase              | 7        |                 |
| Chert                    | tr       |                 |
| Lithics                  | 3        |                 |
| Authigenic Minerals      |          |                 |
| Silica 0. gr.            | 4        |                 |
| Calcite                  | -        |                 |
| Dolomite                 | 9        |                 |
| Muscovite                | tr       |                 |
| Biotite                  | tr       |                 |
| Opaques                  | tr       |                 |
| Accessory Minerals       |          |                 |
| Zircon                   | tr       |                 |
| Voids w/o Clay           | 1        |                 |
| Voids w/Clay             | 13       |                 |
| Clay Minerals            | 1        |                 |
| Kaolinite<br>(Assumed)   | Dom      |                 |
| Chlorite<br>(Assumed)    | tr       |                 |
| Mixed Layer<br>(Assumed) | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7889.2  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 28, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.07  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 13  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples. A few ferruginous clay lenses observed.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>        |
|------------------------|----------|------------------------|
| Quartz                 | 55       |                        |
| K-feldspar             | 1        |                        |
| Plagioclase            | 8        |                        |
| Chert                  | tr       |                        |
| Lithics                | 3        |                        |
| Authigenic minerals    |          |                        |
| Silica O. gr.          | 5        |                        |
| Dolomite               | 14       |                        |
| Muscovite              | tr       |                        |
| Biotite                | tr       |                        |
| Opaques                | tr       |                        |
| Accessory Minerals     |          |                        |
| Zircon                 | tr       |                        |
| Other                  | tr       | Ferruginous clay       |
| Voids w/o Clay         | 1        |                        |
| Voids w/Clay           | 12       |                        |
| Clay Minerals          | 1        |                        |
| Kaolinite<br>(X-ray)   | Mod      |                        |
| Chlorite<br>(X-ray)    | tr       |                        |
| Mixed Layer<br>(X-ray) | Dom      | Illite/montmorillonite |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7890.9  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 29, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.06  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 7  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples. Pore space may be more than what was point counted.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>        |
|------------------------|----------|------------------------|
| Quartz                 | 66       |                        |
| K-feldspar             | 1        |                        |
| Plagioclase            | 7        |                        |
| Chert                  | tr       |                        |
| Lithics                | 4        |                        |
| Authigenic Minerals    |          |                        |
| Silica 0. gr.          | 5        |                        |
| Calcite                | -        |                        |
| Dolomite               | 9        |                        |
| Muscovite              | tr       |                        |
| Biotite                | tr       |                        |
| Opaques                | tr       |                        |
| Accessory Minerals     |          |                        |
| Zircon                 | tr       |                        |
| Voids w/o Clay         | tr       |                        |
| Voids w/Clay           | 7        |                        |
| Clay Minerals          |          |                        |
| Kaolinite<br>(X-ray)   | Mod      |                        |
| Chlorite<br>(X-ray)    | tr       |                        |
| Mixed Layer<br>(X-ray) | Dom      | Illite/montmorillonite |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7892.8  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 29, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.06  
 Grain Size Range (mm): 0.02 to 0.15

% Pore Space: 14  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Very similar to previous samples.

| <u>COMPOSITION</u>      | <u>%</u> | <u>COMMENTS</u> |
|-------------------------|----------|-----------------|
| Quartz                  | 60       |                 |
| K-feldspar              | tr       |                 |
| Plagioclase             | 5        |                 |
| Chert                   | tr       |                 |
| Lithics                 | 2        |                 |
| Authigenic Minerals     |          |                 |
| Silica 0. gr.           | 6        |                 |
| Calcite                 | -        |                 |
| Dolomite                | 11       |                 |
| Muscovite               | tr       |                 |
| Biotite                 | tr       |                 |
| Opagues                 | 1        |                 |
| Voids w/o Clay          | tr       |                 |
| Voids w/Clay            | 14       |                 |
| Clay Minerals           |          |                 |
| Kaolinite<br>(X-ray)    | Minor    |                 |
| Chlorite<br>(Optically) | tr       |                 |
| Mixed Layer<br>(X-ray)  | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-7898.1  
 INTERVAL: Cozzette (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 29, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.06  
 Grain Size Range (mm): 0.02 to 0.12

% Pore Space: 3  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogically similar to previous samples. Sample appears to be more tightly compacted with non-porous clay. Distinct decrease in porosity. Large rounded structure observed in thin section may be worm burrow filled with detritus and lined with ferruginous clay. Could also be some other type of sedimentary deformation. Ferruginous clay also occurs in stringers radiating to or from round structure.

| <u>COMPOSITION</u>      | <u>%</u> | <u>COMMENTS</u>                                       |
|-------------------------|----------|---|
| Quartz                  | 59       |   |
| K-feldspar              | tr       |   |
| Plagioclase             | 4        |   |
| Chert                   | 1        |   |
| Lithics                 | 3        |   |
| Authigenic Minerals     |          |   |
| Silica O. gr.           | 4        |   |
| Calcite                 | -        |   |
| Dolomite                | 9        |   |
| Muscovite               | tr       |   |
| Biotite                 | tr       |   |
| Other                   | 12       | Veinlet? of Fe clay, carbonate and opaque (hematite?) |
| Voids w/o Clay          | tr       |   |
| Voids w/Clay            | 3        |   |
| Clay Minerals           | 6        |   |
| Kaolinite<br>(X-ray)    | Minor    |   |
| Chlorite<br>(Optically) | tr       |   |
| Mixed Layer<br>(X-ray)  | Dom      |   |

APPENDIX E  
PETROGRAPHIC DATA SHEETS  
CORCORAN INTERVAL MWX-2

MULTI-WELL PETROGRAPHIC ANALYSIS

|                                      |                             |
|--------------------------------------|-----------------------------|
| SAMPLE NO: MWX 8105.9                | Petrologist: M. O. Eatough  |
| INTERVAL: Corcoran (MWX-2)           | Date: July 29, 1982         |
| Rock Type: Sandy Mudstone            | % Pore Space: Microporosity |
| *Mean Grain Size (mm): 0.13          | in clay                     |
| *Grain Size Range (mm): 0.02 to 0.45 | Sorting (est.): Poor        |
|                                      | Angularity (est.): A to SR  |

GENERAL DESCRIPTION: Sand-sized detritus floating in a silty clay. Sand-sized detritus usually occurs in lenses which are contorted by sedimentary deformation. Porosity is limited to microporosity in clays, minute fractures and secondary porosity in altered feldspars and lithics.

| <u>COMPOSITION</u>  | <u>%</u> | <u>COMMENTS</u>   |
|---------------------|----------|---|
| Quartz              | 15       | Mostly monocrystalline; few polycrystalline                     |
| K-feldspar          | tr       | Microcline  |
| Plagioclase         | 1        |   |
| Chert               | 2        |   |
| Lithics             | 5        | Carbonate clasts, claystone and plutonic; possibly few volcanic |
| Authigenic Minerals |          |   |
| Calcite             | tr       |   |
| Dolomite            | Dom      | Mixed with clay   |
| Opagues             | 1        | Sand-sized detrital grains                                      |
| Other               | tr       | Stringers of carbonaceous material along bedding planes         |
| Clay Minerals       | 77       | Matrix of silty clay  |
| Kaolinite (X-ray)   | Minor    |   |
| Chlorite (X-ray)    | tr       |   |
| Mixed Layer (X-ray) | Dom      |   |

\*Sand-sized detrital grains

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8107.9  
 INTERVAL: Corcoran (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 29, 1982

Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.04 to 0.30

% Pore Space: 18  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Grain contacts are generally concavo-convex and sutured; many point contacts allowing for very short pore throats. Abundant intergranular pore space filled with clay. Very few open voids. Lenses of calcareous silty clay with floating sand are common. Small fractures are filled with dolomite and ferruginous clay.

| <u>COMPOSITION</u>  | <u>%</u> | <u>COMMENTS</u>  |
|---------------------|----------|--|
| Quartz              | 53       | Monocrystalline few polycrystalline; few very undulose                                   |
| K-feldspar          | tr       | Perthite   |
| Plagioclase         | 5        | Slightly to totally altered to clay and sericite   |
| Chert               | 2        |  |
| Lithics             | 6        | Claystone and carbonate clasts   |
| Authigenic Minerals |          |  |
| Silica O. gr.       | 5        |  |
| Calcite             | 1        | As cement, (twinned)   |
| Dolomite            | 6        | Often replacing detritus; very few rhombs (twinned)                                      |
| Muscovite           | tr       |  |
| Biotite             | tr       |  |
| Opagues             | tr       | Few detrital grains; mostly as interstitial patches which are either globular or massive |
| Accessory Minerals  |          |  |
| Zircon              | tr       |  |
| Voids w/o Clay      | tr       |  |
| Voids w/Clay        | 18       |  |
| Clay Minerals       | 3        | Not impregnated with blue epoxy  |
| Kaolinite (X-ray)   | Mod      |  |
| Chlorite (X-ray)    | tr       |  |
| Mixed Layer (X-ray) | Dom      | Illite/montmorillonite   |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8108.7  
 INTERVAL: Corcoran (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 29, 1982

Rock Type: Subarkose  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.04 to 0.33

% Pore Space: 9  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Detrital mineralogy is similar to previous sample. Large deformed calcareous silty clay lenses are common. This sample is much more tightly compacted than the previous sample.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>                                   |
|--------------------------|----------|---|
| Quartz                   | 52       |   |
| K-feldspar               | tr       |   |
| Plagioclase              | 6        |   |
| Chert                    | 1        |   |
| Lithics                  | 4        |   |
| Authigenic Minerals      |          |   |
| Silica 0. gr.            | 3        |   |
| Calcite                  | 1        |   |
| Dolomite                 | 6        |   |
| Muscovite                | tr       |   |
| Biotite                  | tr       |   |
| Opagues                  | tr       | Few detrital grains; clusters of pyrite framboids |
| Accessory Minerals       |          |   |
| Zircon                   | tr       |   |
| Voids w/o Clay           | tr       |   |
| Voids w/Clay             | 9        |   |
| Clay Minerals            | 18       | Lenses of clay, carbonate, opaques and silt       |
| Kaolinite<br>(Assumed)   | Mod      |   |
| Chlorite<br>(Assumed)    | tr       |   |
| Mixed Layer<br>(Assumed) | Dom      |   |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8110.2  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Lithic Arenite  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.03 to 0.27

Petrologist: M. O. Eatough  
 Date: July 29, 1982  
 % Pore Space: 11  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Detrital mineralogy is similar to previous samples. This rock is not as tightly compacted as at 8108.7 ft.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>                                 |
|--------------------------|----------|---|
| Quartz                   | 27       | Trace of metamorphic quartz also observed       |
| K-feldspar               | tr       |   |
| Plagioclase              | 6        |   |
| Chert                    | 1        |   |
| Lithics                  | 4        |   |
| Authigenic Minerals      |          |   |
| Silica 0. gr.            | 3        |   |
| Calcite                  | tr       |   |
| Colomite                 | 1        |   |
| Muscovite                | tr       |   |
| Biotite                  | tr       |   |
| Opaques                  | 1        | Clusters of pyrite framboids near clay lenses   |
| Accessory Minerals       |          |   |
| Zircon                   | tr       |   |
| Other                    | 45       | Calcareous silty clay lenses with floating sand |
| Voids w/o Clay           | tr       |   |
| Voids w/Clay             | 11       |   |
| Clay Minerals            | 2        | Interstitial clay not impregnated               |
| Kaolinite<br>(Assumed)   | Mod      |   |
| Chlorite<br>(Assumed)    | tr       |   |
| Mixed Layer<br>(Assumed) | Dom      |   |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8111.1  
 INTERVAL: Corcoran (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 29, 1982

Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.03 to 0.24

% Pore Space: 17  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Detrital mineralogy is very similar to previous samples.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>                   |
|--------------------------|----------|-----------------------------------|
| Quartz                   | 59       |                                   |
| K-feldspar               | tr       |                                   |
| Plagioclase              | 4        |                                   |
| Chert                    | 2        |                                   |
| Lithics                  | 5        |                                   |
| Authigenic Minerals      |          |                                   |
| Silica 0. gr.            | 2        |                                   |
| Calcite                  | tr       |                                   |
| Dolomite                 | 4        |                                   |
| Accessory Minerals       |          |                                   |
| Zircon                   | tr       |                                   |
| Other                    | 3        | Calcareous silty clay lenses      |
| Voids w/o Clay           | tr       |                                   |
| Voids w/Clay             | 17       |                                   |
| Clay Minerals            | 2        | Non-impregnated interstitial clay |
| Kaolinite<br>(Assumed)   | Mod      |                                   |
| Chlorite<br>(Assumed)    | tr       |                                   |
| Mixed Layer<br>(Assumed) | Dom      |                                   |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8111.9  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.10  
 Grain Size Range (mm): 0.03 to 0.21

Petrologist: M. O. Eatough  
 Date: July 20, 1982  
 % Pore Space: 15  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Detrital mineralogy is very similar to previous samples. Porosity is also very similar.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>        |
|------------------------|----------|------------------------|
| Quartz                 | 60       |                        |
| K-feldspar             | tr       |                        |
| Plagioclase            | 6        |                        |
| Chert                  | 2        |                        |
| Lithics                | 6        |                        |
| Authigenic Minerals    |          |                        |
| Silica 0. gr.          | 3        |                        |
| Dolomite               | 7        |                        |
| Muscovite              | tr       |                        |
| Biotite                | tr       |                        |
| Opaques                | tr       |                        |
| Accessory Minerals     |          |                        |
| Zircon                 | tr       |                        |
| Voids w/o Clay         | tr       |                        |
| Voids w/Clay           | 15       |                        |
| Clay Minerals          | 2        |                        |
| Kaolinite<br>(X-ray)   | Min      |                        |
| Chlorite<br>(X-ray)    | tr       |                        |
| Mixed Layer<br>(X-ray) | Dom      | Illite/montmorillonite |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8113.5  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Subarkose  
 Mean Grain Size (mm): 0.10  
 Grain Size Range (mm): 0.04 to 0.20

Petrologist: M. O. Eatough  
 Date: July 20, 1982  
 % Pore Space: 16  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Detrital mineralogy is very similar to previous samples. Porosity is also similar; lenses of carbonaceous material with pyrite are present.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>            |
|--------------------------|----------|----------------------------|
| Quartz                   | 52       |                            |
| K-feldspar               | tr       |                            |
| Plagioclase              | 7        |                            |
| Chert                    | tr       |                            |
| Lithics                  | 4        |                            |
| Authigenic Minerals      |          |                            |
| Silica O. gr.            | 4        |                            |
| Dolomite                 | 5        |                            |
| Muscovite                | tr       |                            |
| Biotite                  | tr       |                            |
| Opaques                  | tr       | Pyrite; some large patches |
| Accessory Minerals       |          |                            |
| Zircon                   | tr       |                            |
| Other                    | 10       | Carbonaceous/pyrite lenses |
| Voids w/o Clay           | tr       |                            |
| Voids w/Clay             | 16       |                            |
| Clay Minerals            |          |                            |
| Kaolinite<br>(Assumed)   | Minor    |                            |
| Chlorite<br>(Assumed)    | tr       |                            |
| Mixed Layer<br>(Assumed) | Dom      |                            |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8114.2  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.10  
 Grain Size Range (mm): 0.03 to 0.27

Petrologist: M. O. Eatough  
 Date: July 20, 1982  
 % Pore Space: 18  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: This sample is very similar in porosity and mineralogy to previous samples. No silty/clay lenses observed in this sample.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u> |
|--------------------------|----------|-----------------|
| Quartz                   | 48       |                 |
| K-feldspar               | tr       |                 |
| Plagioclase              | 8        |                 |
| Chert                    | 3        |                 |
| Lithics                  | 7        |                 |
| Authigenic Minerals      |          |                 |
| Silica 0. gr.            | 7        |                 |
| Dolomite                 | 6        |                 |
| Muscovite                | tr       |                 |
| Biotite                  | tr       |                 |
| Opagues                  | 1        |                 |
| Accessory Minerals       |          |                 |
| Zircon                   | tr       |                 |
| Voids w/o Clay           | 2        |                 |
| Voids w/Clay             | 16       |                 |
| Clay Minerals            | 2        |                 |
| Kaolinite<br>(Assumed)   | Minor    |                 |
| Chlorite<br>(Assumed)    | tr       |                 |
| Mixed Layer<br>(Assumed) | Dom      |                 |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8114.9  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.03 to 0.20

Petrologist: M. O. Eatough  
 Date: July 20, 1982  
 % Pore Space: 16  
 Sorting (est.): Well  
 Angularity (est.): A to Sr

GENERAL DESCRIPTION: Mineralogy and porosity are very similar to previous samples. Calcareous silty clay lenses common.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>                                   |
|------------------------|----------|---|
| Quartz                 | 48       |   |
| K-feldspar             | tr       |   |
| Plagioclase            | 6        |   |
| Chert                  | 2        |   |
| Lithics                | 5        |   |
| Authigenic Minerals    |          |   |
| Silica 0. gr.          | 5        |   |
| Dolomite               | 5        |   |
| Muscovite              | tr       |   |
| Biotite                | tr       |   |
| Opagues                | 1        | Pyrite in patches associated with mud lenses      |
| Accessory Minerals     |          |   |
| Zircon                 | tr       |   |
| Other                  | 11       | Calcareous silty clay with carbonaceous stringers |
| Voids w/o Clay         | 1        |   |
| Voids w/Clay           | 15       |   |
| Clay Minerals          |          |   |
| Kaolinite<br>(X-ray)   | Minor    |   |
| Chlorite<br>(X-ray)    | tr       |   |
| Mixed Layer<br>(X-ray) | Dom      | Illite/montmorillonite                            |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8116.2  
 INTERVAL: Corcoran (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 30, 1982

Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.03 to 0.21

% Pore Space: 12  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy and porosity very similar to previous samples.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>              |
|--------------------------|----------|------------------------------|
| Quartz                   | 55       |                              |
| K-feldspar               | tr       |                              |
| Plagioclase              | 7        |                              |
| Chert                    | 2        |                              |
| Lithics                  | 5        |                              |
| Authigenic Minerals      |          |                              |
| Silica 0. gr.            | 4        |                              |
| Dolomite                 | 6        |                              |
| Muscovite                | tr       |                              |
| Biotite                  | tr       |                              |
| Opauques                 | 1        | Pyrite                       |
| Accessory Minerals       |          |                              |
| Zircon                   | tr       |                              |
| Epidote                  | tr       |                              |
| Other                    | 6        | Calcareous silty clay lenses |
| Voids w/o Clay           | 1        |                              |
| Voids w/Clay             | 11       |                              |
| Clay Minerals            | 1        |                              |
| Kaolinite<br>(Assumed)   | Min      |                              |
| Chlorite<br>(Assumed)    | tr       |                              |
| Mixed Layer<br>(Assumed) | Dom      |                              |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8116.9  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.12  
 Grain Size Range (mm): 0.03 to 0.21

Petrologist: M. O. Eatough  
 Date: July 30, 1982  
 % Pore Space: 15  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy and porosity very similar to previous samples; silty clay lenses throughout.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>              |
|--------------------------|----------|------------------------------|
| Quartz                   | 39       |                              |
| K-feldspar               | tr       |                              |
| Plagioclase              | 5        |                              |
| Chert                    | 2        |                              |
| Lithics                  | 6        |                              |
| Authigenic Minerals      |          |                              |
| Silica 0. gr.            | 3        |                              |
| Dolomite                 | 5        |                              |
| Muscovite                | tr       |                              |
| Biotite                  | tr       |                              |
| Opauques                 | tr       | Pyrite                       |
| Accessory Minerals       |          |                              |
| Zircon                   | tr       |                              |
| Other                    | 21       | Calcareous silty clay lenses |
| Voids w/o Clay           | tr       |                              |
| Voids w/Clay             | 15       |                              |
| Clay Minerals            | 2        |                              |
| Kaolinite<br>(Assumed)   | Minor    |                              |
| Chlorite<br>(Assumed)    | tr       |                              |
| Mixed Layer<br>(Assumed) | Dom      |                              |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8119.8  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.10  
 Grain Size Range (mm): 0.03 to 0.21

Petrologist: M. O. Eatough  
 Date: July 30, 1982  
 % Pore Space: 14  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy and porosity are very similar to previous samples; silty clay lenses and stringers of carbonaceous material with pyrite are common.

| <u>COMPOSITION</u>     | <u>%</u> | <u>COMMENTS</u>                                |
|------------------------|----------|--|
| Quartz                 | 44       |  |
| K-feldspar             | tr       |  |
| Plagioclase            | 3        |  |
| Chert                  | 1        |  |
| Lithics                | 6        |  |
| Authigenic Minerals    |          |  |
| Silica 0. gr.          | 3        |  |
| Dolomite               | 4        |  |
| Muscovite              | tr       |  |
| Biotite                | tr       |  |
| Opagues                | 1        | Pyrite and carbonaceous material in stringers  |
| Accessory Mineral      |          |  |
| Zircon                 | tr       |  |
| Other                  | 23       | Calcareous silty clay with organics and pyrite |
| Voids w/o Clay         | tr       |  |
| Voids w/Clay           | 14       |  |
| Clay Minerals          | 1        |  |
| Kaolinite<br>(X-ray)   | Minor    |  |
| Chlorite<br>(X-ray)    | tr       |  |
| Mixed Layer<br>(X-ray) | Dom      | Illite/montmorillonite                         |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8121.2  
 INTERVAL: Corcoran (MWX-2)  
 Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.09  
 Grain Size Range (mm): 0.03 to 0.21

Petrologist: M. O. Eatough  
 Date: July 20, 1982  
 % Pore Space: 13  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy and porosity are very similar to previous samples; A few silty clay lenses are present; some thin stringers of carbonaceous material with pyrite almost look like fracture filling.

| <u>COMPOSITION</u>       | <u>%</u> | <u>COMMENTS</u>                                |
|--------------------------|----------|--|
| Quartz                   | 56       |  |
| K-feldspar               | tr       |  |
| Plagioclase              | 3        |  |
| Chert                    | 2        |  |
| Lithics                  | 5        |  |
| Authigenic Minerals      |          |  |
| Silica 0. gr.            | 5        |  |
| Dolomite                 | 7        |  |
| Muscovite                | tr       |  |
| Biotite                  | tr       |  |
| Opaques                  | tr       |  |
| Accessory Minerals       |          |  |
| Zircon                   | tr       |  |
| Other                    | 5        | Calcareous silty clay with organics and pyrite |
| Voids w/o Clay           | tr.      |  |
| Voids w/Clay             | 13       |  |
| Clay Minerals            |          |  |
| Kaolinite<br>(Assumed)   | Minor    |  |
| Chlorite<br>(Assumed)    | tr       |  |
| Mixed Layer<br>(Assumed) | Dom.     |  |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8122.2  
 INTERVAL: Corcoran (MWX-2)

Petrologist: M. O. Eatough  
 Date: July 30, 1982

Rock Type: Sublitharenite  
 Mean Grain Size (mm): 0.11  
 Grain Size Range (mm): 0.03 to 0.24

% Pore Space: 15  
 Sorting (est.): Well  
 Angularity (est.): A to SR

GENERAL DESCRIPTION: Mineralogy and porosity very similar to previous samples. Silty clay lenses are thin and fairly continuous causing a bedded appearance. Thin stringers of carbonaceous material with pyrite extend from the lenses. Thin veinlets of chlorite follow some of these stringers.

| <u>COMPOSITION</u>     | <u>%</u>   | <u>COMMENTS</u>                                |
|------------------------|------------|--|
| Quartz                 | 51         |  |
| K-feldspar             | tr         |  |
| Plagioclase            | 4          |  |
| Chert                  | 2          |  |
| Lithics                | 7          |  |
| Authigenic Minerals    |            |  |
| Silica O. gr.          | 5          |  |
| Dolomite               | 6          |  |
| Muscovite              | tr         |  |
| Biotite                | tr         |  |
| Opaques                | tr         | Pyrite   |
| Accessory Minerals     |            |  |
| Zircon                 | tr         |  |
| Other                  | 10         | Calcareous silty clay with organics and pyrite |
| Voids w/o Clay         | tr         |  |
| Voids w/Clay           | 15         |  |
| Clay Minerals          |            |  |
| Kaolinite<br>(X-ray)   | Sub<br>dom |  |
| Chlorite<br>(X-ray)    | tr         |  |
| Mixed Layer<br>(X-ray) | Dom        | Illite/montmorillonite                         |

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8124.2  
INTERVAL: Corcoran (MWX-2)  
Rock Type: Sandy Mudstone  
Mean Grain Size (mm): Not Measured  
\*Grain Size Range (mm): 0.02 to 0.18

Petrologist: M. O. Eatough  
Date: August 2, 1982  
% Pore Space: Microporosity  
in clay  
Sorting (est.): Poor  
Angularity (est.): A to SR

GENERAL DESCRIPTION: This rock consists of nearly equal amounts of clay, silt and sand-sized material. Each size fraction occurs in thin beds which have been deformed. Clumps of silt or sand within clayey beds are not uncommon.

Mineralogy of the silt and sand-sized detritus is very similar to other samples in the interval.

The clay is calcareous with dolomite being the predominant carbonate mineral. Siderite may also be present. Carbonaceous material within the clay and compacted along bedding planes is very common.

Thin veinlets of chlorite cut across the bedding planes and surround some detrital grains. Small globs of pyrite are also common. Microfaulting along these veinlets suggest that the sample was fractured before veining.

Clay minerals as identified by X-ray diffraction are mixed layer illite/montmorillonite (dominant), kaolinite (moderate), chlorite (trace).

\*of sand-sized detritus

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8125.9

Petrologist: M. O. Eatough

INTERVAL: Corcoran (MWX-2)

Date: August 2, 1982

Rock Type: Mudstone

% Pore Space: Microporosity  
in clay

GENERAL DESCRIPTION: This rock consists of silt-sized detritus floating in a ferruginous clay. The sample is somewhat bedded with bedding planes strongly distorted.

Detrital constituents are mostly quartz and plagioclase. Stringers and fragments of carbonaceous material are common. A swirling "vein" of a "botryoidal" pyrite with authigenic clay is also present.

Clay minerals as identified by X-ray diffraction are mixed layer illite/montmorillonite (dominant), kaolinite (minor) and chlorite (trace).

MULTI-WELL PETROGRAPHIC ANALYSIS

SAMPLE NO: MWX-8128.1

Petrologist: M. O. Eatough

INTERVAL: Corcoran (MWX-2)

Date: August 2, 1982

Rock Type: Mudstone

% Pore Space: Microporosity in  
clay and fractures

GENERAL DESCRIPTION: This sample consists of scattered silt-sized detritus floating in clay. A few floating sand-sized detrital grains are also present. The sample is bedded with soft sediment deformation.

Clay minerals as identified by X-ray diffraction are: mixed layer illite/montmorillonite (dominant), kaolinite (trace) and chlorite (trace).

Detrital minerals are predominantly quartz and feldspars with minor muscovite.

Fragments of carbonaceous material are scattered throughout. Pyrite is commonly associated with the carbonaceous material as minute euhedra.