

MOBIL EXPLORATION NORWAY INC.
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REPORT NO. 2764

PETROGRAPHY OF SIDEWALL CORES AND
DITCH CUTTINGS FROM THE
33/12-2 WELL, A CORE SAMPLE
FROM 8,270 FEET IN THE
33/12-1 WELL AND A SAMPLE
LABELLED 13,500 FEET

BY

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I

INTRODUCTION

This report contains the results of a petrographic analysis of ten sidewall cores, and one ditch cutting sample from 1,180-90 feet in the Mobil Norway 33/12-2 Well, and of a core chip from 8,270 feet in the 33/12-1 Well. In addition, a further thin section of a sample labelled 13,500 feet, previously described in Robertson Research International Memorandum No. 2577 has been examined. In the 33/12-2 Well two of the sidewalls (11,054 feet and 11,099 feet) have been described together since the glass containers were found to be broken on receipt and the contents mixed together. There was insufficient sample from the ditch cuttings at 11,040-11,300 feet to enable a thin section to be made.

Representative photomicrographs of some of the samples are presented at the end of the report.

II

PETROGRAPHY OF SAMPLES FROM THE 33/12-2 WELL

Each of the sidewall core samples and ditch cutting samples is described separately below.

Sidewall Core : 10,903 Feet

This sample is a poorly sorted, very fine grained micaceous sandstone consisting mainly of detrital quartz grains with subordinate plagioclase feldspar and micas in a clay grade matrix.

The detrital grains are silt to very fine sand sized and subangular to subrounded. Monocrystalline quartz showing slight strain effects is dominant with subordinate plagioclase and minor orthoclase feldspar. Mica is also common and consists principally of muscovite flakes with subordinate chlorite and biotite aligned along bedding planes. Trace amounts of detrital calcite, garnet, zircon and quartzite rock fragments are scattered throughout the rock.

The matrix consists of clay-grade quartz grains with only occasional fine grained mud being present. Flakes of sericitic mica are commonly present along detrital grain contacts.

Small numbers of anhedral crystals of intergranular carbonate cement with a patchy distribution occur in the sandstone. Grain contacts are usually straight to concavo-convex indicating that a moderate amount of pressure solution has taken place. Only rarely in those areas where the clay matrix and carbonate cement are found are the grain contacts tangential. No visible porosity is present in this sandstone.

Sidewall Cores 11,054 and 11,099 Feet : (Composite Sample)

These samples are composed of poorly sorted fine grained sandstone comprising dominant quartz detritals with subordinate plagioclase feldspar in a clay grade matrix.

The detrital grains are silt to fine sand sized and subangular to subrounded. Monocrystalline quartz is dominant and commonly shows evidence of straining. Many of these grains are fractured possibly due to sidewall sampling. Subordinate muscovite and plagioclase with minor orthoclase, microcline and iron ores are also present. Traces of zircon, sphene, garnet and epidote make up the remainder of the detritals.

The clay matrix is composed of clay grade quartz and feldspar grains with occasional sericite flakes.

Traces of small anhedral patches of intergranular carbonate cement occur scattered throughout the sandstone. Grain contacts are straight to concavo-convex showing that moderate pressure solution has occurred. Tangential contacts are preserved where carbonate cement and clay matrix are more common. The sandstone contains no visible porosity.

Sidewall Core : 11,282 Feet (Plate 1)

This sample is bedded as shown by grain size and mineralogical variation in thin section. Two beds are present; both are fine grained sandstones although one contains more fine sand sized detritals and less mica than the other.

In both beds the detrital grains are subangular to subrounded and consist predominantly of monocrystalline quartz which shows rare strain effects. Subordinate feldspar and mica, and traces of apatite, pyrite, garnet, calcite, epidote and zircon are also present. The feldspar is mainly plagioclase with

minor amounts of orthoclase and perthite. Micas are common in most of the sample and consist of subequal amounts of muscovite, chlorite and biotite.

A clay grade matrix is only rarely present and usually shows slight recrystallisation to flakes of sericite.

Small irregular patches of anhedral poikilitic carbonate cement occur scattered throughout the rock. Authigenic quartz overgrowths are occasionally present on the detrital grains but are poorly formed and have not developed euhedral faces. Grain contacts are straight to concavo-convex and result from a moderate degree of pressure solution. This pressure solution, together with the small amounts of intergranular cements, has resulted in the loss of all visible porosity in this sandstone.

Sidewall Core : 11,294 Feet

This sample is a moderately sorted very fine grained sandstone containing common detrital quartz with subordinate feldspar and mica, and partially cemented by carbonate.

The detrital grains are subangular to subrounded, silt to very fine sand sized and consist principally of monocrystalline quartz with subordinate mica and minor plagioclase. The mica is mainly muscovite with subordinate chlorite and biotite and is frequently heavily iron-stained. Plagioclase constitutes the only feldspar and accessory minerals include epidote and zircon.

Small amounts of clay matrix are present and show some recrystallisation to sericite.

Carbonate cement occurs patchily throughout the rock, but is also concentrated into a small concretion where there is partial replacement of the detrital grains. The iron-staining, common throughout the rock, also affects the carbonate cement and therefore appears to be later than the cement. The

mica is frequently deformed between the other detrital grains where contacts are straight to concavo-convex (except where carbonate cement is present). No visible porosity is present in this sample.

Sidewall Core : 11,434 Feet

This sample is a poorly sorted, medium grained sandstone with occasional scattered grains of coarse sand size. The majority of the detrital grains are quartz with subordinate feldspar and mica and minor rock fragments. An intergranular clay matrix is present.

The detrital grains are subangular to subrounded, silt to locally coarse sand sized and consist predominantly of monocrystalline quartz. The subordinate feldspar is mainly plagioclase with lesser amounts of orthoclase and microcline. Muscovite is the most common of the micas with lesser amounts of biotite which is partially altered to chlorite. Discrete flakes of chlorite, which may represent the end product of this alteration, also occur. Occasional quartzite and chert rock fragments are present together with accessory epidote, garnet and zircon.

There is a little intergranular clay matrix composed of quartz and feldspar fragments with minor clay minerals and sericite.

A small amount of intergranular carbonate cement is present as patchily developed anhedral poikilitic crystals. A little cement is also present as authigenic overgrowths of quartz, plagioclase and orthoclase feldspar on the respective detrital minerals. The overgrowths are poorly developed and euhedral faces do not occur. Grain contacts are usually straight to concavo-convex, rarely tangential, and reflect a moderate amount of pressure solution. Flakes of mica have also been deformed around detrital grains during compaction of the sandstone. No visible porosity is present in this sandstone.

Sidewall Core : 12,343 Feet (Plate 2)

This sample is a sandstone consisting of silt to very fine sand sized, subangular to subrounded detrital grains with widespread intergranular carbonate cement. A little clay is present both in patches scattered throughout the rock and as discrete argillaceous laminae.

Monocrystalline quartz is by far the most common of the detrital grains. Plagioclase feldspar and mica are minor constituents, the mica consisting of muscovite with a little chlorite.

The argillaceous patches and laminae are almost completely recrystallised to flakes of sericite.

Poikilitic carbonate cement, amounting to 30% of the rock, is present in the intergranular areas. A moderate degree of pressure solution has affected the rock resulting in straight to concavo-convex grain contacts (except where carbonate cement is present and tangential contacts are found). No visible porosity is present in this sandstone.

Sidewall Core : 12,489 Feet

This rock is a moderately well sorted, very fine grained, quartzitic sandstone consisting of silt to very fine sand sized, subangular to subrounded detrital grains partially cemented with carbonate.

The majority of the detrital grains are monocrystalline quartz which commonly show strain effects. Both feldspar and mica are minor constituents, the feldspar being mainly plagioclase with a little microcline and the mica consisting principally of muscovite. The muscovite commonly shows partial alteration to chlorite and rare biotite flakes also occur. Tourmaline is present in trace amounts.

Small anhedral patches of poikilitic carbonate cement are scattered

throughout the rock. Authigenic overgrowths of quartz are present on some of the detrital grains, but are poorly developed with no euhedral faces. These two cements account for only a small proportion of the rock. Grain contacts are straight to slightly sutured producing a quartzitic texture and suggesting that a considerable amount of pressure solution has occurred. This has resulted in a loss of all visible porosity in the sandstone.

Sidewall Core : 13,300 Feet (Plates 3 and 4)

The sample is a moderately sorted, fine grained sandstone composed of silt to fine sand sized, subangular to subrounded detrital grains with intergranular sericitic mica and minor cement.

Monocrystalline quartz is the most common of the detrital grains with subordinate feldspar and minor rock fragments and mica. The feldspar which varies from completely fresh to almost completely altered, is mainly plagioclase although rare perthite, orthoclase and microcline are also present. A few grains of quartzite rock fragments and traces of garnet, tourmaline and zircon also occur.

Two types of intergranular cement are present; anhydrite is most common and is found as crystals up to 1.5mm in size which poikilitically enclose the detrital grains. Lesser amounts of anhedral carbonate cement occur in isolated patches. Together the cements account for only 5% of the rock. Heavily iron-stained sericitic mica flakes lie tangential to many of the detrital grains and also fill intergranular spaces. This mica has been deformed during compaction, and pressure solution has resulted in straight to concavo-convex grain contacts. The combined effects of pressure solution and cementation have destroyed all traces of any visible porosity that the sandstone originally possessed.

Sidewall Core : 13,382 Feet

This sample is a poorly sorted sandy siltstone which is intensely iron-stained.

The detrital grains are angular to subrounded, silt to very fine sand sized and comprise common monocrystalline quartz with subordinate muscovite and minor chlorite and plagioclase feldspar. Accessory minerals include tourmaline and zircon.

The intergranular areas are filled with intensely iron-stained tangential sericitic mica and iron oxide. A little patchy carbonate cement is also present. The intense iron-staining obscures most of the detail of the intergranular areas though there does not appear to be any visible porosity.

Ditch Cutting Sample : 11,980-90 Feet

All of the cuttings in the sample are of the same rock type, a poorly sorted mudstone containing occasional silt sized, and rarely very fine sand sized, detrital grains.

The detrital grains are subangular to subrounded and consist of monocrystalline quartz with rare epidote.

The clay grade matrix is colourless to pale brown and is isotropic. It is considered to be composed of clay-sized fragments of volcanic glass.

No glass shards are present in this rock and it is likely that the rock is in fact a reworked vitric tuff and that any previously existing shards were broken down during reworking.

III

PETROGRAPHIC DESCRIPTION OF A CORE CHIP FROM 8,270 FEET IN THE 33/12-1 WELL

The rock is a poorly sorted sandy mudstone containing 40% of silt to fine sand sized detrital grains in a partly silicified clay grade matrix.

The detrital grains are subangular to rounded and consist principally of monocrystalline quartz with rare polycrystalline quartz, muscovite, perthite feldspar, chert fragments, zircon and tourmaline.

The grains are supported by a pale buff to reddish brown clay grade matrix which is isotropic and may represent minute fragments of volcanic glass. Clay minerals are also present and are partly recrystallised to sericite.

Some of the detrital grains are cemented with pyrite into concretions up to 1.5 mms. across and the pyrite also shows more irregular patchy distribution as an intergranular cement.

Partial patchy silicification has resulted in the formation of very fine mosaics of quartz cementing the detrital grains in places.

IV

FURTHER INVESTIGATION OF A SAMPLE LABELLED 13,500 FEET

A petrographic description of this sample has already been reported in our Memorandum No. 2577 but at the request of Mobil Norway a further thin section has since been prepared and the results are presented below. The sample contains fragments of a carbonate-cemented sandstone and slightly silty mudstones as previously described in our earlier memorandum.

The sample does, however, contain considerable amounts of rocks consisting of scattered silt sized, and rare very fine sand sized, angular to subrounded detrital grains in a clay grade matrix.

The most common detrital grains are monocrystalline quartz, the only other detrital grains being rare epidote crystals.

The clay grade matrix is variable from neutral to pale and dark reddish brown and is always isotropic. It is considered to consist of minute grains of volcanic glass which suggests that this sample may be a reworked tuff.

PLATES 1 TO 4

Photomicrographs

PLATE 1

DEPTH: 11,282 FEET

DESCRIPTION: Fine grained sandstone showing well developed bedding with gradation from fine to very fine sand sized detrital grains.

Photomicrograph, x 50; crossed nicols.

PLATE 2

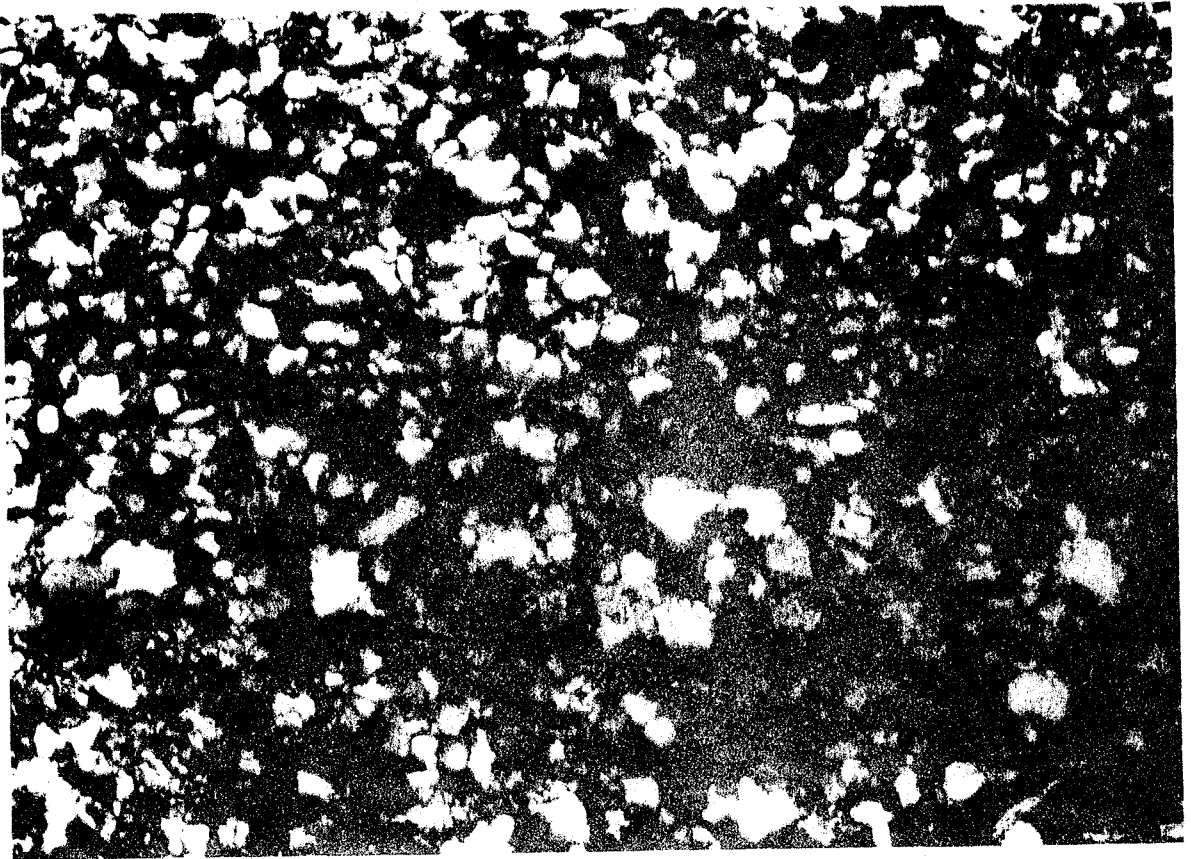
DEPTH: 12,343 FEET

DESCRIPTION: Very fine grained sandstone with common detrital grains of quartz (H5, J15, E12) and rare plagioclase feldspar (E4-F4) cemented by anhedral poikilitic carbonate crystals (D5-G7). Grain contacts are straight (K12) to concavo-convex (J5-J6).

Photomicrograph x 200; crossed nicols.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
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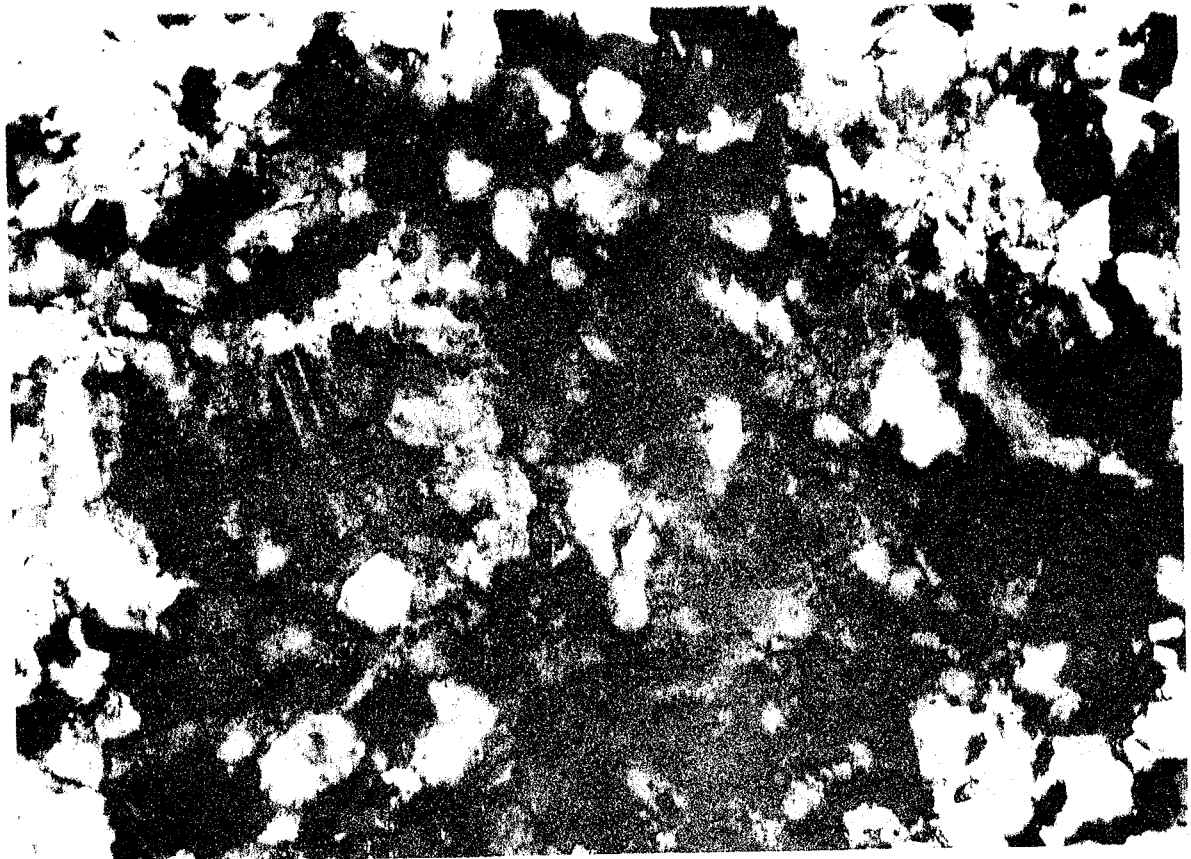
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PLATE 3

DEPTH: 13,300 FEET

DESCRIPTION: Fine grained sandstone comprising detrital quartz (B11-C11; F5) and plagioclase (G11) with a little patchy anhedral anhydrite cement (E10-F12). Grain contents are straight (J10) to concavo-convex (C10-C12).

Photomicrograph x 80; crossed nicols.

PLATE 4

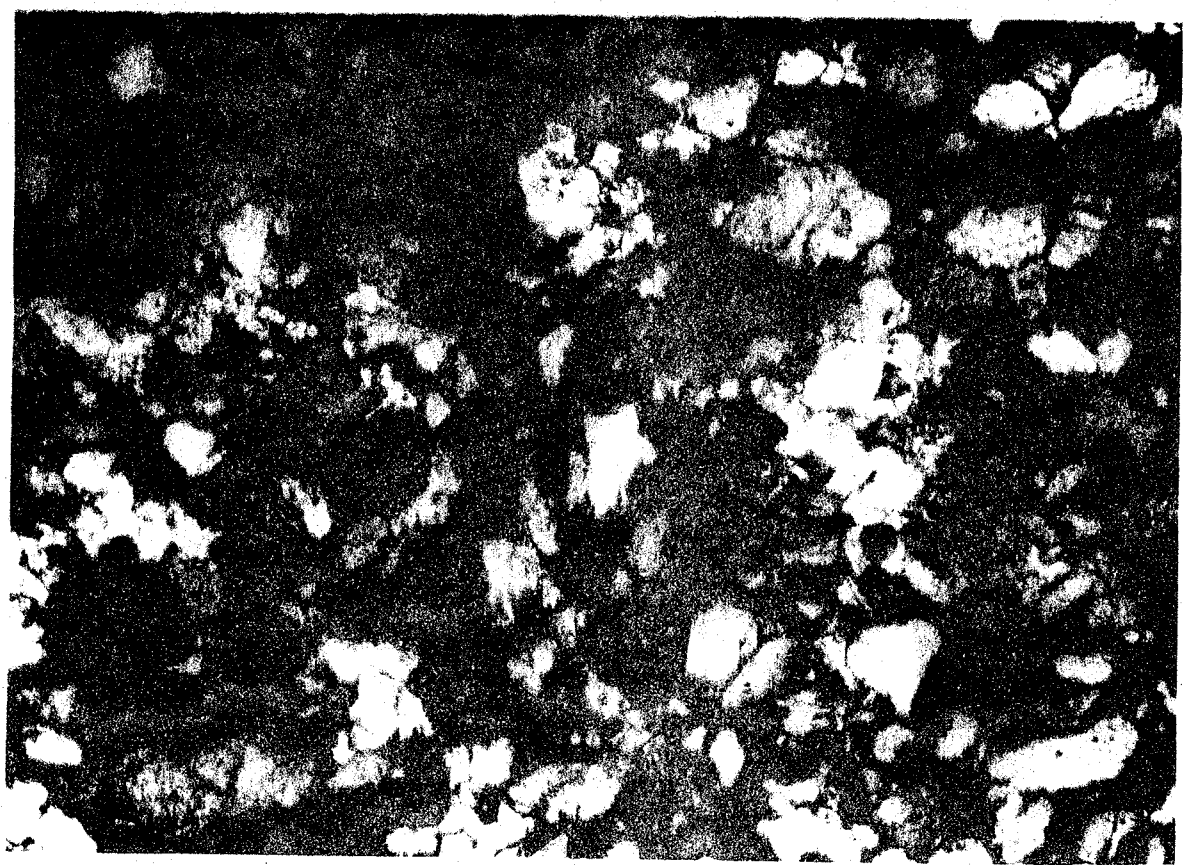
DEPTH: 13,300 FEET

DESCRIPTION: Detail of sandstone figured above showing intergranular anhydrite cement (F5-F7, E2-B3) around detrital quartz (E13-G13) and plagioclase feldspar (A15-D15). Deformed iron-stained sericitic mica is common along grain contacts (G10-E8; H13-F14).

Photomicrograph x 200; crossed nicols.

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