COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

# BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS



**RECORDS:**


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## SOME NOTES ON THE PETROLOGY OF SAMPLES FROM THE LOWER PART OF FROME-BROKEN HILL FLAXMANS NO.1 OTWAY BASIN, VICTORIA.

by

K. J. Edworthy.

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CONTENTS

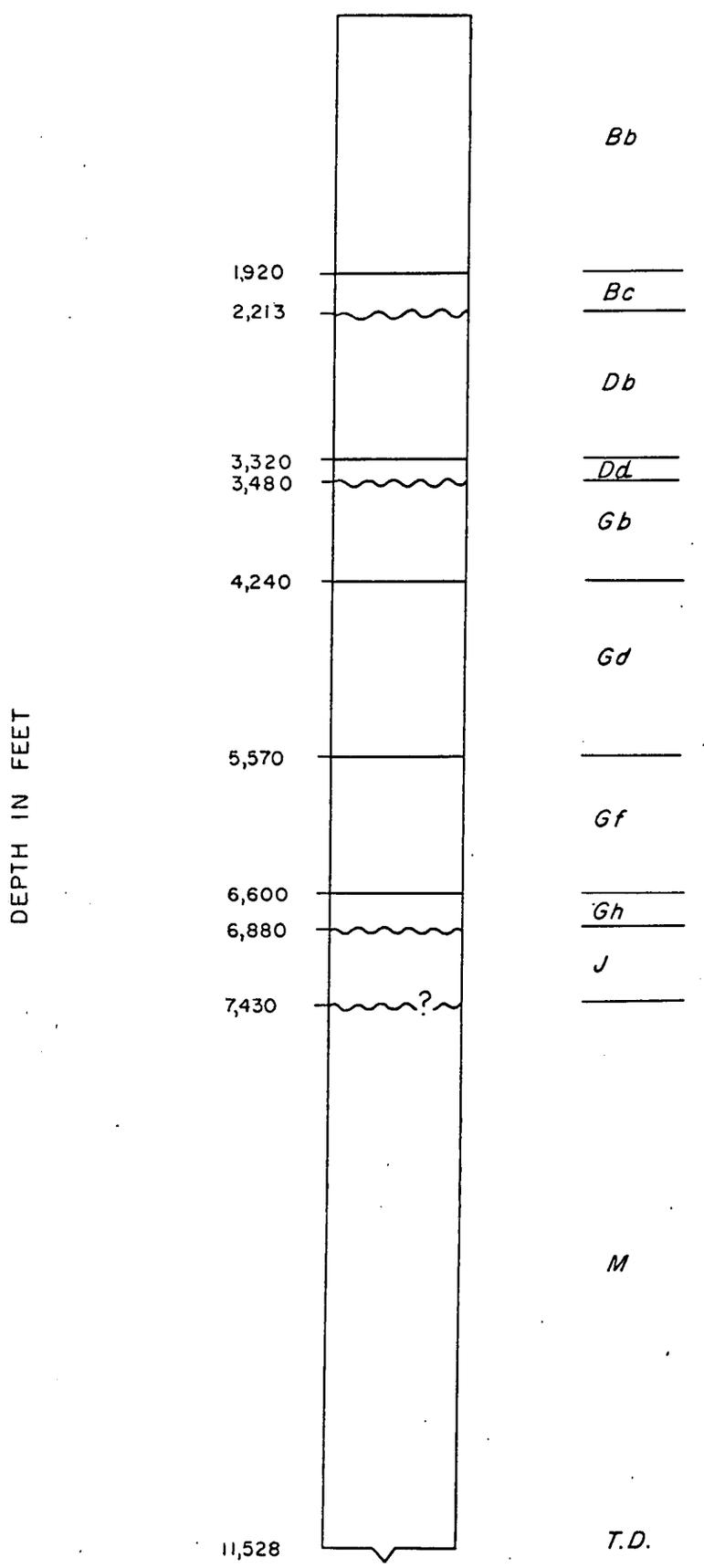
## SUMMARY

The general sequence of sediments in Flaxmans No.1 well bears a very close similarity to the sediments of the Port Campbell area (Port Campbell Nos. 1, 2, 3 and 4 and Sherbrook No.1) and good correlation of all units with those established elsewhere in the basin, is possible.

Upper Cretaceous - Tertiary sediments are thickly developed and the Waarre Formation, Unit J is present. Apparent regional unconformities between the Lower Cretaceous and Flaxmans Beds (unit Gh) and units Db and Bc appear to be present. There is some doubt as to the nature and position of unit Dd, since no samples above 4820 feet are available.

The association of fracture porosity with hydrocarbon shows in units M and Gf was studied.

# FLAXMANS Nº 1

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F.E.

## INTRODUCTION

Flaxmans No.1 well was drilled close to the coast, approximately 14 miles W.N.W. of Port Campbell and 8 miles west of the nearest well, Port Campbell No.3. Details are listed below.

| | | |
|---|---|---|
| Location | Lat. | - 38°33' S |
| | Long. | - 142°46' E |
| 1:250,000 Map Area | - J.54/12 Colac. | |
| Date commenced | 3rd May 1961 | |
| Date abandoned | 25th August 1961 | |
| Total depth | 11,528 | (Driller) |
| | 11,518 | (Electric log). |
| Elevation | Reference Point R.T. | - 221' A.S.L. |
| | Ground Level | - 206' A.S.L. |

Cuttings from 4820 to T.D. and samples of all cores (except cores 1 and 2) were available for examination.

Thin-sections have been made of cores, and selected cuttings intervals of interest.

This report was prepared in connection with the Otway Basin review being conducted by the Subsurface section. It was not a detailed study, as carried out for wells such as Frome-Broken Hill Port Campbell Nos. 1 and 2 (Dellenbach and Hawkins 1964), Pretty Hill No.1 (Edworthy 1964), etc., and a composite log has not been prepared. The stratigraphic division of Flaxmans No.1, however, is shown in Figure 1.

Unit M. The lithology of unit M is abundantly chloritic and bears close affinity with other sediments of unit M found elsewhere. The lithic grains, which characterise the sediments of unit M, are of two main varieties; acid to intermediate volcanic rock fragments and fragments of metamorphic rocks (chiefly of meta-quartzite and phyllite, rarely of schist). Volcanic material is clearly dominant at the top of unit M as can be see in the thin section of core 29 (7652-54ft) Lower down in the unit, metamorphic material appears to be dominant (i.e. thin-section of core 37, 9499-101 ft) The unusually coarse grained nature of the sandstones enables the individual grains to be studied much more easily than has hitherto been possible.

Zeolite has been found as a cementing medium at many levels in the well and is, in fact, present in all thin sections of cores below 7654 feet. The bright orange coloured zeolite heulandite has been studied and described by Baker & McAndrew (1961), and this occurs between 7680 and 7850 feet, close to the top of unit M. A colourless zeolite occurs extensively below 7850 feet to T.D.

Cores were examined for fracturing in unit M, and except for core 43 (11,225-235 feet) in which very fine calcite filled veinlets were present, no evidence for fracturing was observed. Although no hydrocarbons of significance were found in either Pretty Hill No.1 or Eumeralla No.1, fissures and slickensiding were found at some horizons, and there is a possibility that similar features occur in Flaxmans No.1 which are not represented in cores.

Chemical analyses of samples from cores 28, 31, and 41 have been performed and the results are given and commented on by Baker (1963).

Unit J. This formation extends from 7430 feet, the top of unit M to 6880 feet, the base of unit Gh. The relationship between units M and J are not known but there is a strong possibility that the boundary is unconformable. Unit J is separated from unit Gh by definite unconformity; this is evident in thin-section and cuttings studies, as well as the electric logs. Further evidence is provided by the change in lithology over the interval between cores 22 and 23.

The formation may be divided into two parts, the upper part being of orthoquartzite sandstones and carbonaceous siltstones, and the lower part chloritic protoquartzites (Pettijohn 1957) cemented by calcite, together with carbonaceous siltstones and coals.

Porosity and permeability of the sandstones, particularly those of the upper part appear to be of a high order.

Apart from a very significant absence of volcanic rock fragments, the sandstones of the lower part of Unit J (i.e. core 27, 7200-04 ft bear strong genetic resemblance to those of unit M. It is possible that these sediments owe their origin to a mixing of material from the orthoquartzitic source (the source of the youngest unit J sediments) with reworked unit M sediments. The grain size of these sediments (those of lowest unit J), in fact, suggests a purely 'unit M' origin.

Unit Gh. The thickness of unit Gh (or "Flaxmans Beds" Bain, 1961) is approximately 380 feet from approximately 6600 feet to 6880 feet. The lower boundary is well marked but the upper boundary appears to be lithologically gradational.

Primary chemical precipitation has been as important as the deposition of clastic material in the accumulation of these deposits, and between approximately 6600 and 6650 feet, was predominant. The dominant lithology of unit Gh is a carbonaceous pyritic siltstone containing limonite pellets and abundant pellets of ferriferous chlorite*. The minor lithology characteristic of the Flaxmans Beds, is the ferriferous chlorite-cemented chamosite oolite which occurs between 6600-6650 feet. Clastic quartz grains, angular and limonite coated, are present, and in many cases act as nuclei for the ooliths.

There is less limonitisation of ooliths, or sideritisation of the cement than found in Pretty Hill No.1 well.

Concentration of the iron rich detritus and water soluble ferriferous salts seems to have occurred in a shallow basin of restricted extent. Alternatively, the depositional environment could have been an extensive, very shallow water, shelf area subject to conditions of high energy. In either case, the highly oxidised iron compounds appear to have entered a slightly alkaline depositional medium (i.e. saline to some extent).

Chemical analyses of core 19 from the Flaxmans No.1 well show the total iron ($FeO+Fe_2O_3$) to be in excess of 43% (Baker, 1963). Phosphate is 0.9% and the specific gravity of the powdered sample, 3.34. As pointed out by Baker, the low $K_2O$ content (0.7%) indicates that the ferrous silicate matrix is more likely to be greenalite than the potash-bearing glauconite.

Unit Gf. The base of the unit is taken to be 6500 feet and the upper limit at 5570 feet. Abundant glauconite pellets such as found throughout the basin within this formation, known as the Belfast Mudstone equivalent, show a decrease in abundance toward the upper limit. The carbonaceous, pyritic argillaceous siltstone matrix shows no conspicuous change in composition.

As with unit Gh, the thickness of the unit is similar to that found in the Port Campbell area.

The possibility that fracture porosity may be related to the slight gas shows between 6000-6120 feet (Bain, 1961) was studied. Core 17 (6375-91 feet) is very fractured and slickensided and the sample has broken into small pieces. This is however, 300 feet below the interval in question although it demonstrates the susceptibility of this lithology to fracturing, and the lack of fissure infilling. It is concluded that fracture porosity is probably present between 6000 - 6120 feet.

Unit Gd. The unit, which occurs between 4240 feet and 5570 feet, may be divided into two intervals, either side of 5000 feet.

The sandstones examined in thin section, of the lower interval appear coarser grained and the cementing medium is sideritic. Chloritic grains and pellets are abundant and the arenaceous lithology is distinctly ferruginous. Interbedded siltstones are very dark greyish brown, micaceous and carbonaceous. As in the upper interval amber is present in the siltstones.

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* A member of the ferriferous chlorite series.

Interbedded micaceous, slightly carbonaceous siltstones and quartzose sandstones with matrix make up the upper interval. The sandstones are angular and generally of fine grain size. Markings (? tracks) on bedding planes are visible in some cores and there is much deformation of bedding, clearly penecontemporaneous with deposition.

The broad, two-fold subdivision possible in Flaxmans No.1 compares well with similar divisions established in other wells, such as in the Port Campbell area and in the Nelson Bore (Hawkins & Dellenbach, 1963).

Unit Gb. The limits of this unit have been picked using electric logs and cores since no cuttings are available for the section above 4820 feet. Together with the cuttings descriptions from the Well Completion Report (Bain, 1961) the lower boundary has been picked at approximately 4240 feet and the upper boundary at 3480 feet. The dominant lithology is interbedded siltstone and sandstone.

A thin coal seam appears near the base of the unit, above a thin carbonate horizon at 4235 feet.

The siltstones appear to be of fairly constant composition, being dark brown, slightly carbonaceous and micaceous, recurring in decreasing amount up the sequence.

Sandstones fall into two general types; very fine to coarse-grained orthoquartzitic sandstones with detrital matrix, and very poorly compacted, coarse to granule-sized quartzose sandstones.

Coal and carbonate horizons near the base are typical of unit Gb as defined elsewhere. The thickness of the unit is much greater than that found to the west in the "Tyrendarra" embayment" (Edworthy 1964; 1965).

Unit Dd. Only electric logs and cuttings descriptions from the completion report have been available for the recognition of this horizon. From the electric logs, comparing curves with those of unit Dd of Pretty Hill, Eumeralla and the Port Campbell Wells the unit boundaries appear to be at approximately 3480 and 3320 feet.

The sequence above unit Dd is lithologically the same as found in other wells in the Tyrendarra and Port Campbell "embayments", but it is of abnormally great thickness, the Oligocene - Miocene carbonate sequence being over 2000 feet.

## CONCLUSIONS

The Flaxmans No.1 well bottomed at 11,528 feet in unit M sediments. Apart from unit R (or unit P), all formations so far defined in the Otway Basin review (older than and including unit Bb) are intersected. The volcanic material found in unit M of the "Tyrendarra" embayment" is less abundant in the Port Campbell area, and correspondingly more metamorphic debris is present. Some of the unit M sandstones are unusually coarse-grained, though otherwise closely similar to the lithology as found in the Port Campbell area.

The orthoquartzites and carbonaceous siltstones, together with coal horizons, of unit J, separate the Upper and Lower Cretaceous sediments. Unit J is believed to be of Lower Cretaceous age, in part at least. The nature of the lithologic changes at its boundaries suggests that the upper one is an unconformity; the lower one is of uncertain nature but most probably unconformable.

Upper Cretaceous sediments of units Gh, Gf and Gd show good correlation with those of the Port Campbell wells. Unit Gb and the formations of the Tertiary sequence show good correlation with wells elsewhere in the basin, and are notable on account of their great thickness.

A survey of samples failed to provide any evidence of fracture porosity in unit M, but confirmed the likelihood of its presence in unit Gf.

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