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PETROFINA EXPLORATION AUSTRALIA S.A.

ANGLER - 1

1989

WELL COMPLETION REPORT

APPENDIX 1

MICROPALAEONTOLOGY

MICROPALAEONTOLOGY OF PETROFINA ANGLER-1

VIC/P20, GIPPSLAND BASIN

17 AUG 1989

for

PETROFINA EXPLORATION AUSTRALIA S.A.

by

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BASIC DATA

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INTRODUCTION

A total of 31 ditch cutting samples from Angler No.1 were submitted by Petrofina Exploration Australia S.A. for foraminiferal age determination and interpretation of depositional environment.

The foraminiferal zonation used to date this sequence is the scheme developed by David J. Taylor for the Gippsland Basin. A preliminary account of this zonation is given in Taylor (1966). The zonation was based on some initial work done by Carter (1964) and Jenkins (1960), but grew mostly out of Taylor's work for the Esso-B.H.P. partnership on wells in the offshore Gippsland Basin. My interpretation of the significant features of this zonation is based on an unpublished chart of Taylor's (copyright David Taylor, Paltech P/L, 1981).

The Angler No.1 sequence intersects Taylor's Zones A (Late Pliocene) to J (Early Oligocene), although whether the sequence is complete and conformable is impossible to determine. The sequence between 1770m and 2030m is very sparsely fossiliferous, due possibly to very little fauna being released from a hard silty limestone. Below 2170m, most of the fauna appears to be caving from the Late Miocene and Pliocene. Below 2270m, these faunas are joined by Early Miocene caving as well; so that although there are rare indications of Oligocene fauna below 2400m, in general the in situ faunas are heavily masked by the caving. Because of the caving problem, there has been little point in logging the benthonic fauna below 2170m. Only species which appeared to be new down-hole appearances in the benthos have been logged, and little can be said about the water depths present in the Early Miocene and Oligocene.

Below 2730m very rare indications of Eocene age can be seen in the heavily caved planktonic assemblages. All these faunas are tentatively placed in Taylor's Zone N, of Middle Eocene age. Only one sample (at 2790m) can be given a definite Zone N age determination. The planktonic assemblages are accompanied by large specimens of arenaceous benthonic genera which suggest unfavourable bottom conditions, possibly in a channel situation. Taylor (1983) has interpreted similar faunas of this age as indicative of an "estuarine entrance" environment, and has postulated water depths of less than 10m for the assemblage. The quality of

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the ditch cuttings is so poor that no such environmental interpretation could reliably be given for the Angler-1 sequence. The base of the foraminiferal sequence cannot be ascertained from the ditch cuttings because of the persistent caving.

LIST OF SAMPLES EXAMINED

DC 1040m
DC 1160m
DC 1220m
DC 1260m (cement)
DC 1360m
DC 1450m
DC 1670m
DC 1770m
DC 1880m
DC 2030m
DC 2080m
DC 2170m
DC 2270m
DC 2400m
DC 2460m
DC 2490m
DC 2590m
DC 2690m
DC 2730m
DC 2740m
DC 2770m
DC 2780m
DC 2790m
DC 2800m
DC 2810m
DC 2820m
DC 2830m
DC 2840m
DC 2860m
DC 2890m
DC 2945m

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AGE SIGNIFICANCE OF THE FORAMINIFERAL ASSEMBLAGES ENCOUNTERED.

At 1040m : Zone A-3 (- Zone N21): Late Pliocene.

The abundant planktonic assemblage contains common Globorotalia inflata, G. crassaformis ronda and G. scitula scitula. Rare specimens of Globorotalia puncticulata and G. tosaensis tosaensis define the age as Late Pliocene - Early Pleistocene. Assuming that the assemblage is in situ, Globorotalia inflata indicates Taylor's Zone A-3 or younger, and the absence of Globorotalia truncatulinoides indicates an age older than the Pleistocene Zone A-2.

The diverse benthonic fauna contains abundant Euuvigerina cf. peregrina. Cibicides spp. are moderately common, but species such as Vulvulina pennatula and Reophax scorpiurius suggest upper slope water depths. An environment of deep outer shelf to uppermost slope is suggested.

At 1160m : Zone probably B-2 : probably Late Miocene.

The age is based on the presence (indeed, abundance) of Globorotalia miotumida miotumida and G. miozea conoidea. According to Taylor, G. miotumida miotumida does not range above Zone B-2. Very rare specimens of older species such as Praeorbulina glomerosa, Globigerina ampliapertura and Globorotalia miozea miozea are tentatively interpreted as reworked; G. tosaensis tosaensis is interpreted to be caved. With some indication of both caving and reworking within this ditch cutting, and with no sample coverage for 120m above, the age interpretation is necessarily tentative.

Euuvigerina is extremely prominent among the diverse benthonic assemblage. The environmental interpretation is much the same as for the sample above - deep outer shelf to uppermost slope.

1220 - 1450m : Zone D-1? : Middle Miocene.

At 1220m the planktonic assemblage consists of abundant Orbulina universa in a moderately hard calcarenite. Based on the abundance of Orbulina, and the presence of rare Globorotalia cf. miozea, G. menardii and Globigerinoides ruber, a Middle Miocene age is suggested, with a preference for a D-1 age rather than C or D-2. Still present are moderately abundant G.

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miozea conoidea and G. miotumida, so that a Late Miocene age is not out of the question. The benthonic assemblage of this sample appears very much the same as above, and it is not possible to say how much of this is caving.

The sample at 1260m consisted largely of driller's cement, and 1220m was added to the sample set as a substitute. At 1360m the cement has diminished somewhat, and a moderately hard limestone has yielded a low diversity assemblage of Orbulina universa, Globorotalia miozea conoidea, G. fohsi group (logged as G. cf. praefohsi), Nonion sp. and numerically little else. The presence of any representatives of the G. fohsi group are taken to indicate a Zone D-1 age, as the group appears to have only a short time range in Gippsland. Zone D-1 spans the interval of time correlated approximately with zones N10 to N13 of the tropical foraminiferal zonation.

At 1450m the sample consists of hard bioclastic silty limestone which has broken down poorly in processing. A rather sparse assemblage of foraminifera includes moderate numbers of Globorotalia miotumida, possibly as caving, and two specimens of Globorotalia miozea miozea which suggest a Zone D-1 age or older. One specimen of Praeorbulina glomerosa is interpreted to be in place here. The benthonic assemblage consists mostly of small specimens, among which Cassidulina carinata and Cassidulinoides cf. orientale and Globocassidulina subglobosa are common. Such an assemblage, alternating with intervals near-barren of fauna (such as that at 1360m) suggests a correlation with Taylor's "canyon fill" environment.

At 1670m : Zone D? : Middle Miocene?

This sample consists of a hard limestone with very little fauna. Most of the assemblage is the Middle Miocene to Recent species Orbulina universa. The age and environmental interpretation is essentially the same as for the interval above, but the number of specimens is so low as to cause doubt as to whether they are all emplaced by caving. The assemblage of small cassidulinids seen above is not present here.

1770 - 1880m : indeterminable.

Both these samples consist of hard, silty cemented limestone. The higher one has an appreciable number of siliceous spines, probably sponge spicules. The

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foraminiferal assemblages are extremely sparse, and appear to consist almost entirely of caved specimens. Both samples are considered undatable on the basis of insufficient fauna.

At 2030m : Zone probable G : probable Early Miocene.

This sample is still within the same hard lithology as the two samples just discussed, but contains a little more fauna. Small specimens in particular, suggest that the very sparse assemblage is in place. The presence of Globorotalia miozea miozea, G. cf. zealandica and Globigerinoides trilobus trilobus indicate an age of Zone G or younger. The virtual absence of Orbulina (one or two specimens only) and its precursor species suggests that the sample is older than Zones E - F. The rare benthonic species consist of Cassidulinoides, Cibicides and Euuvigerina, in insufficient numbers to give a definite environmental interpretation. The situation of very sparse faunas seems similar to that described by Taylor in the Selene-1 Micropalaeontological Report, where there is interpreted to be a thick submarine canyon sequence. Such an interpretation would also be possible for Angler-1 between 1450 and 2030m, but the quality of the samples is inadequate to be certain.

At 2080m : Zone H-1 : Early Miocene.

The sample contains common foraminifera in a silty grey marl. Some caving is evident, as evidenced by the presence of Orbulina spp., Globorotalia scitula, G. praefohsi, G. conoidea, G. miotumida and G. menardii. The age is indicated by the presence of Turborotalia kugleri and Globorotalia peripheroronda. Because of the amount of caving evident from the Late Miocene and Pliocene, the environmental interpretation of outer shelf is extremely tentative.

2170 - 2270m : age indeterminable due to caving.

These two samples contain common foraminifera, but most of the species recorded are of Middle Miocene or younger age. Only at 2270m are very rare specimens of Globigerina tripartita and Globigerina binaiensis recorded. These are long ranging, and although new occurrences in the sequence, they do not assist in determining the age in this context.

2400 - 22690m : Zone J : Early Oligocene.

The sample at 2400m contains very rare specimens of Globigerina angiporoides and Turborotalia cf. increbescens, indicative of a Zone J age. The sample also contains rare T. opima opima and Globigerina cf. angulisuturalis which may indicate the presence of younger Oligocene above this depth. Massive caving of Miocene foraminifera is evident in this sample. There are almost no benthonic foraminifera present on which to base an environmental interpretation.

The sample at 2460m has little, if any, fauna in place. At 2490m the assemblage again contains some Zone J specimens, in addition to the pervasive caving. Globigerina angiporoides, G. apertura, G. tripartita, Globigerina cipercoensis and Turborotalia cf. increbescens are considered to be in place. Again, the benthonic part of the assemblage is sparse, and affected by the caving problem. The sample at 2590m contains essentially the same fauna, but with the addition of small specimens assigned to Globorotalia scitula (Middle Miocene to Recent). Some of these are indistinguishable from Turborotalia cerroazulensis cocoaensis (Late Eocene), so that problems of homeomorphy and of caving defeat the search for Late Eocene in this well. The Eocene indicator Subbotina linaperta was not seen in this sample.

The sample at 2690m contains an abundant fauna of small Globigerina spp. of Early Miocene to Oligocene type, plus some larger but still long-ranging species: Globigerina praebulloides, G. euapertura, and G. tripartita. The sample contains fewer caved specimens than others in this interval. However, as the in situ fauna consists almost entirely of "background" species, an undifferentiated Oligocene age is assigned to it. As for higher samples, the environmental interpretation is affected by caving of benthonic species. The slope species Karrerella bradyi is perhaps more common here than higher, and may suggest upper slope conditions at the base of the Oligocene section, but this is little more than a suggestion.

22730 - 2790m : Zone N : Middle Eocene.

The sample at 2730m is, as above, affected by Miocene caving. However, the presence of two specimens of Subbotina linaperta indicates an Eocene age. Also present are two specimens of Acarinina cf. primitiva. A. primitiva is one of the index species for the top of

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Zone N, which Taylor correlates approximately with Zones P12 to P14 of the tropical zonation. The remainder of the assemblage consists of sparse Oligocene and common Miocene specimens. The extreme rarity of Eocene indicators, even after prolonged searching, suggests that the Eocene fauna is a sparse one, possibly due to environmental constraints. The next sample at 2740m is of similar character. In that sample the evidence for a Zone N age consists of one specimen of Acarinina collactea, one Planorotalites renzi, one specimen of Turborotalia cerroazulensis cerroazulensis (which as remarked above, could conceivably be a small Globorotalia cf. scitula), and two damaged specimens of Subbotina linaperta. The evidence is hardly impressive. At 2770m very rare specimens of Subbotina linaperta are accompanied by questionable Acarinina primitiva, Globigerinatheka index and G. cf. kugleri. This sample would seem to be definitely Eocene, but the zone is uncertain. There is nothing definitive in the sample at 2780m. At 2790m, one excellent specimen of Globigerinatheka index provides the best evidence in the whole sequence for an Eocene age. Also present are three specimens of Acarinina primitiva which in morphology are transitional to Acarinina pseudotopilensis. The specimens of Subbotina linaperta in this sample are poorly preserved and deformed. Globigerinatheka index ranges from Zone N to the top of the Eocene, but its association with A. primitiva can be considered indicative of Zone N.

Below 2770m the benthonic fauna, despite the continued caving, begins to assume a distinct character. Large arenaceous specimens of the genera Cyclammina, Bathysiphon, Dorothia, Ammodiscus and Haplophragmoides are seen in many of the samples down to 2830m. These are associated with a glauconitic and sandy sediment, and as far as can be seen, there is little associated calcareous benthonic fauna. The assemblages are suggestive of a restricted bottom water circulation, possibly on a poorly oxygenated sea floor. The assemblages may be very similar to those recorded from Zone N in Selene-1 by Taylor (1983), if it is assumed that "Haplophragmoides cf. incisa" of Taylor is identical to Cyclammina sp. identified here (see discussion in Ludbrook, 1977). These assemblages Taylor interpreted from sidewall core material as having lived in a lagoonal situation in proximity to the marine entrance to the system, with a shallow continental shelf beyond. The nature of these ditch cuttings is such that an interpretation of this degree

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of precision cannot be made for the Angler-1 sequence.

2800 - 2830m : possibly Late to Middle Eocene.

Below 2790m there are no new appearances of species which can be definitely said to be in place. Although rare specimens of the Turborotalia cerroazulensis group continue to be present, the problem of caving remains, and it is not possible to say where the base of the marine Eocene should be drawn from the foraminiferal evidence. The placement of samples down to 2830m as possibly Late to Middle Eocene is based only on the similarity of their faunas to those seen above; and this could result entirely from caving.

2840 - 2945m : age indeterminable.

Below 2840m the foraminiferal specimens become so rare that it seems doubtful that any of the specimens are in place.

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TABLE 1: Time stratigraphic subdivision of the interval 1040-2945m in Angler No.1 based on foraminifera.

Depth	Zone	Age	Environment
At 1040	A-3	Late Pliocene	outer shelf to uppermost slope
At 1160	prob.B-2	probably Late Miocene	" " " " "
1220-1450	D-1?	Middle Miocene	possibly canyon fill
At 1670	D?	?Middle Miocene	? " ? " ? "
1770-1880	?	indeterminable	indeterminable
At 2030	prob.G	probably Early Miocene	"
At 2080	H-1	Early Miocene	??outer shelf?
2170-2270	?	indeterminable due to caving	indeterminable
2400-?2690	J	Early Oligocene	indeterminable
-----probable disconformity-----			
?2730-2790	N	Middle Eocene	upper part indet; low oxygen at base (see text)
2800-2830	?	?possibly L.-M.Eocene?	as above?
2840-2945	?	indeterminable (?barren)	?

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DESCRIPTION:

DISTRIBUTION OF BENTHONIC FORAMINIFERA IN THE PETROFINA ET AL ANGLER-1 WELL.
LOGGED BY M. APTHORPE 7/89. X=PRESENT 1=NO OF SPECIMENS FOUND <=C.F. C=CAVED
A=ABUNDANT W=REWORKED F=FRAGMENTARY SPECIMEN ?=QUESTIONABLE IDENTIFICATION

CHECKLIST OF OCCURRENCES BY HIGHEST APPEARANCE

BASIC DATA

Table with columns for depth (e.g., 1040M DC) and species names (e.g., CIBICIDES CF. CYGHORUM, CIBICIDES MEDIOCRIS). Contains presence data (X) and identification codes (C, N).