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BIGSTRATIGRAPHIC REAPPRAISAL and FACIES STUDY - COD-A-1.

This report is the result of a micropaleontological analysis of thin sections recently submitted by Esso. The sections are of core-1 & core-2 from Cod-A-1 (see tabulation - p.3). The thin sections of core-2 (4725-4738), all contained identifiable sections of Orbulina (probably O. universa) and Globigerinoides glomeratus which indicates Zonule D and a middle Miocene age. Therefore my original report (Geol. Surv. Viet., unpubl. rep. 47/1965) was incorrect. I dismissed the middle Miocene planktonic fauna as being contamination which somehow penetrated core-2. At that stage of our knowledge, 3000' of middle Miocene was too much to accept in Victoria. Instead I accepted the lower Miocene fauna (listed below) as being in place. With the new evidence and the experience of the Kingfish-A-1 section I must now revise my earlier determinations. On page 6 I conclude that the mixing of faunas is due to channelling and filling within the lower Miocene during middle Miocene times.

Due to the nature of this cutting and filling, it is impossible to designate the middle/lower Miocene boundary with any accuracy. In core-2, the middle Miocene species comprised 50% of the planktonic fauna, with 40% ubiquitous middle/lower Miocene species (eg. Globigerina aperture, G. woodi & Globigerinoides trilobus) and 10% of the progenitor morphotype of Globoretalia scitula (early form of G. scitula praescitula). The benthonic fauna is almost completely of lower Miocene aspect, including such forms as Astrononion centreplax, Cibicides breveralis, Gyrogoninoides sp.4, Uvigerina sp. 9, U. sp.10 and Vulvulina granulosa. Most of these benthonic forms are present from 4000'. Naturally the percentage of lower Miocene species increases towards the base of the channel. There is no core or side wall core between 4738' and 5603' (core-3). Rotary cutting samples below 5200' are almost completely dominated by Zonule H faunas as listed above.

INTERPRETATIVE

Core-2 is now regarded as basal Zonule D (Globigerinoides trilobus being present) and cutting samples at 5200' are probably Zonule H (lower Miocene). Core-3 (5603') is Oligocene, Zonule I. Because of swamping by lower Miocene forms it is impossible to designate the interval between 4738' and 5200'. Basal middle Miocene Zonule E is probably present. The two higher lower Miocene Zonules F & G do not appear to be present; their diagnostic species are not noted as mud contaminants below 5200'. Therefore a lower Miocene hiatus probably occurred, as in Barracouta and Kingfish.

Zonule G & F faunas are noted in sections of core-1 (3500-28'), but are probably recycled material from further afield.

Revision of the mid-Tertiary biostratigraphic log for Cod-A-1 is given below.

ZONULE A	..... ? - 1000'	.....	UPPER MIOCENE
ZONULE B	..... 1000 - 1700'	.....	" "
ZONULE C	..... 1700 - 2800'	.....	MIDDLE MIOCENE
ZONULE D	..... 2800 - 4738'	.....	" "
	..... 4738' - ?		
*ZONULE E	..... ? ? ?	.....	" "
*ZONULE F	..... P.N.P.	.....	LOWER MIOCENE
*ZONULE G	..... P.N.P.	.....	" "
*ZONULE H	..... ? + 5200'	.....	" "
	..... 5200 - 5450'		
ZONULE I	..... 5450 - 5900'	.....	OLIGOCENE
ZONULE J	..... 5900 - 6040'	.....	" "
ZONULE K	..... 6040 - ?	.....	uppermost EOCENE

* interval 4738' to 5200' difficult to designate.

P.N.P. = probably not present.

FACIES UNITS (see pages 3 - 5):

"battered Rebulus" facies unit 2700' - 74500'

"sponge spicule" facies unit 74500' - ? 50000'.

"Lakes Entrance calcareous" facies unit.....?50000' - 59000'

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THIN SECTION ANALYSIS:

Ten thin sections of Core-1 and three of Core-2 in Cod-A-1, were analysed for fossil content in a manner similar to that applied to Kingfish-A-1 thin sections. The resultant areal percentages are tabulated below

Slide	total count	plank forams	benth forams	sponge spicules	bryozoa	unident. debris	?inorganic
<u>Core-1</u>							
3506.5	500	4% 3%	10%	2%	22%	10%	52%
3508	500	—	—	—	—	68%	32%
3509	600	5%	10%	—	—	50%	35%
3510	500	8%	—	2%	—	50%	40%
3511	800	5%	—	7%	16%	56%	16%
3512	1000	3%	20%	2%	20%	20%	35%
* M1438	500	15%	5%	10%	—	60%	10%
* M1438-A							
- (I)	1000	2%	20%	3%	20%	50%	5%
- (II)	1000	15%	2%	10%	—	70%	3%
* M1438-B							
- (I)	600	5%	25%	5%	20%	35%	10%
- (II)	1000	10%	5%	6%	7%	66%	16%
* M1438-D	500	20%	12%	14%	—	40%	14%
<u>Core-2</u>							
4725	1000	14%	5%	30%	—	40%	11%
4728	500	10%	2%	14%	—	68%	8%
4731	1000	13%	3%	18%	—	54%	12%

* = B.H.P. slides (unstained). Other slides are ESSO stained slides.

The quality of the two sets of slides were different. The Esso stained slides were thinner; almost too thin for palaeontological work. The B.H.P. set were the right thickness, so that the results should be regarded as more reliable and certainly were more interesting. However, the stained slides were useful in quickly distinguishing arenaceous and siliceous (eg. foraminifera and sponge spicules) from calcareous organic material. Siliceous material does not take up the stain.

INTERPRETATIVE

INTERPRETATION of THIN SECTION ANALYSIS:

Core-1 (3500-3528; sec.1005):-Perusal of the tabulated percentages suggests two distinct associations:-

- (I) Dominant percentages of benthonic foraminifera and bryozoal fragments. Planktonic foraminifera and sponge spicules are minor elements, if present at all.
- (II) Dominant percentages of planktonic foraminifera and sponge spicules. Benthonic foraminifera and bryozoa are minor elements, if present at all.

These two distinct associations can be distinguished on a single slide; eg. M1438A, where two distinct micro-textural areas can be seen with the naked eye. Association (I) is in a coarse grained, skeletal, white limestone, while association (II) is in a much finer grained grey micritic limestone.

Association (I) contains an abundance of larger foraminifera, including Austrillina, Cycloekman, Lepidocyclina, Amphiatemina and a large pustulate Robulus. Association (II) contains a rich planktonic fauna, including Orbulina universa and O. naturalis, indicating Zone D in the middle Miocene. Biostratigraphically, these two faunas are incompatible, as the first three listed species of Association (I) do not range above, and are in fact restricted to, Zone F at the top of the lower Miocene.

Paleoecologically, these two associations are also incompatible. Association (I) is indicative of shallow, temperate seas, whilst the high proportion of planktonic foraminifera and sponge spicules suggests deep, cold water conditions for Association (II).

As Association (I) is the oldest, obviously it has been recycled into a younger deep water deposit. Submarine slides could have been responsible for this incompatible faunal association.

The pustulate Robulus sp., recorded in Association (I) (see marked slide M1438A) is also recycled. This Robulus marks a definite horizon in Marlin sections (as already reported as the "battered Robulus level").

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Examination of washed samples, showed that the "battered Robulus" (including the pustulate species) were present below 2300' and abundant from 2700' to below core-1. The base of this "battered Robulus" facies unit is placed at approximately 4500', partially on the scarcity of the pustulate species below this level, partially on its absence in core-2 (4725-38), and partially on the highest appearance of the "sponge spicule" facies unit of core-2.

Core-2 (4725-38: sec. 8'):- In all three slides the dominant association is that of planktonic foraminifera and sponge spicules. Bryozoa are absent. Deep, cold water conditions are evident. Sections of Orbulina sp. ? O. universalis and Globigerinoides glomerosus were present in the slides. In some areas of the slides, elongate axial sections of sponge spicules, show a preferred orientation, suggesting current motion.

Examination of washed material from Core-2, reveals up to 60% recycled species. As already mentioned there is a mixture of lower and middle Miocene forms. The recycled species are mainly lens shaped Cibicides spp. discoidal Astrorionina centroplex and large tapered uvigerinids. Larger foraminifera and "battered Robulus spp." are absent. Arenaceous species are common and are probably not recycled. They suggest deep water conditions. Many specimens have incorporated sponge spicules into their walls, as quartz and other mineral grains are virtually absent. This observation is confirmed from the thin section examination.

This core is an example of the "sponge spicule" facies unit. The incorporation of sponge spicules in arenaceous foraminiferal tests, makes it possible to identify the top of this facies unit in rotary cuttings. In Cod-A-1 the top of the unit is placed at 4500'. It is believed that in the Cod-A-1 the "battered Robulus" and "sponge spicule" are distinct facies units.

In both cases these two facies are lithofacies and not bio-facies, although they are designated on fossil content. The "battered Robulus" are recycled, thus are detrital material. The arenaceous foraminifera use sponge spicules because of an absence of detrital quartz etc., thus the "sponge spicule" facies unit is dictated by the nature of detrital material. It should be noted that arenaceous species in the "battered Robulus" facies unit (including core-1) have quartz incorporated in their tests and not sponge spicules.

INTERPRETATIVE

CONCLUSIONS:

This reappraisal of the Cod-A-1 section has revealed 43000' of middle Miocene (Zonule D = at least 2000'). This would appear extremely thick, but is less than in Kingfish-A-1 where Taylor reports 4000' of middle Miocene. The micropaleontological work confirms the accepted explanation that the thick middle Miocene, Kingfish section is the result of channelling and filling. The same explanation must now be evoked for the middle Miocene at Cod-A-1.

In Cod-A-1, channel developement probably commenced in late lower Miocene to early middle Miocene times, reworking the lower Miocene, richly foraminiferal calcareous shales. They must have been a depositional hiatus towards the top of the lower Miocene. Zonule G & F (lower Miocene) have only been associated with middle Miocene species. Zonule H (base of lower Miocene) is of greatly reduced thickness and the high percentage of Zonule H species in the base of the definite middle Miocene (eg. core-2 at 4725-4738'), so that strong reworking of Zonule H sediment is obvious.

The facies study shows two phases of channel fill:-

Phase I - the silt and foraminiferal debris from the underlying lower Miocene calcareous shale. Apart from foraminifera, coarse detritus was not available, as evident from the composition of the arenaceous foraminifera. This phase is shown in the "sponge spicule" facies unit from approximately 5000' to 4500' and is well demonstrated in core-2 (4725-4738').

Phase II - apparent collapse of channel sides at higher relative levels (either in immediate vicinity or "up-stream"), bringing in, by submarine slides, coarse limestone material which contained the Zonule G & F species. These slides also bore arenaceous material, which could have been of the same provenance as the middle Miocene sand body of the Barracouta structure. This phase is shown in the "battered Robulus" facies unit from approximately 4500' to 2700' with indications extending to 2300'. The facies is well demonstrated in core-1 (3500-3528).

During both these phases the depositional site was in fairly deep water - outer shelf or even slope.

10th August, 1967

INTERPRETATIVE