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GEOLOGICAL SURVEY.

NORTH SECTOR.

Geological Note. No. 93

AN ATTEMPT AT THE GEOLOGICAL INTERPRETATION OF THE SOUTH AND SOUTH-EAST PART OF THE BONAPARTE GULF BASIN.

PERMITS OP.2; OP.83; PE.127 H.

April 1967.

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AN ATTEMPT AT THE GEOLOGICAL INTERPRETATION OF THE SOUTH AND SOUTH-EAST PART OF THE BONAPARTE GULF BASIN

PERMITS OP.2; OP.83; PE.127 H.

We will limit ourselves in this report to a description of the data given by:

Gravity Survey	:	carried out by B.M.R.
Aeromag Survey	:	carried out by B.M.R. in 1958
Aeromag Survey	:	carried out by C.G.G. in 1965
Flexotir & Sparker Seismic Marine Survey	:	carried out by C.G.G. in 1966
Geological Survey	:	carried out by A.A.P. in 1963, 1964 & 1965.
Well Completion Reports	:	of Kulshill 1 and 2, Moyle 1, Bonaparte 1 & 2.
Seismic Marine Survey	:	Medusa bank 1966, ANACAPA.

A study of this data enables us to reach the geological interpretation given in the conclusion. All the data mentioned below may be seen on the interpretative geological map (Enclosure 1).

1. GRAVITY SURVEY.

Thanks to the bouguer anomaly, we have designated the main regional features as follows:

- The important strikes
- The higher and lower areas

We think that the high value anomaly in the centre of the basin is due to a lithological differentiation within the Proterozoic because this value is too high to be only explained by the contrast between Proterozoic and Mesozoic/Palaeozoic sediments. Nevertheless, it seems possible that it represents a horst, which has influenced the sedimentation and the structural picture of the Palaeozoic deposits.

2. AEROMAG SURVEY.

From the interpretative map we have :

- The depth for the sedimentary deposits
- Regional directions and strikes

We have been told that the marker which has been followed by the geophysicist is always the same one. However, whether we cannot contradict this idea from the geological data, it is not possible as the depths given belong to different, and not the same, horizons. According to the aeromag survey, the basement is:

On Moyle - 8000' (C.G.G.), 8000' (G.A.I.) in fact the top of the Gabbro has been reached at 1700' according to Moyle 1 Well. It must be said, that S.N.P.A. interpretation (N. J. Vitart) had given the basement at 2000'.

On shore Queen's Channel - 3000' (C.G.G.), 15,000' (G.A.I.) in fact the Proterozoic is outcropping.

Kimberley, north area: The study began at Cape Londonderry, where Middle Proterozoic lavas are outcropping, and continued into the Wyndham area where Cambrian Antrim Volcanics are outcropping.

3. SEISMIC SURVEY

The different offshore seismic horizons are being correlated, at the present time, to the geological horizons, as follows:

Horizon 8	:	base of the Lower Permian
Horizon 7	:	tope of microconglomeratic shale member
Horizon 5	:	argillaceous sandstones with Oldhamia Base Upper Permian marine beds
Horizon 4	:	Base of lingula shales Triassic to Upper Permian
Horizon 2	:	base of Cretaceous

We also noticed on a few flexotir seismic sections, that contrary to the upper horizons, the thickness between horizon 5 and 7 is reducing from the shore to the centre of the basin or in other words from the East to the West.

4. GEOLOGICAL DATA

a. Paleozoic

4.1 Lower Permian

There is probably a distribution limit of the glacial deposit of the Kulshill formation, but unfortunately, it is not known; somewhere the microconglomeratic shales must pass to detritic sandstones, like those overlying these shales at Kulshill 1.

According to our knowledge of the Timor Permian facies, it seems more than probable that the Permian sedimentation is continuous between the Australian Shelf and the Timor Island.

4.2 Lower Carboniferous

The Milligan formation undoubtedly represents the flysch deposits in a basin with a rapid subsidence. Such basins generally show a very important thickness of thinly bedded detritical sediments in the middle of the trough, and, on the edges, a lateral passage to coarser sandstones or limestones.

Such basins are known in Australia, for example the "Fitzroy Trough", or in Algeria near Colomb-bechar "Ben Zireg Trough".

That means 6,000' to 10,000' of Milligan formation known in drilling should become thinner on the edges of the basin, with a changing of its facies.

4.3 Devonian

Only the Upper Devonian is known in the Bonaparte Gulf Basin. The controls of the Upper Devonian sedimentation are not as well defined as for the Lower Carboniferous, but according to our knowledge, due to the laboratory studies of Kulshill 1 and Bonaparte 1, and the geology of the Canning Basin, we can propose a sketch for the deposition for the whole Devonian.

The middle to lower Devonian sediments are made of sandstones and evaporite sequence; this facies passes into the Upper Devonian to sandstones on the edges of the basin, and siltstones, clays and micrite in the centre. The end of the Devonian cycle is marked by the building of Algal reefs

near the shore, and in the area which will become the Carboniferous trough the deposits are more clayey. The fact that in Kulshill 1 we found a high value of salinity in the Upper Devonian deposit means that a barrier or a platform has isolated the Kulshill sub-basin from the Kimberley sub-basin. That means that on this platform we can expect a changing of the facies deposit similar to the same one we observed on Pincombe Range.

In fact the perenniality of the greater features of the basin since the Proterozoic, we think that the important faults and strikes, we designated on the map, limit the most interesting area for the Devonian.

b. Mesozoic

After the lower Permian deposits, the different sub-basins become a single downwarp which filled more or less with Upper Permian (marine sediments) to Cretaceous. At the present time it is difficult to give an idea of the sort of Mesozoic lithology unless by comparison with what happened on Western Australian shelf.

It seems that the geological sketch in Western Australia is similar to the Timor one (according to the description given by Audley-Charles).

All these results have lead us to build the geological correlation as follows:

TIMOR		BONAPARTE		CANNING - FITZROY		CARNARVON	
APTIAN TO MAESTRICHTIEN	Borolalo Limestone	ALBIAN TO TURONIAN	Bathurst Clay.	CRETACEOUS	Parda F.	MAES-TRICHT	Toolonga F.
	Waibua F.		?		Anketell F.	NEOCOM-IEN TO TURONIEN	Windalia F Muderong F Birdrong F
TRIASSIC TO MIDDLE JURASSIC	Wailuli F.	TRIASSIC	?	MID. TO UPPER JURASSIC	Jarlemai F Alexander F. Jungurra F.	LIAS TO MID. KIMB.	Dingo F.
	Aitutu F.		Lingula shales	TRIASSIC	Erskine sandstone Blina shales	TRIAS	Unnamed F.
PERMIAN	Cribas F.	PERMIAN	Upper Permian Marine beds	PERMIAN	Liveringa F Noonkanbah F	PERMIAN	Marine Permian
			Sugarloaf F.		Pool sandst.		Lyong Group
	Atahoc F.		Kulshill F.		Grant F.		

CONCLUSION.

The North-South Gravity high following the 129th meridian should belong to a horst of the basement, which separates two Proterozoic to Paleozoic ante-Permian sub-basins, which suffered rapid subsidence. This horst seems to be in the north prolongation of the Halls Creek Mobile zone.

If the axis of the Mesozoic basin and Upper Permian (all the formations above horizon 5) coincide with the axis of the gravity high, it is not so for the underlying formation.

According to our first geophysical data (Flexotir Seismic Survey 1966) the Lower Permian deposit below horizon 5 seems to become thinner from E to W towards the gravity high, and according to sedimentologic studies the Lower Carboniferous and even the Devonian have been deposited in sub-basins rapidly subsiding, and which can be correlated to the two gravity holes (low) situated for each side of the central anomaly.

In our opinion, it would be wrong to believe that there was a constant subsidence of the central part of the basin since the beginning of the Paleozoic deposit until the end of Mesozoic or Tertiary deposits.

If the Mesozoic deposits are much thicker in the centre of the basin than at the rim, the Paleozoic deposits should not be thicker, as was seen in Kulshill or Bonaparte wells.

The Paleozoic formations might be of different ages, as for instance, the paleozoic extension of the Tournaisian change from the south of the basin to Kulshill 1.

This structural interpretation of the basin should also allow an understanding of the seismic anomalies, known at the present time.

One can notice that the anomalies follow the important strike (designated by gravity). That means, following the weakness zone due to faulting, intrusions have made their way. These intrusions could belong to either Devonian salt or acid lavas from the basement.

In conclusion, the main features are as follows :

n I. In the whole area, South and South East of the Bonaparte Gulf Basin, horizon 5 is never deeper than 10,000'.

II. Below horizon 5, the Permian deposit should be thinner as well as ante-Permian Paleozoic sediments.

III. On account I and II, the carboniferous targets defined in Kulshill wells, it seems, should be reached in some offshore wells. (Maximum depth 14,000')

IV. The seismic programme on OP.2 and OP.83 and on PE.221H, south part, must be orientated in obtention of information below horizon 5.

LIST OF ENCLOSURES :

Enclosure 1 : Interpretative geological Map scale 1/1,000,000

Enclosure 2 : Geological sketch sections, OP.2 - 127 H
OP.2 - OP.83