JOURNAL OF THE PALAEONTOLOGICAL SOCIETY OF INDIA
VOL. 16, 1971, pp. 35—40

STATISTICAL STUDIES FOR THE MICROFAUNAL CORRELATION IN THE BARAIL GROUP OF RUDRASAGAR OIL FIELD, ASSAM

JAGDISH PANDEY[1] AND K.S. SOODAN.[2]

Oil and Natural Gas Commission.

ABSTRACT—The Barail Group (Oligocene-Lower Miocene) of Upper Assam is an important oil bearing horizon in India. Owing to the extreme paucity of the fossils in the sediments constituting the group, the conventional methods of palaeontological correlation are not helpful. Statistical devices, based on the microfauna, however, proved to be fruitful in well to well correlation of the Barail sediments in one of the oil fields of Upper Assam, revealing important data regarding the basin configuration during deposition and geometry of the oil bearing sand bodies.

INTRODUCTION

Petroleum exploration in Upper Assam, has proved the importance of Barail strata as host rock and a probable source for hydrocarbons in this province. In the subcrops of Sibsagar District (Upper Assam), the Barail Group bears a conformable relation with the Kopili Formation (locally Middle & Upper Eocene) whereas the Tipam Formation (?Middle Miocene) overlies it. In the outcrops, a prominent unconformity intervenes between Barail Group and the Tipam Formation (Evans, 1932). It is difficult to distinguish this unconformity in the subcrops of Sibsagar. In the subcrops of Sibsagar the Barail group may be informally classified as follows:-

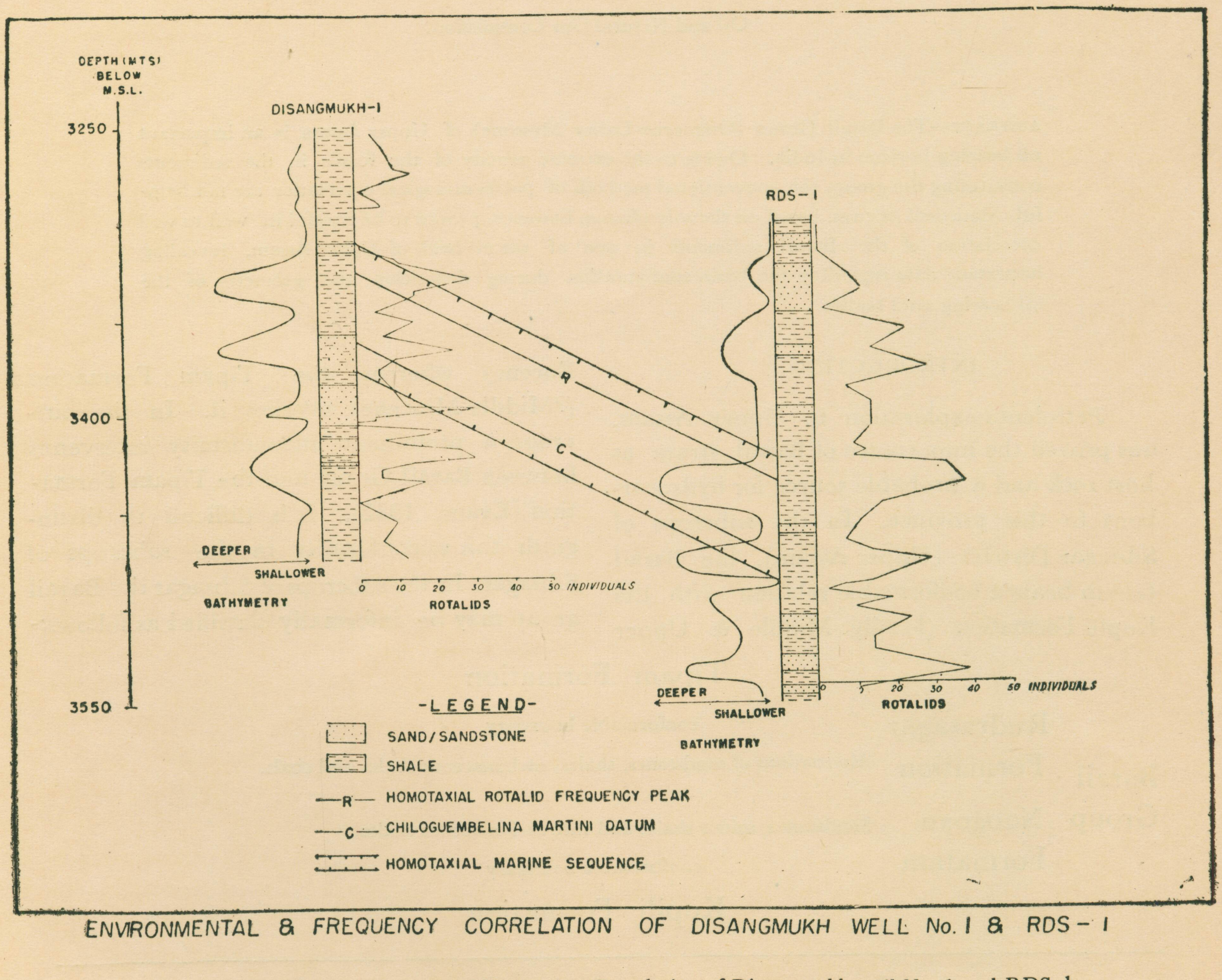
		Tipam Formation
		conformable boundary
Barail Group	Rudrasagar Formation	Alternations of sandstones, shales, carbonaceous shales and coals.
	Naogoan Formation	Sandstones, minor shales and rare carbonaceous shales.
		conformable boundary
		Kopili Formation

* The views expressed in this paper are of the authors only and not necessarily of the organisation for which they are working.

1. Geological Laboratories, Baroda-9.
2. Institute of Petroleum Exploration, Dehra Dun.

In the fields explored by the Oil and Natural Gas Commission, hydrocarbon occurrences in the Barail Group are either within the Rudrasagar Formation or in the upper part of Naogaon Formation, near the contact of Rudrasagar and Naogaon Formations. A detailed correlation of Rudrasagar Formation is, therefore, a prerequisite for interpreting the relationships among the oil sands in the different wells, as also, the stratigraphic and structural problems of the local oil fields. In this context, two important factors militate against well to well palaeontological correlation of the Barail strata; first, the extreme paucity of the microfauna, and second, chronologically non-diagnostic features of the recovered microfauna.

The Barail fauna of Sibsagar subcrops is constituted by sporadic arenaceous foraminifera along with the very rare, impoverished Rotaliids. The paucity of the fauna may be estimated by comparing the highest yield of about fifty microfossils in the 20 grammes flush sample of Rudrasagar well No. 34.



Text Fig. 1—Environmental and Frequency Correlation of Disangmukh well No. 1 and RDS–1

In general, arenaceous foraminifera are not important for precise inter-regional and intra-regional correlations of Tertiary strata. Moreover, the Barail forams are badly preserved and even for the highest yield, specimens worth specific identification are hardly four or five. With the help of this microfauna, a correlation involving the orthodox biostratigraphic practices is not feasible for the Barail Group of Upper Assam. Keeping in view the failure of conventional biostragraphic practices, the applied aspect of the palaeontological studies was pursued by the authors, in the well to well correlation of the Barail strata. Rudrasagar field (26°55' — 27°0'N : 94°39'—94°40'E; abbreviated as RDS for well numbers) was chosen as model. The methods adopted and the results obtained therefrom are discussed in the paper.

METHODOLOGY

A sedimentary sequence is not merely an accumulation of the strata but is also a stratified record of the physicochemical conditions, that existed during the deposition and lithification of the sediments. The energy factors that constitute the environments of deposition equally affect the contemporaneous biota. In general, the organic remains are more sensitive indicators of the depositional environments than the associated sediments themselves. Consequently, thanetocoenosis may serve as an excellent guide to infer a series of vertical (successive) paleoecological changes that are usually untraceable by the lithological criteria. Such vertical changes, if homotaxial, could be correlated in a particular area.

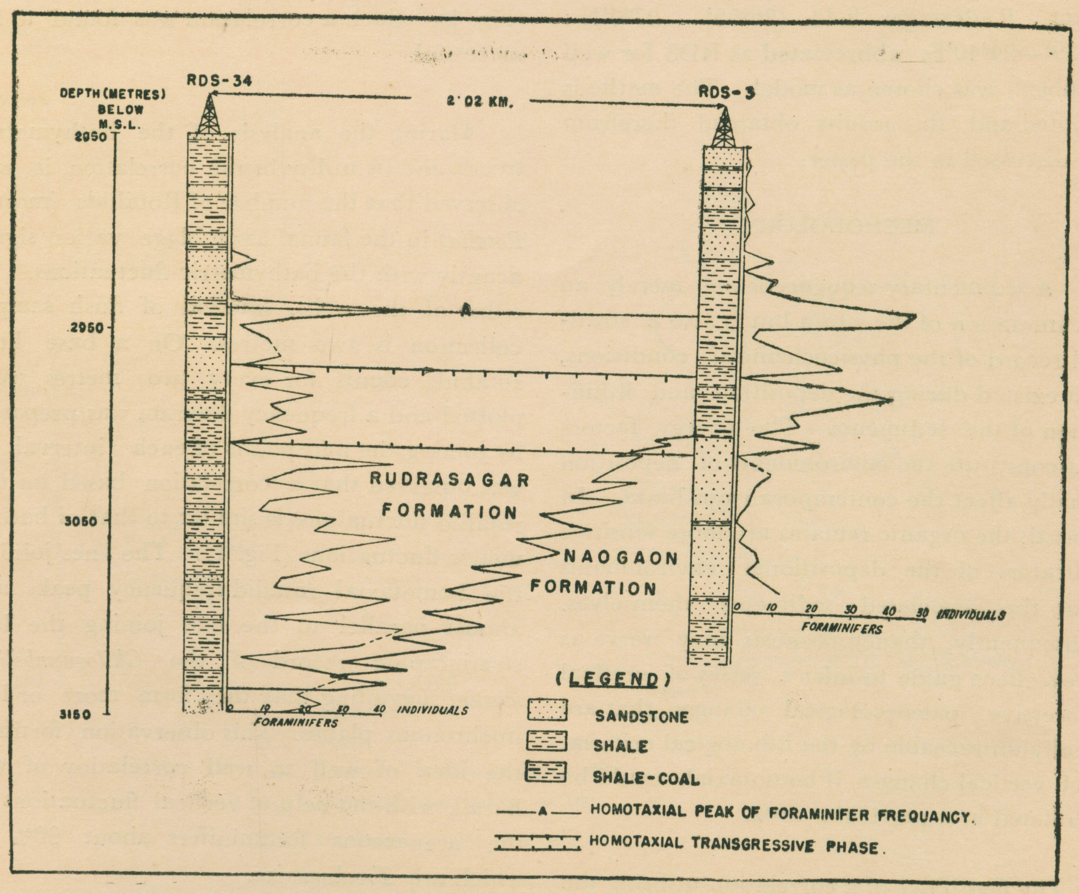
The feasibility of a correlation utilising the above principles was examined for the Kopili Formation in RDS-1 and Disangmukh Well No. 1 in Sibsagar (93°46' - 95°20'E : 26°38' - 27°53'.) The distance between the two wells is 11.75 kms. The Kopili Formation was chosen, mainly because biostratigraphic checks are also available in the formation to assess the accuracy of such a correlation.

Based on the study of microfauna a sequence of bathymetric fluctuations, related ultimately to the local transgressions and regressions, was established in the Kopili Formation of the Disangmukh Well No-1 and RDS-1. A correlation was attempted between the two wells, bringing out the bathymetric fluctuation (Fig. 1). Such a correlation was found to be successful.

During the analysis of the bathymetric trends and its utility in the correlation, it was observed that the number of Rotaliids (mostly *Rotalia*) in the faunal assemblage varies significantly with the bathymetric fluctuations. In either of the wells, interval of flush sample collection is two metres. On a base line, rotaliids counts for every two metres were plotted and a frequency diagram was prepared by joining the mid-points of each interval. It was observed that a correlation based on the rotaliid fluctuations is similar to that of bathymetric fluctuations (Fig. 1). The lines joining the homotaxial rotaliid frequency peaks are almost parallel to the one joining the last stratigraphic record of the *Chiloguembelina martini* suggesting that they form more or less isochronous planes. This observation fortified the idea of well to well correlation of the Barail, with the help of vertical fluctuations of the arenaceous foraminifers about 90% of which are *Trochammina*.

Some tools of correlation, involving ratios of the two faunal groups, differing in their mode of life have been suggested by Stehli and Creath (1964). However, such a method is not applicable for the Barail Group of Rudrasagar field as the recorded arenaceous forams have a single mode of life. Therefore, the method of successive fluctuations of foraminiferal populations was the only alternative solution, although it has certain severe drawbacks. This method will be ideal within a homogeneous rock type, where, the frequency of foraminifers will be directly related to the bathymetric trends. However, where the heterogenity of lithology prevails, as is the case in the Barail Group, at times the results may be considerably modified and a more cautious approach is necessary. Nevertheless, possibility of correlation, between closely spaced wells using the method of the faunal frequency was bright considering that the local Barail sediments were laid down on a more or less even basin floor.

FORAMINIFERAL FREQUENCY CORRELATION OF RDS. 3 & 34



Text Fig 2—Foraminiferal Frequency Correlation of RDS. 3 and 34

The fauna of Rudrasagar Formation and underlying Naogaon Formation is suggestive of dominantly brackish water paleoecological conditions. The calcareous forams are either absent or diminutive and brackish water arenaceous foraminifers make about 99% of the assemblage. These faunal characteristics, in conjugation with the lithological attributes, imply a deltaic environment of deposition. In this environment the phenomenon of short term marine transgression and delta progradation are frequent. Presumably, these fluctuations will be more accurately reflected by the foraminifers than sediments, as all the heterogenous lithotypes of the local Barail Group could be deposited either under brackkish water or fresh water condition, while the fauna is only brackish water. Currently the flush samples of Barail Group are collected at every five metre interval. The total faunal count from specific weight sample of each interval therefore reflects the approximate magnitude of brackish water condition during that interval. The fluctuations in the faunal frequencies apparently provide a pattern indicating differing intensities during the different intervals.

Keeping in view the above facts, detailed studies on the Barail Section of RDS-3 and 34, separated from each other for 2.02 km, were conducted to utilize the outlined method of correlation. In both the wells, twenty gramme sample of each flush interval was sorted completely for the microfauna.

The highest stratigraphic occurrence of the Barail forams is slightly below the Tipam/Barail contact in RDS-3 and other wells of the field. However, it is only below 2925 metres (subsea) that the occurrences of forams become more regular. In general, the frequency is higher in the lower parts of Rudrasagar Formation compared to the Naogaon. The pattern of the population fluctuation of forams, in lower Rudrasagar Formation and Upper Naogaon Formation, as recorded in the RDS-3 and 34; and a detailed correlation of the Rudrasagar Formation on the basis of the faunal frequency is attempted in Figure 2.

RESULTS

The correlation, attempted on the lines discussed above brings out the occurrence of homotaxial faunal fluctuations within the interval 2940 to 3025 metres in RDS-3 and 34. Some of the fluctuations are clearly defined, even if in one well, shale and in other sand, is present. In shaly parts, however, frequency peaks are more prominent than the coarser for a specific weight of sample. It is cogent to presume, that in five metres thick heterogenous lithological suite the maximum faunal yield will be from shales. More often, a very low resistivity shale bed occurs within sample interval where the frequency is very high. The factors responsible for decrease in the resistivity have been probably the same that prompted the frequency. The probable cause for the decrease in the resistivity is inferred to by the decreased particle size and the increased salinity of the formation water. The salinity increase could be assigned to renewal of marine conditions that favoured the prolifiration of the foraminifer population. The relationship between the higher yield of the the foraminifers and marine transgression, and association of higher frequencies with the low resistivity shales was examined further. The increase in the frequency of the forams was referred to marine transgression. Eviently, the lowest resistivity zones within the five metre interval were interpreted as transgression markers if they were associated with the frequency peaks. At times, when shales are not present, the transgression markers were extended through the mid-points of higher frequency intervals.

The correlation of RDS-3 and 34, and further studies on the vertical variation of faunal counts in different Rudrasagar wells, suggest that there was an impact of a prominent transgressive phase all over the Rudrasagar field between 2925 and 3000 metres subsea. Within this interval, several frequency peaks could be correlated from well to well.

In attempting the frequency correlation the authors were guided by the conditions following the Kopili sedimentation. There was a regression after Kopili during the deposition of Naogaon Formation, then rejuvenation of marine influence during the deposition of the lower part of the Rudrasagar Formation. The marine influence ceases only after Barail sedimentation. Hence the final retardation of marine influence, marked by the absence of forams in RDS-34 and extremely reduced frequency in RDS-3 was correlated.

The frequency correlation of RDS-3 and 34 reveals that all the important frequency markers fall almost against the same depths, implying that in RDS-34, a part of the Rudrasagar Formation is the facies of the Naogaon in RDS-3. This correlation was extended to the other wells of the Rudrasagar field also. Profiles were drawn across the field, illustrating the relationship between Rudrasagar Formation and the underlying Naogaon Formation. This correlation was also utilised to prepare certain stratigraphic maps, bringing out the basin configuration at the time of deposition of oil bearing Barail sediments and the geometry of the sand bodies in this field.

CONCLUSIONS

The simple statistical device, on microfauna, discussed above, has proved to be an effective tool for subsurface correlation in an oil field where the palaeontological studies were otherwise impracticable owing to the paucity of fauna and chronologically nondiagnostic features of the recorded microfauna. The poor record of fauna is due to the prevalance of estuarine and deltaic conditions at the time of deposition. The work introduces the possibility of similar correlation in the other fields as well where parallel difficulties are encountered.

ACKNOWLEDGEMENTS

The authors are indebted to Shri S.N. Talukdar, Director of Geolgy for according permission to publish and to Dr. D. K. Chandra, Chief Geologist and Shri A. C. Rangachari, Suptdg. Geologist, for encouragement. They are thankful to Shri Madan Mohan, Sr. Geologist for reading through the manuscript and suggestions.

REFERENCES

EVANS, P., 1932. Tertiary succession in Assam. *Trans. Min. and Met. Inst.* Ind., **27**, 155-260.

STEHLI, F. G. AND CREATH, W. B., 1964. Foraminiferal ratios and Regional Environments. *Bull. Am. Assoc. Petrol. Geol.*, **48**, 1810-1827.