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**ORGANIC CARBON PATTERN AND FORAMINIFERAL  
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# ORGANIC CARBON PATTERN AND FORAMINIFERAL ASSEMBLAGE IN THE SEDIMENTS OF GULF OF KUTCH

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## ABSTRACT

The organic carbon/matter distribution pattern in the shallow restricted marine environment of the Gulf indicates very low values but it is found to rise as the particle size of the sediment decreases; however it appears to be erratic.

The foraminiferal number (TFN) and the species diversity (TSN) seem to fluctuate with the variation in the sediment pattern. It is highest in the fine clays chiefly with embryonic or meiofaunal in size, thin-walled and hyaline, whereas it is large, thick-walled, and also porcellaneous in silts and sands. The agglutinated species being uncommon, the planktonic forms are characteristically rare.

The relationship between organic carbon content, the substrate, and the number of foraminifers is not consistent at all stations, since organic carbon percentages are very low to monitor the sharp changes.

## INTRODUCTION

This paper presents the results of analyses, distribution and the possible relationship of organic carbon/matter with the sediment of the substrate and its influence on the foraminiferal assemblage in the restricted marine environment of the Gulf of Kutch. The samples were collected during the Cruise II-1976 of *RV Gaveshani*, using Van Veen grab and La Fond-Dietz snapper. Out of 30 sampling stations selected, only 15 yielded surface (sediment-water interface) samples, mainly from the mouth of the Gulf adjoining the Arabian sea and from the region of the Head of the Gulf (Fig. 1). As the middle region of the Gulf is rocky, it did not yield any sediment samples. This suggests that very little sedimentation is taking place in a larger part of the Gulf. These samples are from very shallow depths and range from 15 to 46 m. The depth of the sample and the nature of the lithology of the substrate suggest the rate of accumulation of organic matter in the region.

The organic carbon content present in the sediment was estimated by the El Wakeel and Riley method (1957). The organic matter content is estimated by

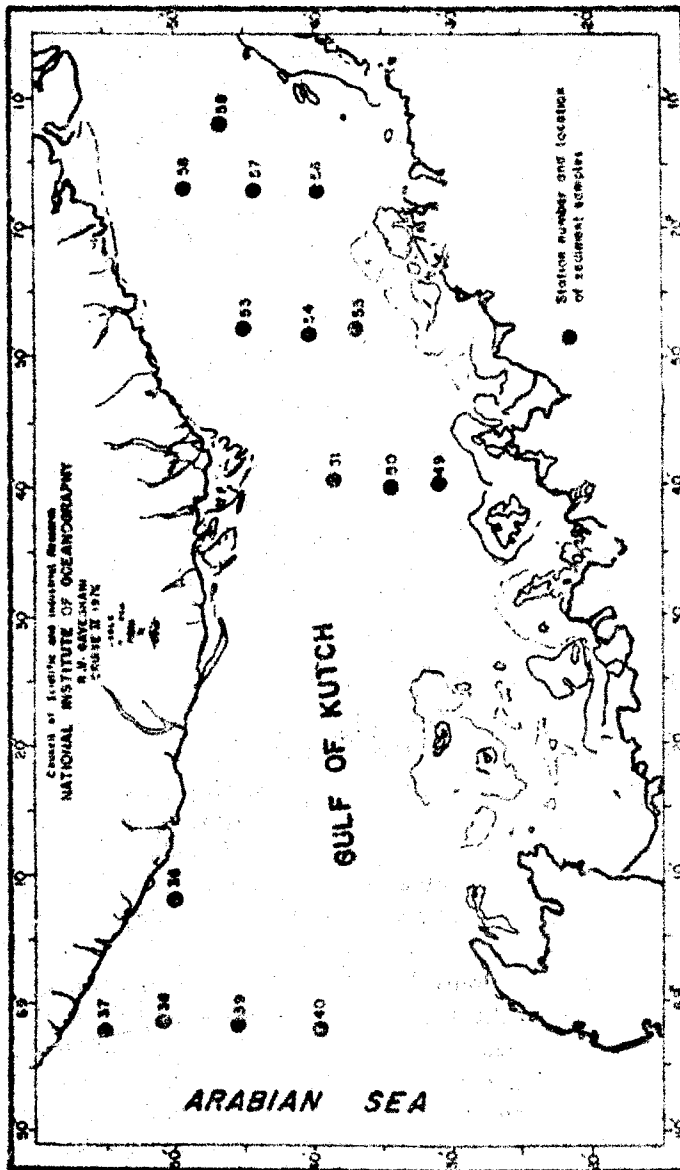


Fig. 1. Station Locations.

oxidising a known quantity of the sample and then titrating it against ferrous ammonium sulphate and finally the value thus obtained is multiplied by a factor of 1.724 as recommended by soil scientists. This represents the amount of organic matter present in the sample, however, the content in the sediment is discussed in terms of organic carbon ( $C_{org}$ ) in this paper. This because, generally the organic content is determined in terms of carbon or nitrogen in the material.

### RESULTS AND DISCUSSION

Table 1 represents the percentage and also distribution pattern of both organic matter and organic carbon content in total sample for purposes of comparison. Further, it also shows the sample location, depth and the nature of lithology of the study area.

The percentage values of organic carbon are found to be very low here and they range from 0.138 to 0.529. These values, though very low compared to other regions are consequent of the character of the substrate. The retention capacity of organic matter is found to be more in fine clays, less in sandy clays but least in sands, coarse sands, and also shelly calcareous sands. This confirms the observation of Trask (1939) that the concentration of organic matter rises as the particle size of the sediment decreases.

The low values may also be due to the fact that the region is highly rocky, shallow, and less disturbed by the circulating waters of the adjoining open sea, but it is deeply influenced by the surrounding arid land, sparse vegetation and also lack of any inflow through streams or rivers. On the whole, the low values of the Gulf may be attributed to the low rate of sedimentation and rapid decay or low rate of supply and/or the fast rate of decay.

The organic matter appears to be more authigenic in nature (contributed by corals, algae and molluscs) rather than enriched from the adjoining land (terrestrial augmentation) bordering on either side of the Gulf.

Though the distribution pattern of organic matter and the sediment is quite well understood, the percentage values of organic carbon present in the Gulf sediment is erratic. Though with increase in depth at certain stations, the sediment pattern does not change considerably, but the organic matter content shows marked changes, however, the foraminiferal behaviour is characteristically constant. Both the foraminiferal number and the species diversity fluctuate only with textural variations in the sediment.

Though the texture of the sediment largely controls the concentration of organic carbon content, the variation observed in similar sediment at two different stations is not conventional. It is well illustrated in Stn. Nos. 49, 51, 55-58, where the substrate is mainly sandy with some silt and clay, the fluctua-

TABLE 1—PERCENTAGE DISTRIBUTION OF ORGANIC CARBON

Serial No.	Station No.	Coordinates		Depth (Mètres)	Type of Sampler	Substrate	Organic Carbon (Percent) Dry Weight	Organic Matter (Percent) Dry Weight
		Latitude	Longitude					
1	36	22°50.2'	69°08.2'	15	Sanpper	Silty Clay	0.23	0.4
2	37	22°50.2'	68°57.9'	14	"	Silty Clay	0.391	0.67
3	38	22°51.0'	68°58.6'	15	"	Clayey Silt	0.46	0.79
4	39	22°45.3'	68°58.3'	26	"	Silty Clay	0.368	0.63
5	40	22°39.7'	68°58.1'	42	"	Sand Silt Clay	0.345	0.59
6	49	22°31.1'	69° .40'	36	"	Sand Silt Clay	0.299	0.51
7	50	22°34.35'	69°39.95'	38	"	Silty Clay	0.414	0.71
8	51	22°38.8'	69°40.2'	41	"	Sand Silt Clay	0.276	0.47
9	53	22°45.2'	69°52.2'	30	"	Silty Sand	0.138	0.24
10	54	22°41.7'	69°52.2'	39	"	Sandy Clay	0.161	0.28
11	55	22°36.7'	69°52.1'	32	"	Clayey Silt	0.529	0.91
12	56	22°39.4'	70°08.1'	22	"	Sand Silt Clay	0.299	0.51
13	57	22°44.4'	70°03.1'	21	"	Sand Silt Clay	0.368	0.63
14	58	22°49.5'	70°03.3'	21	"	Sand Silt Clay	0.322	0.55
15	59	22° 47'	70°08.2'	14	"	Clayey Silt	0.46	0.79

tion of organic carbon is from 0.27 to 0.37 to as high as 0.529 per cent (Fig. 2). Hence, though the depth ranges from 21 to 41 m, its influence is insignificant though it is widely held that depth has a decisive effect on determining the composition of organic matter (Bordovskiy, 1965). Similarly, at all stations at the mouth of the Gulf the above pattern is again repeated. Bordovskiy (*op. cit.*) further explains that this behaviour is due to unfavourable hydrodynamic conditions responsible to settle the organic matter irrespective of its origin—local, transformed, or transported. Further, the accumulation of organic matter is affected by the slope and other morphological features as well as the wave and current action in the waters of the basin.

The total foraminiferal number (TFN) is highest in the fine clays whereas it is lowest in the sands. However, the foraminifers in the clays are mostly embryonic types whereas they are large and adult types, though few, in the sands. It is not clear whether some of these had their origin in the clays and later migrated into the sandy environment and attained their adulthood there. The species diversity is observed to be highest in the very fine and fine fractions and decreased considerably in the coarser fractions. Wass (1967) attributes that the smallness or meiofaunal size and the abundance in fine clays of these benthonic types is indicative of stress or disturbance in the environment and that whether it can be referred to as 'Organic pollution' in the region.

However, among the embryonic, thin-shelled forms, the hyaline type miliolids are dominant in the silts and clays whereas they are the porcellaneous types in adult form in the sandy substrate. They are dominant at Stn. nos. 38, 49, 54, 56 and 59. The commonly predominant ones are *Quinqueloculina seminulum*, *Q. tropicalis*, *Q. vulgaris*, *Q. laevigata*, *Q. lamarekiana*, *Triloculina trigonula*, *T. tricarinata*, *Spiroloculina eximia*, *S. andersoni*, *S. antillarum*, *Scutularis* sp. and *Biloculina champmani* and *Q. longirostra*.

The agglutinated species are dominated by *Ammobaculites salsus*, *Sigmoilopsis* sp., *Milliammina fusca*, *Siphonoperta macheathi*, and *Haplophragmoides* sp., *Textularia agglutinans* and *T. schencki*. Though they are very uncommon, they are present in considerably large proportions at Stn. nos. 36 and 37, at the mouth of the Gulf, but they are less so at Stn. no. 49 (located at the heart of the Gulf).

Planktonic foraminifera are very rarely found, but if present, they are chiefly embryonic forms of *Globigerina bulloides* and noticed in Stn. nos. 37 and 38 at the proximity of the Gulf to the open sea.

This open sea environment at the mouth of the Gulf has many other common benthonic forms like *Ammonia* and variants, *Elphidium* sp., *Bolivina subaenariensis*, *B. barbata*, *B. striatula*, *B. lowmani*, *B. hastata*, *Nonionella atlantica*, *Florilus basispinata*, *F. grateloupi*, *Brizalina vaughani*, *Poreponides labatus*,

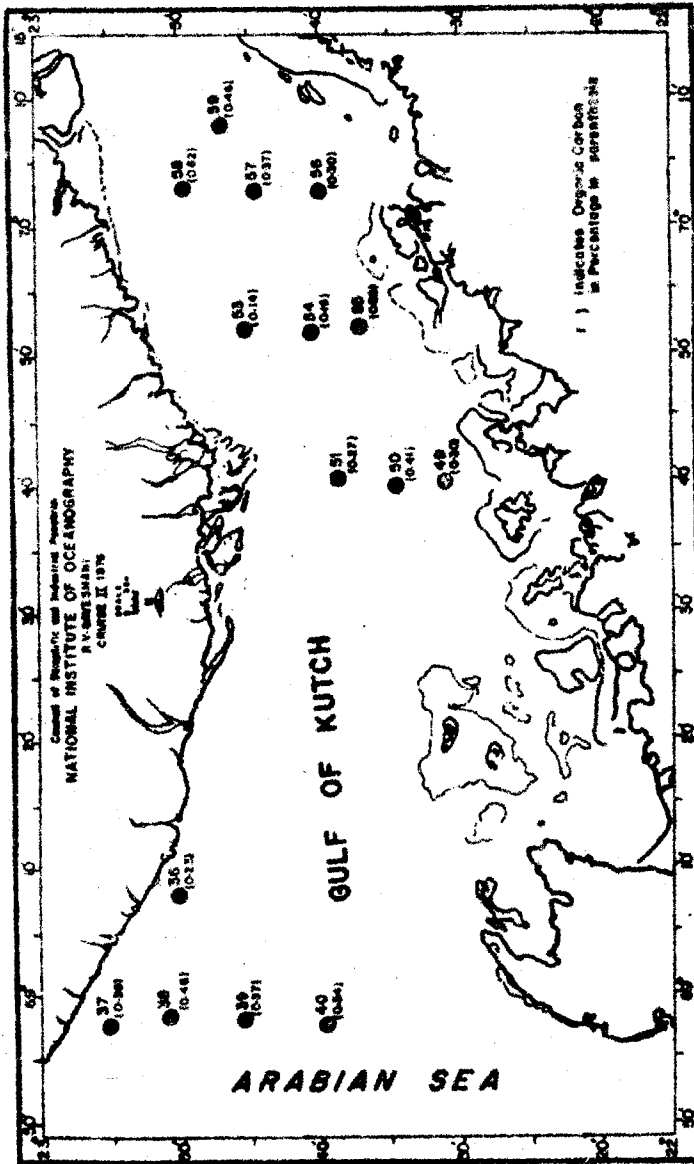


Fig. 2. Station Location and Organic Carbon percentages.

*Nonion* sp., *Cibicides phlegeri*, *C. fletcheri*, *Caribbeanella* sp. *Cancris sagra*, *Rosalina* sp. and such other forms. These decrease in number towards the distal side of the Gulf. However, some of them fluctuate and become restricted to certain stations only. Such a selective local habitat is dependent upon the nature of the substrate.

The presence of *Hyalina balthica* at Stn. no. 36 is very significant though very rare. Earlier, it was reported from the shelf sediments off Kerala coast (Setty, 1974). Many other species encountered here were reported from the western shelf of India (Setty 1976a, 1976b).

*Ammonia beccari* and its variants like *A. tepida*, *A. annectans*, *A. dentata* together with *Pararotalia nipponica* is dominant throughout both in embryonic forms in finer sediments and large to very large size in the coarser sediments. Further they exhibit various morphologic variations and are commonly and invariably associated with *Elphidium crispum*, *E. minutum*, *E. incertum*, *E. excavatum* and *E. gerthi*. *Poreponides lobatus* appears to be closely associated in this assemblage.

The foraminifera seem to be very abundant where the substrate is clayey or silty and also high in organic carbon as seen in Stn. nos. 55, 59, 57, 50 at the distal end and Stn. nos. 38 and 39 at the proximal side of the Gulf but this pattern is found to be similar with those at Stn. nos. 58 and 36 where the organic carbon content is less but the nature of the substrate remaining the same. At Stn. nos. 40 and 49 where the organic carbon is fairly high but the nature of the substrate changed considerably, the foraminiferal abundance has not decreased at Stn. nos. 53 and 54, where the organic carbon decreased to the lowest value though the substrate remained constant. Therefore, it is difficult to enumerate here the causes of this maladjustment between the two except to conclude that it is not possible to find the relationship of organic carbon with the number of foraminifers as clearly as Lidz (1965) found in Nantucket Bay, Massachusetts and Lehmann (1957) at Matagorda Bay, Texas, since the organic carbon percentage is very low to monitor the sharp changes.

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#### REFERENCES

- BORDOVSKIY, O. K. (1965). Sources of organic matter in marine sediments, *Mar. Geo.* 3 (1-2, Spl. Issue): 5-8.
- EL WAREL, S. K. and RILEY, J. P. (1957). Determination of organic carbon in the marine muds. *Jour. Cons. Perm. Int. Explor. Mer.* 22.



- LEHMANN, E. P. (1975). Statistical study of Texas Gulf coast recent foraminiferal facies. *Micropaleontology* 3 (4) : 325-56.
- LIDZ, L. (1965). Sedimentary environment and foraminiferal parameter: Nantucket Bay, Massachusetts. *Limnology and Oceanogr.* 10 No. 3 : 392-402.
- SETTY, M. G. ANANTHA P. (1974). Holocene benthonic foraminifera from the shelf sediments of Kerala Coast. *Bull. Earth Science* 3 : 21-28.
- (1976). The relative sensitivity of benthonic foraminifera in the polluted marine environment of Cola bay, Goa. *Sixth Coll. Ind. Micropaleo. and Stratigr. Proc.* : 361-70.
- (1979). Foraminiferal abundance in the modified marine environment of Cola Bay region of Goa. *Coll. Paleont. Geol. Survey of India, Miscellaneous Publ.* 45 : 239-42
- TRASK, P. D. (1939). Organic content of recent marine sediment. In : P. D. Trask (ed.), *Recent Marine Sediments* : 428-53.
- WASS, M. L. (1967). Biological and physiological basis of indicator organisms and communities in pollution. In : T. A. Olson and E. J. Burgess (eds.), *Marine Ecology* : 271-83. Interscience, John Wiley, New York.