SindhUniv. Res. Jour. (Sci. Ser.) Vol. 50 (003) 421-430 (2018)

http://doi.org/10.26692/sujo/2018.09.0069

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Paleo bathymetery and Paleo environment of Fort-Munro Formation at Bara Nala Section, District Jamshoro, Sindh

H. NAZ++, O. MUGAL, S. A. KHAN*, F. ARSHAD** K. MEMON

Centre for Pure and Applied Geology, University of Sindh, Jamshoro

Received 01st July 2017 and Revised 17th May 2018

Abstract: The paleobathymetry and paleoenvironmental analyses were carried out from Fort-Munro Formation (early Maastrichtian age) at Bara Nala Section of Lower Indus Basin. Fort-Munro Formation was succeeded by the Pab Sandstone at all across the Bara Nala Section. Following certain paleontological procedures, a diversified assemblage of age diagnostic benthic foraminifers were observed from the studied section. The variations in grain size revealed the evaluation of transgression-regression curve and relative sea level changes during the deposition of Fort-Munro Formation. Based upon paleontological investigations, marine environmental conditions were inferred possessing inner shelf to bathyal platform.

Keywords: Fort-Munro Formation; Bara Nala; Benthic Foraminifers

1. INTRODUCTION

Kirthar Province forms a part of Laki Range at Lower Indus Basin and is considered as one of the excellent exposures of geological outcrops possessing rich paleontological record. Bara Nala Section (Toposheet No. 35N/16) is exposed in the Northern part of the Laki Range about 20 kilometers west of Amri village at District Jamshoro of Sindh Province (Pakistan) **(Fig. 1)**. Bara Nala traverses the Laki Range from west to east at a point coincident with the apex of the anticlinal structure thus exposing an interesting succession at the Kirthar Province. Bara Nala section provides the much significant geological horizon at Lower Indus Basin, having great stratigraphic significance i.e., being the only locality in the western part of Sindh Province, where the rocks are exposed in continuous succession from Cretaceous to the Pliocene.

The late Cretaceous outcrops at Bara Nala Section are mainly attributable to Fort-Munro Formation. The rock units of the Fort-Munro Formation have been categorized in the Sulaiman Province and Axial Belt to "Pab Sandstone" however in Kirthar Province it has been recognized as "*Hemipneustes* Limestone" (Hunting Survey Corporation, 1961). The variable lithological units of Formation (mainly comprised of thickly bedded limestone with intercalation of marl, sandstone and shale) exhibits a rich and diversified occurrence of microfossils as well as megafossils usually prevailing in calcareous shale (Shah, 2009)..

2. LOCATION AND ACCESSIBILITY

Fort Munro Formation at studied area is easily accessible, well exposed and jeepable. Bara Nala section is situated near Amri village (25°25′28″N. at latitude and 68°16′52″E. at longitude) in District Jamshoro of Sindh province.

160 km in North West direction of Karachi.
90 Kilometer North West of Hyderabad.
Studied area is the channel cutting known as Bara Nala, which is 19 kilometer North West of Amri Village of Sindh province of Pakistan.

Latitude 26° 06'52.64" to N 26° 06'47.96"N.
Longitude 67°53'53.16"E to 67°53'10.43"E.

Fig. 1 Map of Pakistan highlighting the study area.

++Corresponding author Humaira Pathan <hnp_geol@yahoo.com
*Institute of Plant Sciences, University of Sindh, Jamshoro, Sindh, Pakistan.
**Department of Biological Sciences, University of Okara

3. GEOLOGICAL SET UP OF THE STUDIED

The studied area is mainly comprised of a mixed litho logy of classic and non-clastic sediments belonging to Cretaceous (Maastrichtian Stage) Period. Major litho logical constituents prevailing in the outcrop are predominantly shale, limestone, sandstone, clay stone and ironstone. Shale represents the detrital origin possessing gypsiferous, fossiliferous and sandy incursions (Shah, 2009). The oldest formation in the Bara Nala area is recognized as Fort-Monro Formation of which lower contact is not exposed due to the thrust fault however, it comes in contact with Laki Formation of Eocene Epoch but upper contact with Pab Sandstone is transitional (Williams, 1959). The Fort-Munro Formation is composed of shale, limestone, sandstone, Clay stone and ironstone. The maximum thickness is 410 feet in which 100feet of area are covered. Joints and fractured are common features of the outcrop (Shah, 2009).

Fort-Munro Formation in the studied area dips from 62° EW. The general trend of the strike throughout the area is in E° 4 N° direction.

The transgression and regression (T-R) cycle curve was drawn on the basis of variations in grain size of lithological units that exhibits the depositional environment of the Formation under various oscillations of transgression and regression (T-R) but mostly when sea is regressed from the area **(Fig. 2)**. The absence of significant preserved micro fauna from the sediments also depicts the metastatic level indicating the period of maximum regression

4. MATERIAL AND METHODS

62 samples were examined for pale bathymetry pale environmental analysis from Fort-Munro Formation. Collected samples were mainly comprised of Shale, Limestone and Chalk, which varied from generally hard and compact to soft material. In order to obtain micro paleontological inferences, standard techniques described by Kummel and Raup (1965) with significant modifications were adapted for the isolation and separation of micro fauna from inorganic remains. Samples were collected from contact to upward at regular (05 ft.) intervals. Samples were washed, sieved and micro faunal remains were picked under binocular microscope at 30X and 70X magnifications.

Micro fauna mainly comprised of benthic foraminifers was micro photographed and systematically categorized **(Fig 3 and 4).** and data was further evaluated in terms of distribution of foraminifers and pale bathymetry and pale environmental analyses.

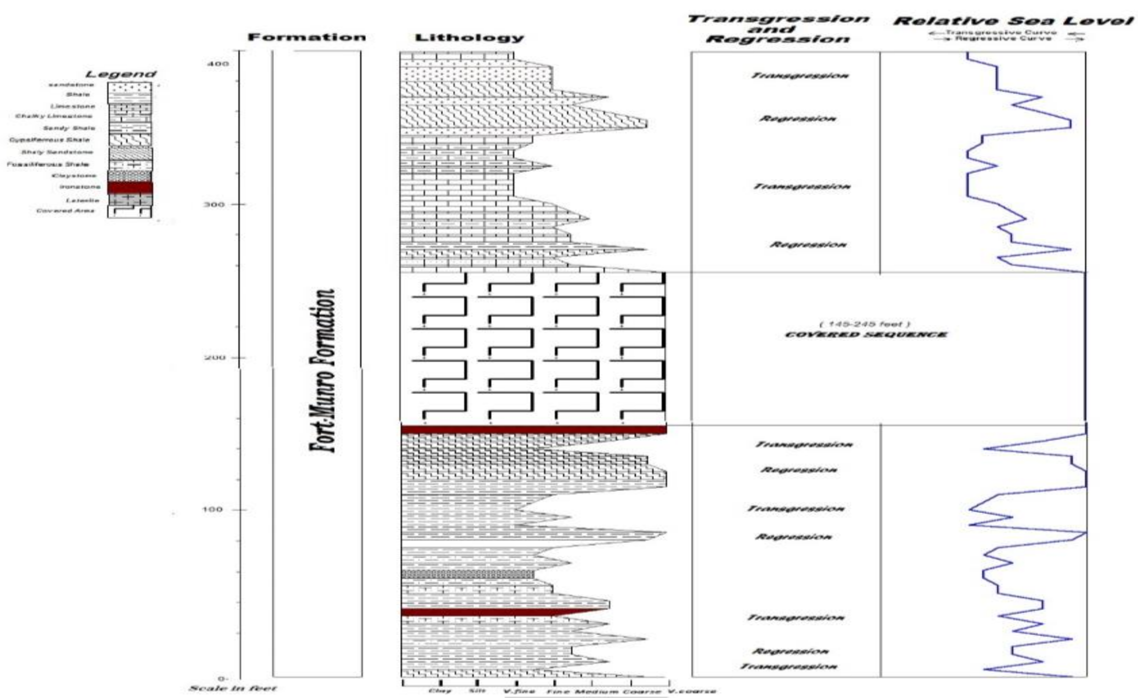

Fig.No.2. Showing lithology and T-R cycle.

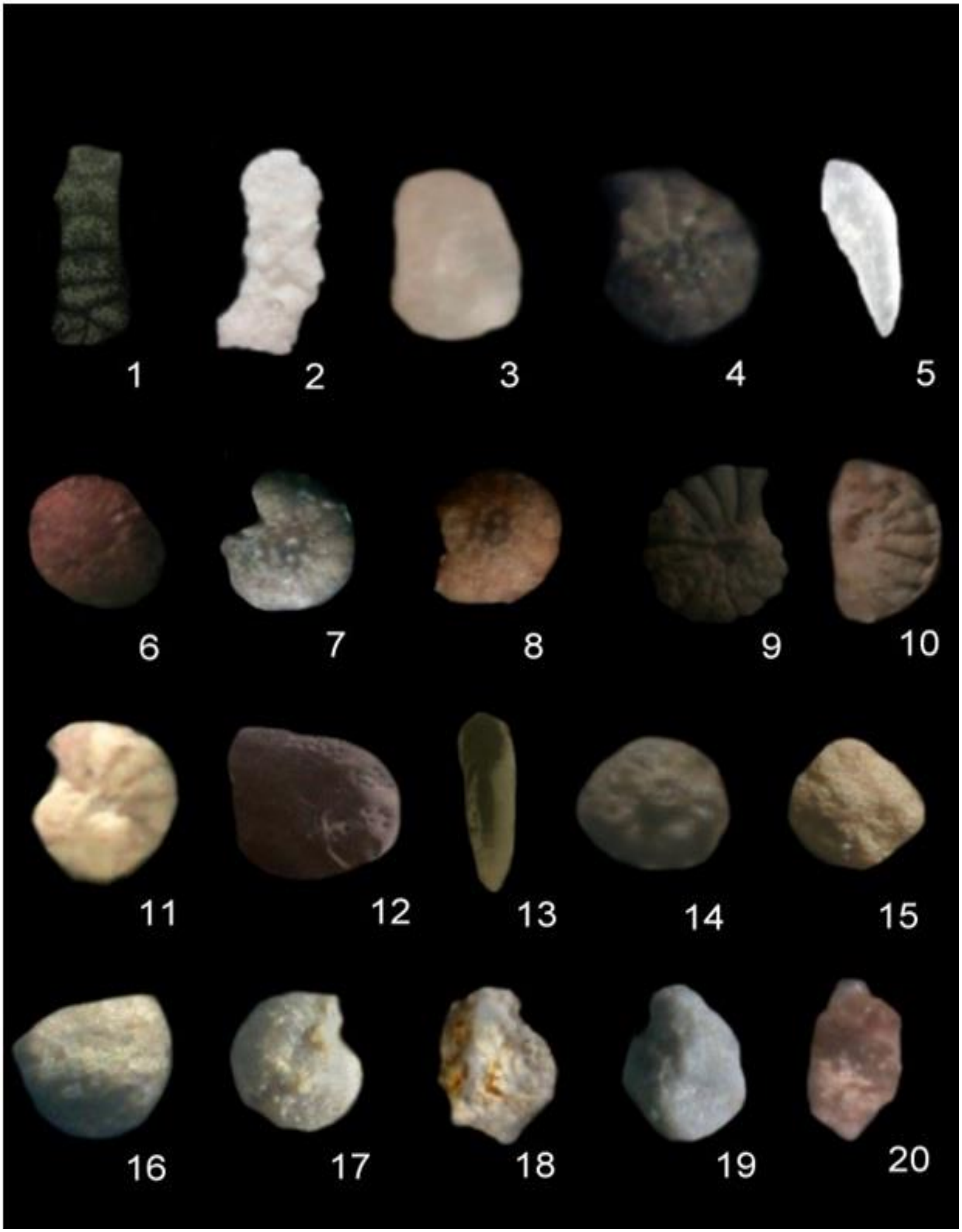

Fig. 3 Microphotographs of Benthic Foraminifers obtained from th outcrop of Fort-Munro Formation at Bara Nala Section, Sindh Province (Plate-I).

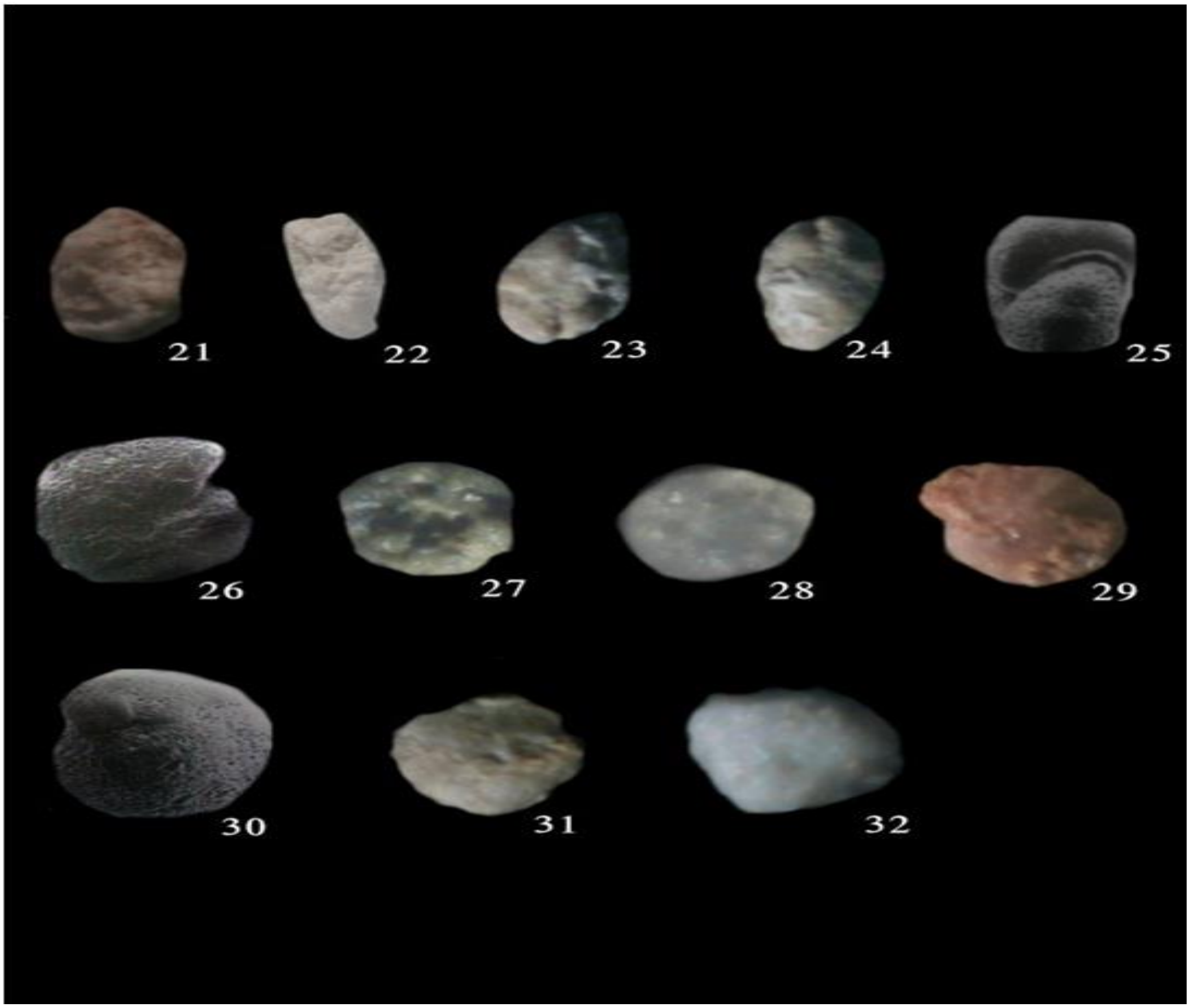

Fig. 4. Microphotographs of Benthic Foraminifers obtained from th outcrop of Fort-Munro Formation at Bara Nala Section, Sindh Province (Plate-II).

<u>Explanation of Plates</u>:

Figs. 1-2: *Ammobaculites* Cushman, 1910 (Sample H-48).
Fig. 3: *Ammovertella* Cushman, 1928 (Sample H-36).
Fig. 4: *Eponides* Montfort, 1808 (Sample H-12).
Fig. 5: *Bolivina* d'Orbigny, 1839 (Sample H-51).
Figs. 6-8: *Cibicides* Montfort, 1801 (Sample H-60 and20).
Figs. 9-11: *Stensioina exsculpta* (Reuss) (Sample H-4, 15 and19).
Figs. 12-13: *Gavelinella compressa* (Olsson) (Sample H-34 and46).
Figs. 14-16: *Gavelinella texana* (Cushman) (Sample H-17 and27).
Fig.17: *Lingulogavelinella globosa* (Brotzen) (Sample H-3).
Figs. 18-19: *Pseudogaudryinella capitosa* (Cushman) (Samle H-53).
Fig. 20: *Bolivinoides decorate* (Jones) (Sample H-8).
Figs. 21-22: *Bolivinoides decorate* (Jones) (Sample H-9 and3).
Figs. 23-24: *Praebolimina kickapooensis* (Cole, 1938) (Sample H-34 and59).
Figs. 25-26: *Gavelinella pinguis* (Jennings) (Sample H-14, 24).
Figs. 27-28: *Gavelinella clementiana* (d'Orbigny) (Sample H-27 and31).
Fig. 29: *Gavelinella dumblei* (Applin) (Sample H-36).
Fig. 30: *Cibicidoides* (?) *coltziana* (d'Orbigny) (Sample H-31).
Figs. 31-32: *Pernerina redbankensis* (Olsson, 1960) (Sample H-54).

5. Systematic Paleontology

The systematics of foraminifers was carried to observe major morphological suits of microfauna mainly composed of benthic foraminifers. Based upon the structural pattern of microfossils, following taxonomic features were illustrated.

Family Lituolodae
Subfamily Haplophragmiinae
Genus Ammobaculites Cushman, 1910
Ammobaculites Cushman, Bull. 71, U.S. Nat. Mus., pt.1, 1910, p.114.
(Plate No. 1, Figs. 1-2.)

Stratigraphic Range: *Ammobaculites* ? has a characteristic range from Carboniferous - Recent.

Distribution: The figured specimen was recovered form Sample No. H-35 and24.

Family Ammodiscidae
Subfamily Tolypamminimae
Genus *Ammovertella* Cushman, 1928
Ammovertella Cushman, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 8.
(Plate No. 1, Fig. 3)

Stratigraphic Range: *Ammovertella* ? was ranged from Pennsylvanian - Recent.

Distribution: The figured specimen was recovered from Sample No. H-48 andH-17.

Family Rotaliidae
Subfamily Totaliinae
Genus *Eponides* Montfort, 1808
Eponides Montfort, Conch. Syst., vol. 1, 1808, p. 127.
(Plate No. 1, Fig. 4)

Stratigraphic Range: *Eponides* ? was ranging from Jurassic - Recent.

Distribution: The figured specimen was recorded from Sample No. H-12 andH-60.

Family Bolivinitida Cushman, 1927
Subfamily Bolivinitinae Cushman, 1927
Genus *Bolivina* d'Orbigny, 1839
Bolivina d'Orbigny, Voy. Amer. Merid., vol. 5, pt. 5, 1839, p. 61.
(Plate No. 1, Fig. 5)

Stratigraphic Range: *Bolivina* characterized the range from Cretaceous - Recent.

Distribution: The figured specimen was recovered from Sample No. H-8 andH-22.

Family Anomalinidae
Genus *Cibicides* Montfort, 1808
Cibicides Montfort, Conch. Syst., vol. 1, 1808, p. 123.
(Plate No. 1, Figs. 6-8)

Stratigraphic Range: *Cibicidesis* ranged form Cretaceous - Recent.

Distribution: The figured specimen was observed from Sample No. H-52 andH-60.

Family Rotaliidae
Subfamily Discorbinae
Genus Stensioina Brotzen, 1936
Stensioina exsculpta (Reuss)
Stensioina Brotzen, Sver. Geol. Under., Ser. C, No. 396, 1936, p. 164
(Plate No. 1, Figs. 9-11)

Stratigraphic Range: *Stensionia exsulpta* was amongst significant record of Cretaceous microfaunal assemblage.

Distribution: The figured specimen was obtained from Sample No. H-15 andH-50.

Family Anomalinidae Cushman, 1927
Subfamily Anomalininae Cushman, 1927
Genus *Gavelinella* Brotzen, 1942
Gavelinella compressa (Olsson)
Cibicides compressa Olsson, 1960, p. 53, pt.12, Figs. 13-15.
Gavelinella compresssa Sliter. Olsson and Nyong, 1984, pl. 2, Figs. 15-16.
(Plate No. 1, Figs. 12-13)

Stratigraphic Range: *Gavelinella compressa* had stratigraphic range from Santonian - Maastrichtian.

Distribution: The figured specimen was recorded from Sample No. H-14 andH-36.

Gavelinella texana (Cushman)
Planulinatexana Cushman, 1938b, p. 69, pl. 12, Figs. 3a-e.
(Plate No. 1, Figs. 14-16)

Stratigraphic Range: G*avelinella* texana had stratigraphic significance of the beds belonging to Austin age in Coast and ranged into Campanian.

Distribution: The figured specimen was observed from Sample No. H-14 andH-16.

Family Gavelinellidae
Genus *Lingulogavelinella* (Brotzen)
Lingulogavelinella globosa (Brotzen)
(Plate No. 1, Fig. 17)

Stratigraphic Range: *Lingulogavelinella globosa* was ranged from upper Cenomanian - Middle Turonian.

Distribution: The figured specimen was recorded from Sample No. H-1 andH-10.

Family Verneuilinidae
Genus *Pseudogaudryinella* Cushman, 1936
Pseudogaudryinella capitosa (Cushman)
Pseudogaudryinella capitosa Cushman, 1922, p, 52, pl. Figs. 8a-e.
(Plate No. 1, Figs. 18-19)

Stratigraphic Range: *Pseudogaudryinella capitosa* has been reported from various parts of the Taylor and Austin of the Gulf Coast. The species characterized the Campanian stage.
Distribution: The figured specimen was recovered from Sample No. H-19 andH-33.

Family Heterphelicidae
Subfamily Bolivinitinae
Genus *Bolivinoides* Cushman, 1927
Bolivinoides decorate (Jones)
Bolivinoides Cushman, Contr. Cushman Lab. Foram. Res, vol. 2, pt. 4, 1927, p.89.
(Plate No. 1, 2, Figs. 20-22)
Stratigraphic Range: *Bolovinoides decorate* was ranged from Upper Cretaceous.
Distribution: The figured specimen was observed from Sample No. H-26 andH-35.

Family Turrilinidae Cushman, 1927
Superfamily Buliminacea Jones, 1875
Genus *Praebulimina* Hofker,1953
Praebulimina kickapooensis (Cole)
Praebulimina kickapooensis (Cole), Hofker, 1957, p. 190, Fig. 233-234.
(Plate No. 2, Figs. 23-24)
Stratigraphic Range: *Praebulimina kickapooensis* was originally described from the Tylor Marl of Texas. The species was ranging from Upper Campanian - Maastrichtian.
Distribution: The figured specimen was recorded from Sample No. H-34 andH-54.

Family Anomalinidae Cushman, 1927
Subfamily Anomalininae Cushman, 1927
Genus *Gavelinella* Brotzen, 1942
Gavelinella pinguis (Jennings)
Gavelinella pinguis Jennings, 1936, p. 37, pl. 5, Fig. 1.
Gavelinella pinguis (Jennings) Olsson and Nyong, 1984, p. 68. Pl. 1, Figs, 1-2.
(Plate No. 2, Figs. 25-26)
Stratigraphic Range: *Gavelinella pinguis* was first described from the Maastrichtian of New Jersey. The range was uppermost Campanian - Maastrichtian.

.

Distribution: The figured specimen was recovered from Sample No. H-14 andH-27.

Gavelinella clementiana (d'Orbigny)
(Plate No. 2, Figs. 27-28)
Stratigraphic Range*:* *Gavelinella clementiana* characterized the Upper Campanian stage.
Distribution: The figured specimen was recovered from Sample No. H-24 andH-27.

Gavelinella dumblei (Applin)
Truncatulina dumblei Applin, in Applin, Ellisor and Kniker, 1925, p. 99, pl. 3, Fig. 6.
(Plate No. 2, Fig. 29)
Stratigraphic Range: *Gavelinella dumblei* was common and widely spread from the upper beds of the Tylor Group in the Gulf Coast. *Gavelinella dumblei* was ranged from the Campanian to Lower Maastrichtian Stage.
Distribution: The figured specimen was recovered from Sample No. H-51 andH-55.

Family Anomalinidae
Subfamily Cibicidinae
Genus *Cibicidoides* Brotzen, 1936
Cibicidoides (?) *cotziana* (d'Orbigney)
(Plate No. 2, Fig. 30)
Stratigraphic Range: *Cibicidoides* (?) *coltziana* was most characteristic of Upper Campanian and Lower Maastrichtian.
Distribution: The figured specimen was recovered from Sample No. H-48.

Family Valvulinidae
Genus *Pernerina* Cushman, 1933
Pernerina redbankensis Olsson, 1960
Pernerina redbankensis Olsson, 1960, p. 8, pl. 1, Figs, 22, 23.
(Plate No. 2, Figs. 31-32).
Stratigraphic Range: *Pernerina redbankensis* was originally reported form the Maastrichtian Redbank Formation of the New Jersey Coastal plain. It occupied the Maastrichtian stage.
Distribution: The figured specimen was recovered from Sample No. H-51 andH-59.

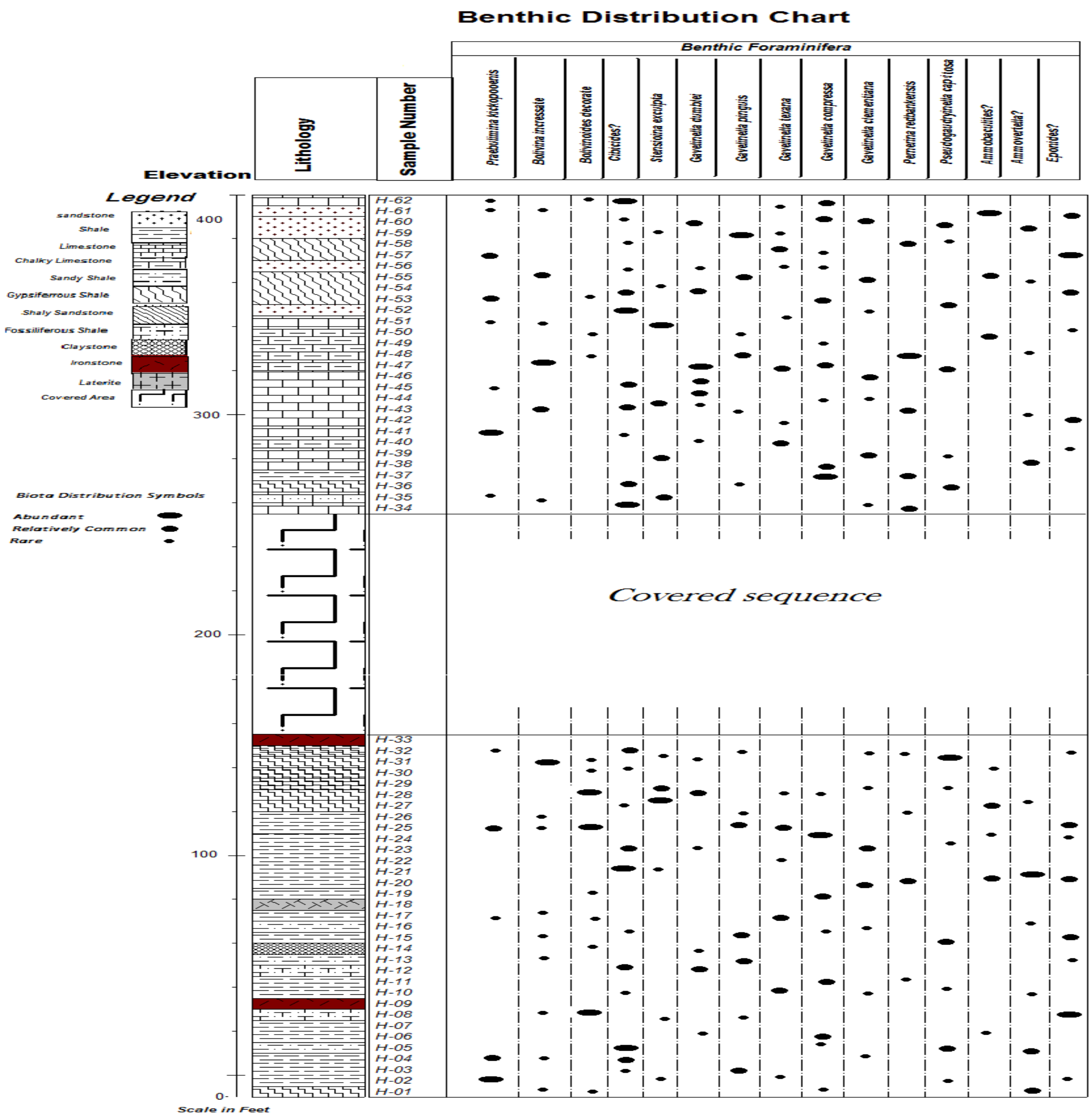

Fig. 05. Distributional patterns of benthic foraminifera from various lithologial horizons of Fort-Munro Formation. Bara Nala Section. Sindh Province.

6. PALEO-BATHYMETRY

To study the ocean depths and topography of the ocean floor in the geologic past, the basic principle of paleobathymetric modeling for a single sample was carried out of which each fossil occurrence indicated a range of possible water depth that fossil could tolerate. The inter-section of such a range for all the fossils in the sample defined the paleobathymetric range for the sample **(Fig. 05).** The bathymetric subdivision like, shelf = 0 – 200 m, inner shelf = 20 meter, middle shelf =100 meters, outer shelf = 200 meters, Bathyal = 2000 meters and abyssal>2000 meters was employed based upon observation of benthic foraminifeers remains from various sedimentary horizons. *Cibicides* indicated the Middle shelf - upper to Bathyal (Bandy, 1960), *Bolivina* colonized muddy sediments of inner-shelf to bathyal environments, *Ammobaculites* (Cushman, 1910), mostly observed abundantly in brackish to bathyal environments.

Cibicides exhibited their marine, inner to mid shelf deposition while *Gavelinella* (Brotzen, 1942), was adapted to shelf, slope and abyssal environment (Nyong and Olsson, 1984; Olsson and Nyong 1984; Sikora and Olsson, 1988). *Gavelinella pinguis* group characterized inner shelf sedimentation during Campanian to Maastrichtian. The *Gavelinella minima* – *Gavelinella compressa* group occupied middle to outer shelf environments. The *Prebulimina kickapooensis* Cole characterized the middle to outer shelf deposition of sediments. *Pernerina redbankensis* Olsson recognized the Maastrichtian shallow shelf facies. Genus *Stensioina* showed the epifaunal group thus indicated that, *Stensoinia exculpta* was adapted to deep sea environment. The range of bathymetry of different species of smaller microforaminifera was depicted in **(Fig. 6).**

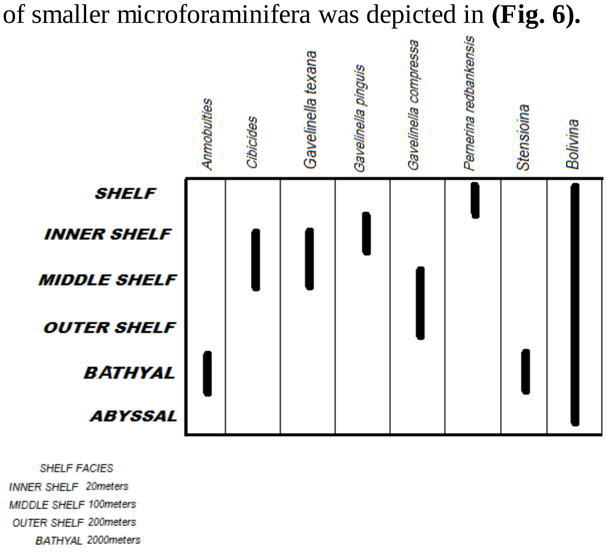

Fig. 6 The Paleobathymetric patterns of various genera of benthic foraminifers from the rock units of Fort-Munro Formation.

7. PALEOENVIRONMENT

Several species of benthic microforaminifers were identified from Fort-Munro Formation at Bara Nala Section that represented various environmental fluctuations that occur during the deposition of sediments. The benthic foraminifers usually occupied shallow shelf to abyssal environments. However, *Bolivina* was observed to colonize muddy sediments of inner-shelf to bathyal environments and it was recognized to be a probable detritivorous species that resided infaunally or epifaually in marine salinities (Murray, 1991; Sliter and Baker, 1972). *Boilivina* species was belonged to the elongated flattened morphogroup of B(ernhard 1986), whose genera were adapted to anoxic environments. *Bolivina* and *Cibicides* were observed from the sea water with a salinity of 32 to 35'/oo (i.e. slight brackish tolerance). *Ammobaculites* were mostly abundant in brackish environment thus indicating bathyal environment. *Ammobaculites* was an infaunal deposit feeder and was recognized as a native of muddy sediments with brackish to normal-marine salinities from marshy to bathyal environments having low oxygen levels. Presently, *Ammobaculites* has been observed from all ecological niches of marine environments (Culver and Buzas, 1981; Koutsoukos *et al.*, 1990; Murray, 1991).

The environmental associations of dominant genera occurred at different levels in a continuous sequence in brackish marsh, however simple agglutinated genera possessed very low diversity.

Cibicides and its relatives formed typical life habit, relatively thin test and would tend to exhibit greater morphological variability than seen in sediment dwelling that were also preserved as trace fossils in the studied area. The infaunal species were thin shelled, delicate and elongated e.g. *Bolivina*, and their activities could produce minute burrow system. *Cibicides labatulus* specified the marine, inner to mid-shelf environments often in area distributed by water currents. *C. labatuls* resided clinging or attached to firm substrates such as shell. The range of occurrence of *Cicibides* was examined from shallow shelf environment - normal or near normal salinity. Presence of *Ammobaculites* and *Cibicides* species indicated brackish lagoon and normal marine lagoonal facies respectively. *Bolivioides* was adapted to an outer shelf environment while *Gavelinella* was restricted to shelf, slope and abyssal environments (Nyong and Olsson, 1984; Olsson and Nyong, 1984; Sikora and Olsson, 1988). The present study revealed the evolutionary specialization of three morphogenetic groups (i.e., *Gavelinella Gavelinella tennesseensis* W. Berry – *Gavelinella pinguis* Jennings Group, *Gavelinella texana* Cushman – *Gavelinella dumblei* Applin Group, and the *Gavelinella minima* Vieux – *Gavelinella compressa* Olsson Group) thus indicating the occurrence of shelf environment during Santonian to Maastrichtian. The *Gavelinella tennesseenis* – *Gavelinella* *pinguis* Group characterized inner shelf environment in the Campanian and Maastrichtian. *Gavelinella texana* Cushman – *Gavelinella dumblei* Applin Group also exhibited its occurrence during mid-late Cretaceous Period. The *Gavelinella minima* – *Gavelinella compressa* Group occupied middle to outer shelf environment and was able to tolerate oxygen minimum condition or anoxic conditions at certain stances,.

Praebulimina belonging to the tapered morphogroup of (Bernhard (1986), (Koutsoukos *et al.* 1990) was the characteristic of low oxygen values. Similarly, other genera i.e., *Neobulimina, Globobulimina* and *Bulimina*, were indicative of reduced oxygen content (Bernhard, 1986; Kaiho, 1994; Miller and Lohmann, 1982); (Van der Zwaan, 1983).

The *Prebulimina kickapooensis* Cole was specified the middle to outer shelf paleoenvironments. Among the agglutinates, *Pernerina redbankensis* Olsson was recovered from Maastrichtian shallow shelf facies thus possessing very less diversity patterns from the studied sediments.

The recovered microfossils of *Stensioina* inferred the low nutrient levels in the deposits because of higher percentage their feeding habits amongst the epifaunal groups.

8. CONCLUSIONS

Fort-Munro Formation was characterized not only by its abundant and much diverse formainferal species but also by remarkably good state of preservation of benthic microforaminifera. The microfauna from Fort-Munro Formation never had been reported from the Lower Indus Basin Biostratigraphy.

As a result of present investigations, the recognized microforaminiferal assemblage was consisted of 10 families possessing 13 genera and 12 species. The micropaleontological data inferred the shelf to bathyal, brackish to marine environment with low oxygen level and infaunally or epifaunally in marine salinities (Murray, 1991; Sliter and Baker, 1972). The microforaminifers were attributed to Santonian - Maastrichtian stage. The occurrence of *Gavlinella compressa* in Sample No. 6 and7 of massive shale as well as in shaly limestone respectively indicated middle - outer shelf environment.

Gavelinella texana present in Sample No. 40 and42 of chalky limestone and limestone respectively designated the middle shelf - upper slope environment during Campanian Stage.

Gavelinella pinguis observed from Sample No, 32 of lithologically gypsiferous shale indicated the inner shelf environment during Campanian – Maastrichtian Stage. *Pernerina redbankensis* occurred in Sample No. 44 possessing limestone specified the shallow self facies of Maastrichtian Stage. *Bolivina* colonized muddy sediments of inner-shelf - bathyal environment and it abundance was marked from Sample No. 53 (Upper Cretaceous). Through micropaleontological analysis, the Fort-Munro Formation was evaluated in terms of paleoenvironment and paleobathymetry. The distribution chart of benthic foraminifers (Log No. 3) with their abundance in collected samples and the water depth of different species (Fig. 05) was also observed. The paleoenvironment of Fort-Munro Formation was marine indicating inner shelf to abyssal environment (normal lagoon, saline to brackish with a tolerance of anoxic conditions due to presence of recovered microfauna belonging to *Bolivina* and *Cibicides* species. During the deposition of the Fort-Munro Formation, the environment was changed from the base of the outcrop which that not exposed but upper contact with Pab Sandstone was associated with numbers of trans-regression cycles but the absence of microfauna might mark the period of maximum regression. The paleobathymetry exhibited different levels of water depth based upon occurrence of various groups of benthic foraminifers, (shelf to bathyal environment). But abundance of *Gavelinella* species indicated the predominance of inner shelf to abyssal environment (e.g. 20 m to 2000 m).

REFERENCES:

Armstrong H.A. and M.D. Brasier (2005) Microfossils. Blackwell Publishing limited, 153Pp.

Bilal U. Haq and J. D. Milliman (eds)(1984) Marine Geology and Oceanography of Arabian Sea and Coastal Pakistan. Newyork: Van Nostrand Reinhold Company Inc. 235Pp.

Cushman J. A. (1920) The Foraminifera of the Atlantic Ocean. Washington Government Printing Office. Bulletin (104), 1-37

Cushman J. A. (1959) Foraminifera. Harvard University press, 234-289.

Fatmi, A. N (1977) Mesozoic in Ibrahim Shah, S. M. (eds): Stratigraphy of Pakistan Geol. Sur. Pak Mem. 12: 29-56.

Farshori M. Z. (1972) The Geology of Sindh, University of Sindh Publishers 1-4.

Holger G. (1998) Benthic Foraminifera e Maastrichtian Lower Mamu Formation near Leru (Southern Nigeria): Paleoecology Andpaleogeography significance. Journal of Foraminifera Research. 28(1), 77-78.

Hunting Survey Corporation Limited (1961) Reconnaissance Geology of Part of West Pak 195-199.

Jenkins D. G. and J. W Murray (1981) Stratigraphical Atlas of Fossil Foraminifera. London: Ellis Horwood Limited, 180-199

Kazmi A. H. and M .Qasim Jan (1997) Geology of Tectonic of Pakistan. Karachi: Graphic Publishers, 235.

Kummel, B and D. Raup, (1965) Hand Book of Paleontological Techniques. W. H. Freeman, San Francisco.

Loeblich, A. R. Jr and H. Tappen, (1974) Recent Advances in the Classification of the Foraminifera. Foraminifera. 1, 1-50.

Memon A. D. and I. Siddiqui (2005) Petroleum Geology and Hydrocarbon Prospects of Sindh, Pakistan. Aakash Press, 33, 35-36.

Olsson R.K and J. D. Wright (2009) Intergrated Late Santonian- Early Campanian Sequence Stratigraphy, New Richard K.

Stearn C. and R, Carroll (1989) Paleontology The Record of Life. John Wiley and Son, Inc, 317Pp..

Shimer H. W. and R. . Shrock (1959) Index Fossils of North America. London: The Technology Press Massachusetts Institute of Technology, 15-33.

Shah S.M.I. (2009). Stratigraphy of Pakistan. Government of Pakistan Ministry of Petroleum and Natural Resources No. 22, 381Pp.

Svetlana F., M., James V. Browning, K. G. Miller, R. K Olsson and P. A. Usmani (1992) Upper Cretaceous Foraminifera in Santonian to Maastrichtian depositional sequences in the New Jersey Coastal Plain. Implication for global sea-level studies. *Stratigraphy*, 6 (1): 49Pp.

Woods H. (1950) Paleontology Invertebrate. The Syndics of the Cambridge University Press, 88Pp.