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Study of Planktonic Foraminifera from the Cretaceous-Paleogene Boundary in Khuzdar District, Balochistan

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Abstract: The study of Planktonic foraminifera in relation to the Cretaceous – Paleogene boundary in Khuzdar district, Baluchistan, Pakistan have been carried out based on examination of material from three section of Cretaceous - Paleogene sequence, named: - (1) PAK. Section (2) MG. Section (3) HR. Section

The focus yielded is typical Cretaceous - Early Tertiary Planktonic Foraminifera such as Globotruncana contusa, Globotruncana stuarti, Globotruncana ventricosa, Globotruncana arca, Recemiguembelina fructicosa, Pseudoguemblina elagans and appearance of Parasubbotina pseudobulloides in Danian of PAK. Section.

In MG. and HR. Section the presence of Parasubbotina pseudobulloides, Morzovella aequa, Morozovella acuta, Hantkenina dumblie, Globigerina lozanoi, Globigerina pseudovenezuela and Ghagni the zone marker of Paleocene to Late Eocene and also presence of Globigerina taupemsis, Dentaglobigerina carpulenta, zone marker Oligocene strata in MG. and HR. Section. The age of the redefined Jamburo Group ranges from the Mastrichitian to the Middle Oligocene. The Cretaceous –Paleogene boundary is determine above the Pab sandstone and base of the Jamburo Group in PAK. Section and below the gray breciated limestone in MG. Section, where as in HR. Section it is located between limestone and shale of the Jamburo Group.

Keywords: Cretaceous – Tertiary boundary, Maastrichtian Pab Sandstone.

1. INTRODUCTION

Cretaceous-Paleogene boundary and presence or absence of break there has been of interest to stratigraphers the world over. It is particularly so in the case of stratigraphy of Pakistan in broader context of tectonics and the related plate motion. In the context of stratigraphy of Pakistan this aspect received early attention; Naggapas work (1959) based on foraminiferal evidence, highlighted the nature of disconformable contact in the Lower Indus Basin while Lower Jhankra Group in the Southern Axial Belt Region showed continuity of deposition. However, later studied showed that in Axial Belt Region, basin configuration suffered repeated fluctuation in response to the tectonics, which was being influenced by northward motion and collision of the Indian Plate and the development of marginal sub basin along its western boundary, i.e. existing Indian Platform-Baluchistan boundary, designated as Axial Belt. However, no detailed faunal studies have so far been undertaken to establish the exact stratigraphic position of the units involved. In a more recent benthic foraminiferal biostratigraphic study of these rock units from Khuzdar area, these units have redefined (Brohi, 1994). But the faunal group most suitable for this purpose are the Planktonic foraminifera, which help not only in correctly age dating these sequence but also in their regional correlation. Hence this detailed study of Planktonic foraminifera of the sequences straddling the upper most Cretaceous – Paleocene boundary and to redefined the undifferentiated Jamburo Group either as a single depositional Unit or into two or more depositional formations in terms of its exact age determination. The Stratigraphic units that occupy key position in the context of this study, the Southern and Central Axial Belt region are:-

Jamburo Group

It is well exposed in the vicinity of khuzdar district Baluchistan, between the underlying Cretaceous Parh Group (Monajhal Group) and the overlying Nari Sandstone.

Moughal Kot Formation

It is between the underlying Parh Sandstone and overlying Jamburo Group.

2. MATERIAL AND METHODS

Previous Work

Planktonic foraminiferal biostratigraphy regarding to Late Cretaceous-Early Tertiary is not well studied in the southern Baluchistan especially around Khuzdar area. Some works dealing with larger and planktonic foraminifera and those of Verdenburg (1907) Williams (1959). Second publication was monograph of Haque (1956) in which he emphasis on the smaller benthoic foraminifera, additionally he reported the presence of a few planktonic species from

the Ranikot and Laki of Nammal George. Haque (1959), Naggapa (1959), Hunting Survey Corporation (1960), Dorren (1974), Fatmi (1977), Chema *et al.*, (1977), Fatmi *et al.*, (1986) Brohi and Marzaban (1986). The Stratigraphy of the Cretaceous Parh Group has been studied on the basis of ammonites with some modification by Fatmi (1977) and Fatmi *et al.*, (1986) **(Fig. 01)**. The brief description of the stratigraphy in the descending order is as follows: -

Jamburo Group	**(Fatimi etal 1986) Tertiary**
	Disconformable Contact
Mughal Kot Formation	**(William 1959) Maastrichtian**

The upper contact of Mughal Kot is conformable with Fort Manro Formation in the most areas of Pakistan but not in Khuzdar area, where as its upper contact is unconformable with Paleocene to Eocene Dunghan Formation marked in laterite bed.

Jamburo Group	Tertiary
	Unconformable Contact
Parh Limestone	(Blandford 1879) Late Cretaceous

The Stratigraphic Succession and Biostratigraphy of the studied area

The Jamburo Group is distributed in the calcareous zone of Pakistan, Hunting Survey Corporation (1960) and is well exposed in the South and Southeast of Khuzdar Baluchistan, consisting mainly Limestone, but Sandstone, Shale and other components are common and in some places dominant. According to Naggapa (1959) the lithology of the group is well exposed especially in the western flank of the ridge forming Kirthar Range whose geomorphography is profoundly influenced by the Himalayan Orogeny. The lithology of the Jamburo Group mainly comprises marine variegated calcareous shale, marlstone and marly limestone. But in some place fine to medium grained Sandstone which exhibits lithology similar to Maastrichian Pab sandstone exposed about 400 m. thick in the Pab Range.

The Lower part of the Jamburo Group conformably lies on the micritic porecelaneous Campanian Parh Limestone or the top of the Maastrichitian Monajhal Group (Fatmi etal 1986) instead of Parh Group, while the upper contact is apparently conformable with Nari Sandstone. The Jamburo Group consisting of the Late Cretaceous and Paleogene sedimentary sequence is here redefined and sub divided into the Paleocene-Middle Oligocene Jamburo Group, the Cretaceous part of the Mughal Kot Formation and Pab Sandstone.

The underlying Mughal Kot Formation of the Group was introduced by William (1959) for the dark gray calcareous mudstone shale with intercalation of argillaceous limestone underlain by the companion

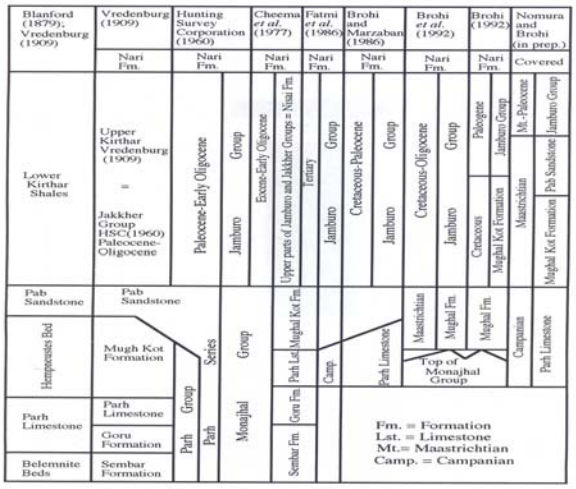


Fig. No. 01 Stratigraphical nomenclature of different work on the stratigraphy of the Cretaceous to Lower Tertiary of Balochistan, Pakistan

Parh Limestone. Fatmi *et al*., (1986) recognized the Mughal Kot Formation in Monajhal Group for the rock overlying the Parh Limestone.

The Stratigrphical Subdivision in the PAK Section

Kirthar Limestone	Eocene
Jamburo Group	Maastrichtian-Paleocene
Pab Sandstone Mughal Kot Formation Parh Limestone	Maastrichtian

The section named after Pakistan is located in the Western Gaj River. In this section the Jamburo Group contains the Maastrichtian-Paleocene sediments and has conformably on the Parh Limestone. It consists of mainly shale, marlstone with a thin bed of Sandstone which is separated as Maastrichtian Pab sandstone.

The upper contact is not exposed in the studied area and is believed to be covered with Nari Formation of Oligocene. On the lithological basis this Group is further divided into four units. **(Fig. No.2)**.

Unit 01

It consist of dark gray shale, being fragmented nodular calcareous and associated with the gray hard limestone, characterized by subconcoidal fracture.

Unit 02

It is mainly shale with some minor gypsum streaks in places. The shale is dark gray, flaky and calcareous.

Unit 03

Dominantly shale with a thin bed of sandstone. The shale is yellowish dark gray, fragmentary and loose.

Unit 04

Mainly consist of shale with intercalation of grayish mudstone at the top. The shale is dark gray to black, with calcite veins and contains sulfide grains at some horizons.

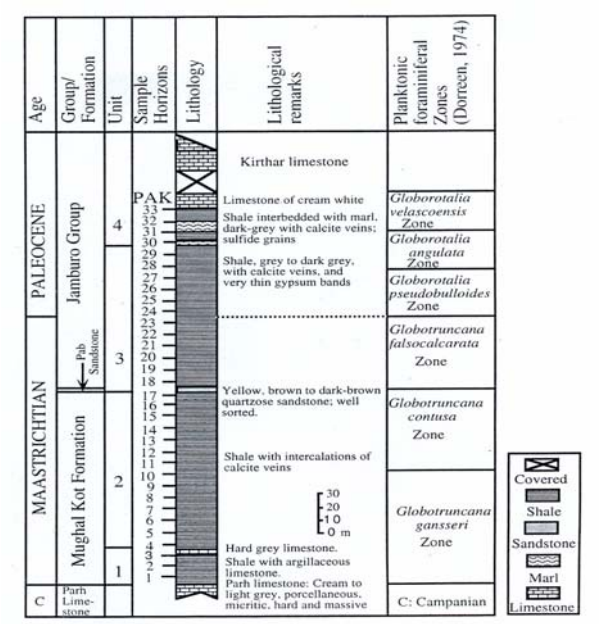


Fig. No. 02 Columnar section of the PAK -Section

3 RESULTS AND DISCISSION

Planktonic Foraminifera from PAK Section

From Mughal Kot Formation

Globotruncana contusa, Globotruncana stuarti, Globotruncana lapparenti, Globotruncana ventricosa, Globotruncana area, Ganserina gansseri, Globotruncana minuta, Globotruncana stuartiformis, Globotruncana linnine, Globotruncana angulata, Globotruncana aegyptica, Globotruncana falsostuarti, Globotruncana calacrata, Recemigumnbelina fructicosa, Hetrohelixplanta, Hetrohelix semicoslata, Hetrohelix striata, Hetrohelix reussi, Pseudo textularia elagans, Pseudoguembelina castulata Exolata palpbera, Hedbergella halmdelensis, Hedbergella amabilis, Rugoglobigerina rugosa, Rugoglobigerina scotti, Rosita plummera, Gandolffi, Rosita contusa. (Plate No. 01-02)

From (Pab Sandstone) Jamburo Group

Globotruncana falsostuarti, Globotruncana calcarata, Globotruncana aegyptica, Globotruncana lininnae, Rugoglobigerina rugosa, Rugoglobigerina scalli, Hedbergella holmdelensis, Hedbergella amabilis, Pseudo textularia elegens, Hetrohelix planate, Pseudo guembelina excolata. (Plate No. 01-02)

From Jamburo Group Paleocene

Para subbolina pseudo bulloides, Pseudo textularia elegans, Pseudo guembline costulata, palpebra, Recemiguenblina frusctieosa, Morozovella aequa, Morozovella acuta, Morozovella uncinate, Morozovella incanstae, Morozovella angulata, Morozovella conicotruncate, Globanomalina pseudomenardi, Morozovella velascoensis, Globoconsa daubjergensis, Subbtina triloculinoides, Globigerina chapmani, Globigerina velasconsis, Subbotina eocaena. (Plate No. 01-02)

The Stratigraphical Subdivision in Mai Gatti (MG.) Section

Nari Sandstone Jamburo Group Pab Sandstone Mughal Kot Formation Parh Limestone	Maastrichtian-Mid Oligocene Maastrichtian

The section is named after the geographic name of Mai Gatti grave yard South of Khor village, Khuzdar district. Here the Jamburo Group is characterized by the shale facies which are dominant throughout the section with marly limestone, sandstone and shelly limestone. The lower contact of the Group in this section is conformable with the Late Cretaceous Parh Group (Monajhal Group), and the upper contact seems to with the Oligocene Nari Sandstone. The Jamburo Group at this locality is divided into three members **(Fig. 3).**

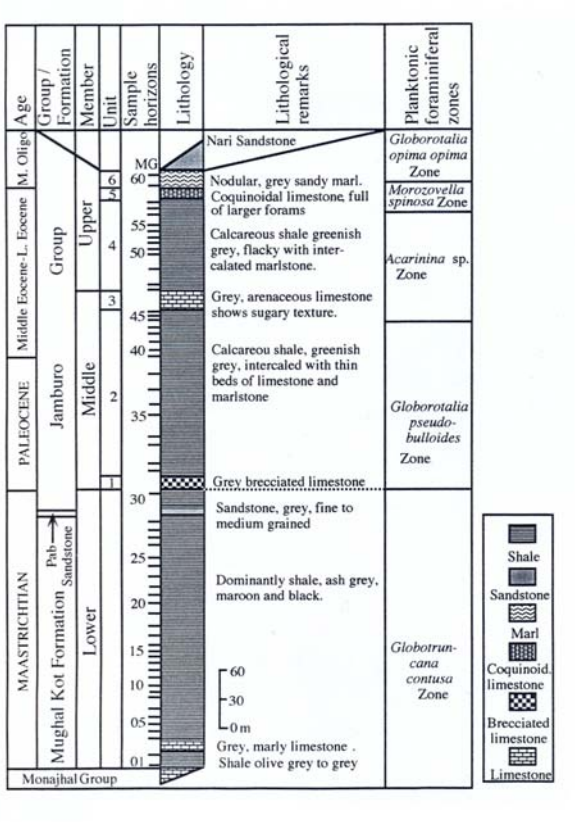


Fig. No. 03 Columnar section of the MG-Section

Lower Member

The Lower Member consist of mainly calcareous various colored shale, gray marl, medium to coarse grained poorly sorted brown quartizite sandstone. This member yields the Maastrichtian Planktonic foraminifera and correlated with the Mughal Kot Formation.

Middle Member

The Middle Member mainly consists of Shale with coarse breciated limestone in the basal part and arenaceous limestone in the upper part. This member yields the Paleocene and Eocene Planktonic foraminifera.

Upper Member

The Upper Member consists of shale and marl with an intercalation of prominent coquinal limestone bed, and is rich in Oligocene larger foraminifera and molluscus.

Planktonic Foraminifera from Mai Gatti (MG.) Section

The planktonic foraminifera are poor to very poorly preserved in the Mughal Kot Formation and well to moderately preserved in the Paleogene Jamburo Group. The common species of Planktonic foraminifera in Jamburo Group from Middle to Upper member are: -

Subbotina triloculinoides, Globoconusdaunjergensis, Parasubbotina pseudobullaides, Morozovella angulata, Morozovella acuta, Morozovella aequa, Morozovella marginodentata, Morozovella aragoanensisria, Morozovella formosa formosa, Acarinina pentacamerarata, Acarinina bullbroki, Acarinina mckanni, Subbotina eocenica, Globigerina subconlobata, Globigerina hagni, Globigerina inequispira, Globigerina lozanai, Catapsydrax dissimitis, Globigerina biansis, Hantkenina liebui, Turborotalia wilsoni, Turborotalia ceroazulensis ceroazulensis, Dentalglobigerina tripartila, Globigerina triangularis, Globigerina turgida, Globigerina frontosa, Turborotalia passangebnsis, Catapsydrax dissimilis, Hastigerina c.f. boliviarana. (Plate No. 04)

The Stratigrhical Sub division in the HR Section

The HR section is named after Hinar River which drains in the Gaj Kolachi main river, located in the south of Zidi village, Khuzdar district. The Maastrichtian Oligocene strata exposed here lie conformably on the Parh Group and are conformably overlain by the Nari sandstone. The Jamburo Group of HR Section consists of olive grey to light green or brown calcareous sandstone inter bedded with olive grey limestone in the lower part. The middle part consists of grey marly limestone whereas the upper part is hard fissile and flaky calcareous shale marl. In this locality the Pab sandstone is missing. This section is lithologically subdivided into 8 units **(Fig. 4).**

Planktonic foraminifera from HR Section are very well preserved; the Late Maastrichitian is represented by only few genera.

Planktonic Foraminifera from HR Section

Rugoglobigerina rugosa, Globotruncana area, Hetrohelix striata and Pseudo guenblina exolata from unit 1. Parasubbotina pseudobulloides, Morozovella aequa, Morozovella aragoneusis, Morozovella marginodentata, Hantkenina dumblei, Aearanina penta camerata, Globigerina lozanai, Globigerina venezuala, Globigerina pseudo venezuala, Globigerina hayness and Globigerina inequensis from unit 2, 3 and 4. The reappearance of Morozovella aequa and Morozovella velaseaensis in unit 4 indicate the presence of Fault during this period. (Plate No. 03).

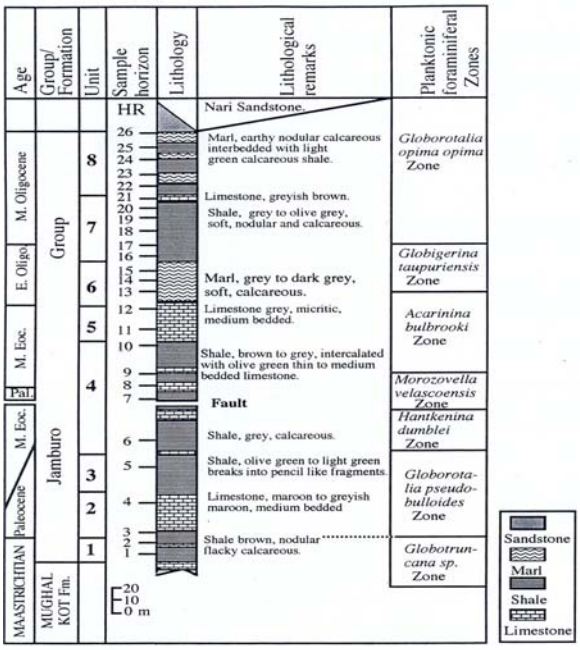


Fig. 04. Columnar section of the HR-Section

Cretaceous-Tertiary boundary in the studied area

There is a physical break in sedimentation and faunal characteristics at the Cretaceous-Tertiary boundary in most parts of the world, for example, the rust colored ferruginous layer at the base of clay, ELKef, Tunisia (Keller, 1988); grayish black claystone, Kawaruppa, Hokkaida, Japan (Kaiho and Saito, 1986; Saito *et al.*, 1986; Kahio, 1992); brown grey marl in Sopelana Spain (Lamolda 1983). The Cretaceous–Tertiary boundary of the PAK Section is marked in the shale sequence between PAK-23 and 24.

In Monaghal Group Section, it can be traced between the sample horizon of MG-29 and 30, at the base of breciated or coarse grained limestone. On the other hand the boundary in the HR-Section has been positioned in between the sample No. HR-2 and HR-3 in alternate shale-micritic limestone sequence. The Cretaceous- Tertiary contact in Pakistan reported by Nagappa (1959) also Dorren (1974) was marked on the top of the Maastrichtian Pab Sandstone overlain by the Lower Paleocene Cardita beaumonti shale in Sindh Province and Glauconitic horizon in the Dughan Formation in Quetta region of Baluchistan. Dorrean (1974) describe that case Northern Italy (Bolli and Cita, 1960) is similar to deep water shale in Gaj river section, which he correlate with the contact of Velasco Formation and Mendez Formation in Mexico (Hay, 1960). Not much work has been carried out on the Cretaceous-Tertiary boundary in Pakistan, however as per data available.

In the studied areas, the breciated limestone or coarse grained limestone occurred in the boundary of MG section, breciated limestone with larger foraminifera in Monajhal section (Fatmi *et al.,* 1986) transitional contact with deep marine shale in the PAK Section and micritic limestone shale in the HR Section.

In the presence of study an attempt has been made to correlate the boundary with the disappearance of such planktonic species as Globotruncana area, Globotruncana stuatiforanis and the appearance of Para subbotina pseudo bulloides in PAK Section. The foraminiferal record of the PAK Section suggests the age of the Jamburo ranging from Maastrichtian to Paleocene.

In MG Section due to poor preservation of the Maastrichtian planktonic foraminifera are not identified well, the Late Cretaceous index benthic foraminifera from this zone are similar to PAK Section (Brohi 1994). The presence of Para subbotina pseudo bullaides, Subbotina triliculinoides above the grey breciated limestone as well as the Planktonic foraminifera from middle and upper members of the MG Section, suggest that the age of the Jamburo Group ranges from Maastrichtian - Middle Oligocene.

In the HR Section Globotruncana area, Hetrohelix striata and Pseudo guenblina exolata are the only observed Maastrichtian species. The Paleocene to Middle Oligocene Planktonic Foraminiferal zone is similar to MG Section. However the Early Oligocene Planktonic foraminiferal zone of Globigerina topuriensis is present between the samples of no. HR-6 and HR- 7, a thrust fault is inferred because the former contains the Middle Eocene Planktonic foraminifera Hantkenina dumblei and the later include the Paleocene Morozovella aequa and Morozovella velascocusis.

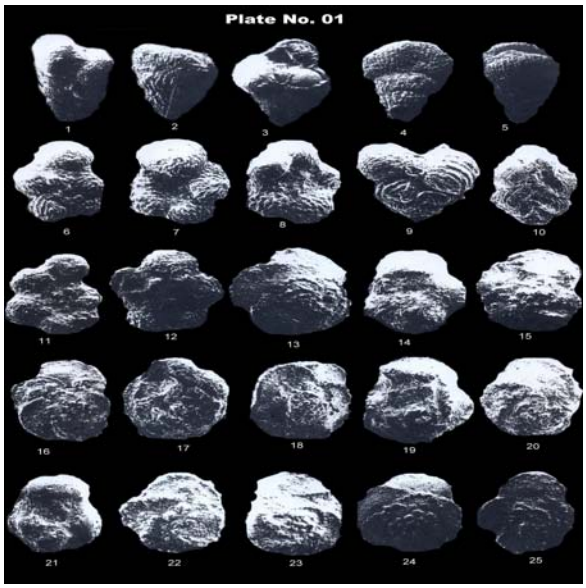
4. CONCLUSION

The results of the study of the Planktonic Foraminifera from the Jamburo Group in three localities of Khuzdar district Baluchistan, Pakistan are summarized as follows: -

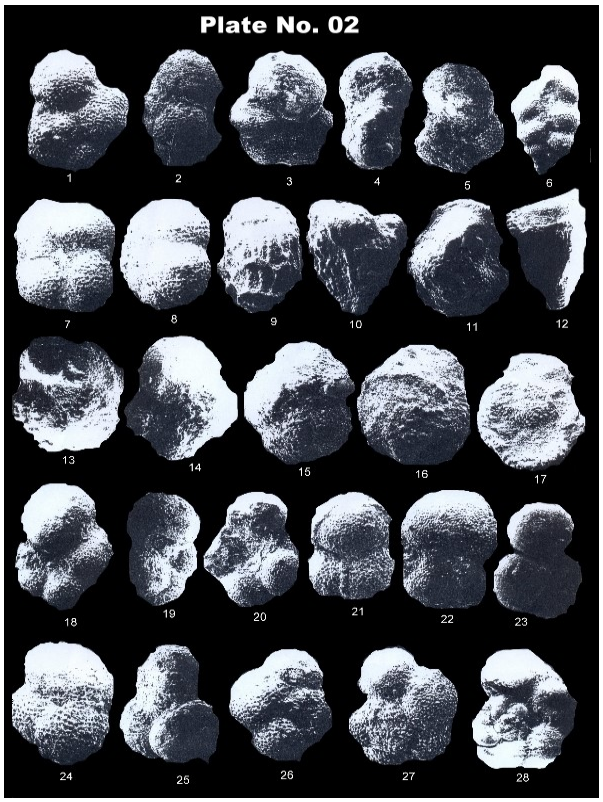
The lithological and biostratigraphical studies of the Jamburo Group indicate that its age is from Upper Maastrichtian to Middle Oligocene.

The Lower part of Section yielding the Maastrichtian Foraminiferal fauna is correlated to the Mughal Khot Formation, the upper most unit of the underlying Parh Group.

The Cretaceous - Tertiary boundary is marked above the Pab sandstone, where the Pab sandstone is not developed, the Cretaceous - Tertiary boundary is positioned within the strata of Jamburo Group.

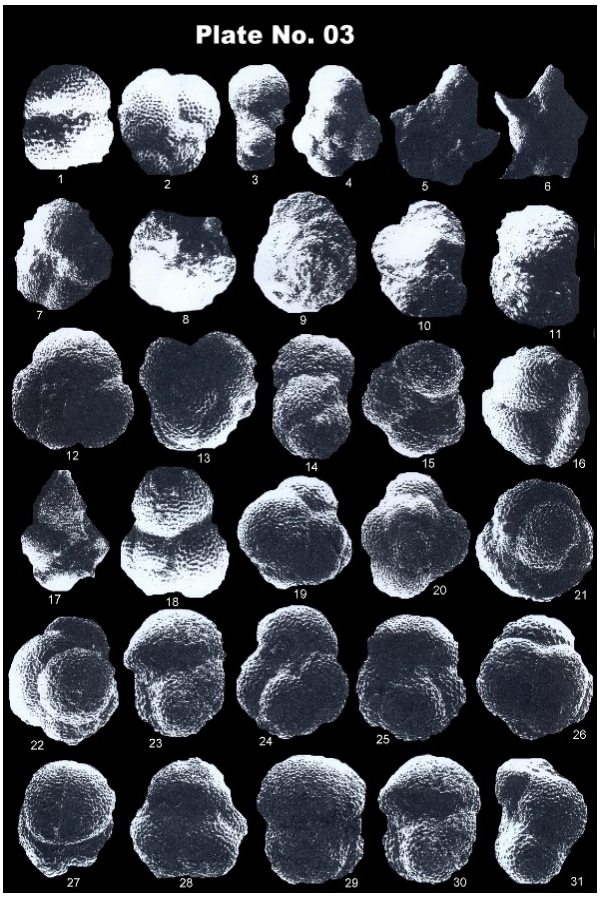


Pate No. 1	PAK – Section
1	*Hetrohelix reussi*
2	*Hetrohelix striata*
3	*Guembelina cretacea*
4	*Pseudotextularia elegosa*
6-7	*Rugoglobigerina rugosa*
8	*Rugoglobigerina scotti*
9	*Pseudoguemblina elegan*
10	*Pseudoguemblina exolata*
11	*Hedbergella holmdlensis*
12	*Hedbergella amabit*
13	*Globotruncana area*
14-15	*Globotruncana stuarti*
16	*Globotruncana linnine*
17-18	*Globotruncana falso stuarti*
19-20	*Globotruncana calearata*
21-22	*Globotruncana aegyptica*
23	*Globotruncana ganssari*
24	*Globotruncana Jininn*
25	*Globotruncana aegyptica*



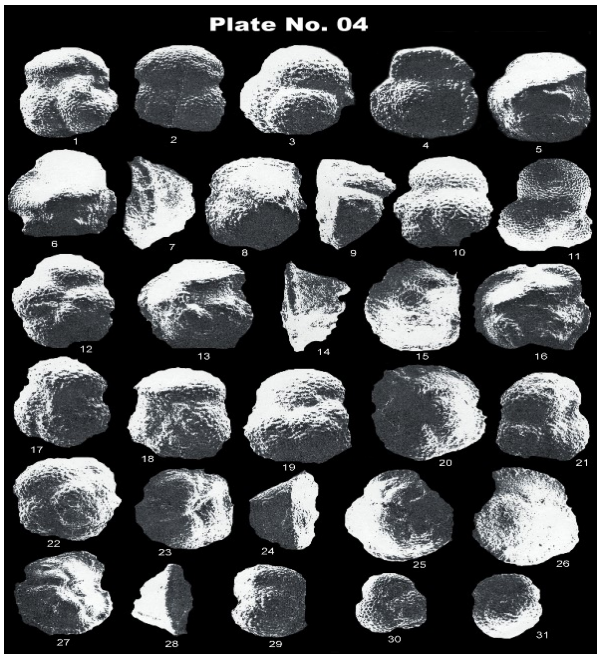
Pate No. 2 PAK – Section

1-2	*Parasubbotina pseudobullaides*
3-5	*Globoanomalina pseudomenardii*
6	*Pseudotextularia costulata*
7-8	*Archeo aff blow passango*
9	*Pseudotextularia palpbera*
10	*Raeemiguemblina fructicosa*
11-13	*Morozovella acuta*
14	*Morozovella conicotrumcata*
15	*Globoanomalina pseudomenardii*
16-17	*Morozovella velascoeusis*
18-20	*Globoanomalina chapmani*
21-22	*Subbotina vellascoeusis*
23-28	*Globigerenella sp.*
24	*Igorina tadjkistansis*
25	*Subbotina triloculinoides*
26	*Globoconus daubjergensis*
27	*Praemurica inconstanec*



Pate No. 3 HR – Section

1-2	*Rugoglobigerina rugosa*
3-4	*Parasubbolina pseudobullaides*
5-6	*Hautkenina dumblie*
7	*Acaranina pentacamerata*
8-9	*Morozovella aragonensis*
10-11	*Morozovella acqueta*
12-13	*Globigerina venzuela*
14-15	*Globigerina hagni*
16	*Globigerina binaieusis*
17	*Hantkenina liebeue*
18	*Globigerina triangularis*
19-20	*Globigerina sp;*
21	*Hastigerina cf. bolivariana*
22	*Denta globigerina venezuela*
23	*Turborotatlia ceroazulensis*
24-25	*Denta globigerina corpulemta*
26	*Catapsydrax dissimilis*
27	*Globigerina quinqueloba*
28-29	*Globigerina laupriensis*
30	*Denta globigerina selli*
31	*Globigerina pseudovenezuela*



Pate No. 4 MG – Section

1-2	*Subbotina triloculinoides*
3	*Globigerina thaka subconglobata*
4-5	*Morozovell acuta*
6-8	*Morozovella marginodentata*
9	*Morozovella aequa*
10	*Globigerina hagni*
11	*Globigerina incquispira*
12	*Acaranina pentacanerata*
13-15	*Morozovella crater*
16	*Morozovella Formosa*
17-18	*Morozovella bullbroki*
19	*Globigerina lozanai*
20	*Morozovella aragonensis*
21	*Subbotina triloculinaides*
22	*Globoconus daubergensis*
23-24	*Morozovella aragonensis*
25-26	*Morozovella formosa*
27-28	*Morozovella occIusa*
29	*Globigerina sp.*
30	*Globigerina eocenia*

REFERENCES:

Bolli, H. M. and M.B. Cita, (1960) Upper Cretaceous and Lower Tertiary Planktonic foraminifera from the Padernod' Adda Section Northern Italy. Rep. Internat Geo\. Congr. Session 21, 150-160.

Brohi, I. A. and J. Marzaban (1986) The Systematic Study on Forams of Jambura Section. Geo\.Surv, PAK. Inf. Re\. (**267**): 1-36.

Brohi, I. A., (1994) Late Cretaceous and Early Tertiary Benthic foraminifera Biostratigraphy in Khuzdar district, Baluchistan Pakistan with Special reference to influence of Tethy sea closure. Jour. Sce. Hiroshima Univ. Ser. IO, (**I**): 25-86.

Chema, M. R., S.M. Raza, and H. Ahmed, (1977) Cainozoic. In Shah, S. Ill. I (ed) Stratigraphy of Pakistan. Mem. Geo\. Surv. PAK., vol. (**1**): 56-98.

Dorren, J. M. (1974) The Western Gaj river Section Pakistan, and the Cretaceous-Tertiary boundary, Micropaleont. 20 (**2**): 178-193.

Fatmi, A. N., (1977) Mesozoic. In Shah, S. M. I. (ed) Stratigraphy of Pakistan. Mern, Geo\. Surv. PAK, (**12**): 56-98.

Fatmi, A. N., I. Hydari, M. Anwar and J. Mengol, (1986) Stratigraphy of Zidi Formation (Ferozabad Group) and Parh Group; Khuzdar District Balochistan Pakistan Records. Geo\. Surv. PAK (**1**): 1-32.

Haque, A.F.M. (1956) The Smaller foraminifera of the Ranikot and Nammal Gorge, Salt Range. Palaeontologia Pakistanica Mem. Geo!. Surv. PAK., (**I**): 01-35.

Haque, A.F.M. (1959) Some Late Cretaceous Foraminifera from West Pakistan. Mem. Geol, Surv. PAK. 2 (**3**): 2-33.

Hay. W. W., (1960) The Cretaceous-Tertiary Boundary in the Tempico embayment Mexico. Rep. Internat. Geo!. Congr, Session (**21**): 70-77.

Hunting Survey Corporation, (1960) Reconnaissance Geology of Part of west Pak. Toronto Canada, 550Pp.

Kaiho, K. and T. Saito, (1986) Terminal Cretaceous sedimentary sequence recognized in the northernmost Japan based on Planktonic foraminiferal evidence. Proc. Japan. Acad., vol. (**62 B**): 145-148.

Kaiho, K., (1992) A low extinction rate of intermediate-water benthic foraminifera at the Cretaceous/Tertiary boundary. Mar. Micropaleont. vol. (**18**): 229-259.

Keller, G., (1988) Biotic turnover in benthic foraminifera across the Cretaceous/Tertiary boundary at EL Kef, Tunisia, Palaeogeog. Palaeoclimatol. Palaeoecol., vol. (66):153-171.

Lamolda, M.A., E.X. Orue, and F.P. Decima (1983) The Cretaceous/Tertiary boundary in Sopelana (Biscay, Basque Country). Zitteliana, (**10**): 663-670.

Nagapa, Y. (1959) Foraminiferal Biostratigraphy of the Cretaceous-Eocene Succession in the India-Pakistan-Burma region. M icropaleont., 5, (**2**): 145-192.

Vredenburg, E. W., (1907) Notes on the distribution of the genera Orthophragmina and Lepidocyclina in the Nummulites Series of the Indian Empire. India Geol. Surv. Rec. (**35**): 62-67.

Williams, M. D. (1959) Stratigraphy of the Lower Indus Basin, West Pakistan. World Petroleum Cong. 5th, New Ilak 1959, Proc. Sec. I, (**19**): 377-390.