Upper Cretaceous Planktonic Foraminiferal Biostratigraphy of East Dorfak Area (Guilan – North of Iran)

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Abstract: East Dorfak(studied area) are located in Northern Iran(within Gorgan-Rasht region). The Upper Cretaceous sequence in this region comprises three lithostratigraphic unites (K2 Slm, K2 1, K2 ml). Two stratigraphic sections have been investigated in this area and outcrops samples collected in the measured sections. Previous studies have been very sparse and general. Consider of prepared thin sections and analysis the Late Cretaceous planktonic foraminifera content have presented detailed data. Identification of fifty-two index species belonging to the genera Dicarinella, Whtienella, Gansserina, Globotruncanita, Globotruncanella, Contusotruncanana, Macroglobigerinelloides, Marginotruncana, Radotruncana, Rugoglobigerina, Racemiguembelina, Heterohelix, Abathampalus and Kuglerina has led to the recognition of nine (eight in Gurag section) biostratigraphic zones in this study. The biozones ranged in age from Coniacian to Late Maastrichtian. The Campanian and Early Maastrichttian demonstrated the largest diversity fauna. Sedimentary characteristics and planktonic foraminiferal content illustrated that deposition is done in deep marine environment. Moreover the study showed a little difference in the two sections under study.


Keywords: Planktonic foraminifera; Biozone; Coniacian; Campanian; Maastrichtian; Cretaceous; Biostratigraphy; Iran.

1. Introduction
The area under investigation is situated in Northern Iran, in south eastern part of Guilan province within Alborz zone (Nabavi. M.H 1976). The studied area is located between 50°0', 2' to 50°0', 10' longitude and 36°0', 47' to 36°, 51' latitude (Fig.1). Upper Cretaceous Planktonic foraminifera Of East Dorfak has been rarely studied in previous studies and comprehensive biostratigraphic works were not carried out.

In this paper, the biostratigraphy and micropalaeontology investigation of outcrop samples were collected in the measured sections from East Dorfak Area in the West Gorgan-Rasht Region are presented and discussed.

The aim of this paper is to present Upper Cretaceous biostratigraphic data that allows reconstruction of the micropaleontology of this region during the Late Cretaceous.

2. Materials and Methods
Eighty-Six closely spaced outcrop samples were collected from two stratigraphic sections that were measured from East Dorfak Area (Fig.1). The samples were taken from medium to thin bedded hemiplegic limstone (K1 2 Slm); and thin to medium bedded clayey hemiplegic to plagic limstone (K2 ml) and thin to medium bedded arenaceous limestone (K2 Slm) of Upper Cretaceous lithostatigraphic unites.

Because it was very difficult to disaggregate the limstones and process them with normal washing, thin sections were prepared and analyzed the planktonic foraminifera.

The position of apertures and presence of supplementary and accessory structure that have been used to distinguish genera were not identifiable in thin sections (Caron 1985).

However most of the diagnostic criteria, including the size and shape of test, thickness of well, size, number and arrangement of chambers, form and position of aperture and ornamentation such as ridges, spines and position and number of peripheral thickenings or keels, could be recognized in axial and
subaxial sections (passing through or parallel to the axis of coiling (Sliter, 1989) (Fig.2).

A large number of specimens were encountered in the thin sections, but most of them were of no use for identification, because of partial or oblique cuts through the test. Accordingly axially oriented forms were picked to identify most taxa with a high degree of confidence.

The atlases of the European working group on Cretaceous Planktonic Foraminifera by Robaszynski and Caron (Coordinators 1979) and Robaszynski and others (1984) and the studies of Caron (1985) and Permulisilva and Sliter (1994) were the bases of the identification in this study. In addition Postoma (1971), Wunders (1979), Fleury (1980), Sliter (1989), Robaszynski and others (2000) and Permulisilva and Verga (2004) were useful references, as they include illustrations of thin sections of Planktonic foraminifera.

3. Regional Setting

The studied area (East Dorfak) which is approximately 80km long is oriented W-E and extends from East of Dorfak to West of Somamus in the North of Iran at East of Guilan province.

Iran is a part of short section of the Alpine orogenic belt that is located between the Arabian-African block (Gondwana margin) and the Asian Plate (Eurasia margin). It is interpreted as an assemblage of marginal Gondwana fragments that was detached from the Gondwanian-Arabian plate during the Late Palaeozoic (Permian) or Early Triassic (Stocklin, 1977). It was attached to Turanian plate (Eurasia) at the end of Middle or late Triassic (Stocklin, 1974, 1977; Sengor and Kidd, 1977; Wensink and Varekamp, 1980; Soffel and Forster, 1980; Davoudzadeh and Schmidt, 1982).

In the Late Cretaceous, Iran again joined with the Gondwanian Afro- Arabian plate, but the ocean area was not completely closed in some parts of Iran (Babazade, 2003). Three major tectonic units (Turanian, Iranian and Arabian plates) recognized by Lensch, et.al (1984) in Iran, are separated from each other by ophiolitic complexes (Stocklin, 1977) (Fig.3). These are subdivided in to smaller elements, such as kopet Dagh, Southern Caspian Sea, Zagros Thrust, Zagros. Folded belt, Alborz Montain,Central Iran and etc. Stocklin, 1977; Eftekharnejad, 1980; Alavi 1991; Nog-olsadat, 1993, Aghanabati, 2004).

Alborz in North of Iran and South of Caspian Sea is a great mountain chain that is oriented W-E and extend from Azarbadjan in West to Kopet Dagh in East. It is a part of Alpine-Himalayan orogenic belt. This mountain is in the vicinity of Great Kavir fault in the east (Berberian, 1976; Nogol, 1977) and is connected to Pamir Montain in west and is joined with Caucasus from Azarbadjan. Concerning tectonical and stratigraphical characteristics Alborz is subdivided in few subzones just like the: Eastern Alborz and Kopetdagh, Central Alborz; and Western Alborz & Azarbadjan (Stocklin,1968; Stocklin and Nabavi, 1973; Nabavi,1976). Central Alborz in width is subdivided in Gorgan-Rasht region and Southern & Western Alborz.

Gorgan-Rasht region the studied area is located in this region is situated between Caspian Sea in the north and Alborz fault in the south. Deposition of calcareous sediments is continued during Jurassic and Cretaceous. In the western part abrobly Late Cretaceous volcanic rocks is presented. The Cenozoic is distinguished by absence of Paleocen-Eocene and Oligocen in a great compartment of this region and Miocene Sedimentary rocks directly but unconformatable overly Cretaceous rocks. Yet in the studied area Cretaceous sedimentary rocks are covered by Eocene volcano- sediment and volcanic rocks.

4. Lithology

Most sedimentary outcrops across the Upper Cretaceous in the studied area consist of three microfacies, clastic limestone such as calcareous microconglomerate and calcarenite with varying contents of coarse grains such as quartz and glauconite (up to 15 %) that is deposited in toe of slope, plagic limestone, (Plagic mudstone to wackstone with many intraclasts, (Dunham, 1962)) that deposited in deep
shelf marine and marly limestone to marlstone (Plagic wackstone to packstone, (Dunham, 1962)) include calcareous mud with varying amounts of influx of fine siliceous and mud materials together with plankton rain that is deposited in a deep sea environment as basin.

All of these microfacies have bioclastic contents of planktonic fauna especially foraminifera.

In the middle part of Firuzkuh section among Upper Cretaceous sedimentary rocks volcanoclastic unite is presented too. In addition, Guraj section is thicker than Firuzkuh section (Fig.4)

4-1 Firuzkuh section

Upper Cretaceous sedimentary rocks in this section had 319m thickness and were subdividable into three parts:
The lower part with 131.5m thickness included an alternation of varying color and bedding fine grain limestone (Plagic mudstone to wackstone; Dunham, 1962) with a few chert nodules, (K$_{2}^{1}$). The middle part with 19.5m thickness included medium layer light calcareous tuffacious sandstone, (K$_{2}^{tv}$). The upper part with 168m thickness included medium layer light marly limestone to marlstone (Plagic wackstone to packstone; (Dunham, 1962)), to upward chert nodules and two chert laminate were presented in this part, (K$_{2}^{ml}$).

In this section Upper Cretaceous sedimentary rocks covered Tizkuh Formation (Lower Cretaceous) with low angle angular unconformity, and Upper Cretaceous rocks were presented in a syncline core. For this reason upper boundry is uncertain, but in the west and north Chakrud (South Malakut-North of studied area) Upper Cretaceous rocks is contacted with Paleogen volcanic and volcanoclastic rocks (Annels; Arthurton; Bazeley & Davis, 1972, in this study, 2010).

4-2 Guraj section

In the Guraj section, thickness of Upper Cretaceous sedimentary rocks was 433.3m and was subdividable into three parts. The lower part was 47m in thickness and contained alternation of calcarenite and calcareous microconglomerate with variations in color and bedding (K$_{2}^{Sm}$). The middle part was 367.9m in thickness and contained fine graine limstones of varying colors (Plagic mudstone to wackstone, (Dunham1962)) (K$_{2}^{5}$). The upper part was 64.8m and contained limestone, marly limestone to marlstone. (Plagic wackstone to packstone, (Dunham, 1962)) (K$_{2}^{ml}$).

In Guraj section, Upper Cretaceous rocks overlay Tizkuh Formation (Lower Cretaceous). This boundry is a low angle angular unconformity. In this section, Upper Cretaceous rocks are presented in a syncline core for this reason, the upper boundry is uncertain, but in the West and North Chakrud (South Malakut-North of studied area) Upper Cretaceous rocks is contacted with Paleogen volcanic and volcanoclastic rocks (Annels; Arthurton; Bazeley & Davis , 1972; in this study, 2010).

5. Biostratigraphy

The Upper Cretaceous sequence is deposited in a deep marine environment and it is accurately dated with succession of index planktonic foraminifera. Moreover the presence of a well preserved index species Globotruncanid assemblage, makes this region is very important for study.

5-1 Zonal subdivisions

The researcher has identified nine biozones based on the occurrence of index planktonic foraminifera in the studied area. (Fig.5 & Fig.6).These biozones are recognized from lower Coniacian to Upper most Maastrichtian in Firuzkuh section (Fig.5) and eight biozones are distinguished in the Guraj section (Fig.6). Identification of specimens is based on microscopic observation of thin sections (Plates, 1 to 4).

1. **Biozone A:** Dicarinella primitiva and Whiteinella archaeocretaceae assemblage zone.
   Age: Early to Middel coniacian.
   Definition: This zone in the two studied sections is an assemblage zone.
   Remarks: The diversification of Marginotruncanata and presence of two very index Dicarinella fall within this zone.

   In the Firuzkuh section this zone includes: Dicarinella primitiva (Dalbize, 1995) Dicarinella imbricate (Monard, 1950) Whiteinella archaeocretacea (Pessagno, 1967), Murichohedbergella planispira (Tappan, 1940), Marginotruncanata marginata (Reuss, 1850), Marginotruncanata pseudolineineana Pessagno, 1967, Marginotruncanata coronata (Bollí, 1945).

   This zone in the Guraj section is called Murichohedbergella planispira and Whiteinella archaeocretacea assemblage zone and includes: M.planispira, Heterohelix globulusa (Ehrenberg, 1840), Macroglobigerinelloides bolli (Pessagno, 1967), and M. pseudolineineana.

2. **Biozone B:** Dicarinella concavata zone.
   Age: Late Coniacian to Early Santonian.
   Definition: Interval zone between first occurrence (FO) of Contusotruncanata fornicata (Plummer, 1931) and last occurrence, (LO) of Dicarinella concavata, (Brotzen1934). Remarks: This zone contains the last occurrence (LO) of Murichohedbergella simplex (Morrow, 1934), first occurrence (FO) of Globotruncanata lapparenti Brotzen, 1936, and first occurrence (FO) of Murichohedbergella holmdolensis (Olsson,1964). In this zone the dominant taxa belong to the genera Marginotruncanata (e.g. M.pseudolineineana, M.marginita, M.coronata) and Murichohedbergella, (e.g. M. planispira, and M. holmdolensis).

   The species Dicarinella asymmertica (Sigal, 1952) and D. concavata exist but are rare.

   In Firuzkuh section, this zone includes: Archacoglobigerina cretacea (d’Orbigny, 1840), H.globulusa, Loebichella hessi, (Pessagno, 1962). Equivalent this zone in Guraj section is recognized as M. holmdolensis and Globotruncanata linneiana zone. This zone is characterized by the presence of first occurrence (FO) of C. fornicata and first occurrence (FO) of G. linneiana.

   This zone in Guraj section is called Murichohedbergella holmdolensis and Globotruncanata linneiana assemblage zone and contains, first occurrence (FO) of G. lapparenti, first occurrence (FO) of G.linneiana and first occurrence (FO) of M. holmdolensis, and includes: M. planispira, H. globulusa, M. pseudolineineana, M. bolli.

3. **Biozone C:** Marginotruncanata pseudolineineana and Globotruncanata bulloides assemblage zone.
   Age: Middel to Late Santonian.
   Definition: This zone is characterized by the assemblage of first occurrence (FO) of Globotruncanata bulloides Vogler, 1941 and last occurrence (LO) of M.pseudolineineana and in the Firuzkuh section includes: H. globulusa, M. bolli, A. cretacea, C. fornicata, M.holmdolensis too.

   Remarks: In this zone, the dominant taxa belonges to the genus, Globotruncanata (e.g.G.bulloides, G.linneiana, G. lapparenti) and so this zone contains last occurrence (LO) of M.planispira, and M.coronata and first occurrence (FO) of Globotruncanata hilli (Pessagno, 1967).

   In the Firuzkuh section, upper part of biozone consists of 19.5m tuffaceous calcareous sandstone (K1) do not exist any fossils.

   In the Guraj section from bed nos. C G 171 to C G 176, this assemblage zone contains first occurrence (FO) of G. bulloides and last occurrence (LO) of M.pseudolineineana, and so includes: M. planispira, L. hessi, H. globulusa, A. cretacea, C. fornicata, M. holmdolensis, G. lapparent,G.linneiana.

4. **Biozone D:** Globotruncanata mariei zone.
   Age: Early Campanian.
   Definition: Interval zone between first occurrence (FO) of Globotruncanata mariei (Banner&Blow,1960) and first occurrence (FO) of Rugoglobigerina rugosa (Plummer,1926).

   Remarks: In this zone, dominat taxa are from genus Globotruncanata (e.g. Globotruncanata lapparenti, Globotruncanata linneiana, Globotruncanata bulloides and Globotruncanata hilli) and so this zone in Firuzkuh section includes: C.forncitaca, M. holmdolensis, H. globulusa, M.bolli, A.cretacea,

   In the Guraj section, from bed nos. C G 177 to C G 181 this interval zone is between first Occurence (FO) of Globotruncanita stuartiformis (Dalbiez,1955) and first Occurence (FO) of R. rugosa .This zone in Gurj section and so contains first Occurence (FO) of G. hilli and first Occurence (FO) of G. mariei ,and includes:M. planispira, C. fornicata, G. arca, M. holmdolensis, G.lapparenti, G. linneiana, G. bulloides .

5. **Biozone E:** Globotruncanata ventricosa zone.
   Age: Middle Campanian.
   Definition: Interval zone between first occurrence (FO) of Globotruncanata ventricosa White,1928, and first occurrence (FO) of Murichohedbergella monnothenosis (Olsson,1960).

   Remarks: This zone contains first occurrence (FO) of Macrogloglobigerinelloides praehilensis (Pessagno1967), first occurrence (FO) of Globotruncanata rosetta (Carsey, 1926) and first occurrence (FO) of
Macroglobigerinelloides alvarezi (Eternod Olvera 1959). In this zone, dominant taxa belongs to the genus Globotruncana (e.g. G. linneiana, G. hilli, G. bulloides, G. mariei and G. lapparenti) and so this zone in Firuzkuh section includes: M.holmdolensis and R. rugosa.

In the Guraj section it is interval zone between first occurrence (FO) of G. ventricasa and first occurrence (FO) of M. alvarezi. In this section first occurrence (FO) of G. rosetta is presented and dominant taxa are from genus Globotruncana (e.g. G. linneiana, G. lapparenti, G. hilli and G. bulloides) and so this zone in Guraj section includes: M. holmdolensis, M. bolli, C. fornicata, R. rugosa.

Faunal diversity and frequency in Guraj section is more than Firuzkuh section in this zone.

Age: Late Campanian.
Definition: This zone in Firuzkuh section is assemblage zone, includes: G. rosetta, H. globulusa, A. cretacea, C. fornicata, M. holmdolensis, G. lapparenti, G. linneiana, G. bulloides and R. rugosa. first occurrence of M. prairihilensis and last occurrence of M. bolli are presented in this zone.
Remarks: In the Firuzkuh section dominant taxa are belong to genus Globotruncana (e.g. G. lapparenti, G. linneiana, G. bulloides).
In the Guraj section this zone has been called Radotruncana calcarata zone.

Plate 1

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1. Marginotruncana coronata (Bolli 1945), FK 70d, Middle Turonian–Early Campanian × 100.
2. Dicarinella asymetrica (Sigal 1952), FK 72a, Lastest Coniacian–Earliest Campanian, × 80.
3. Globotructacana linneiana (d'Orbigny 1939), FK74, Santonian- Beginnig of Late Maastrichtian, × 80.
4. Globotruncanita peteri (Gondolfi 1955), CG198, Maastrichtian × 60.
5. Marginotruncana marginata (Reuss 1845), FK 71b, Late Turonian-Santounian, × 100.
6. Dicarinella concavata (Brotzen1934), FK 71b, Coniacian–Santonian, × 80.
7. Murichohedbergella holmdolensis (Olsson 1964), CG 169, Coniacian- Maastrichtian to Paleocen, × 120.
8. Murichohedbergella simplex(Morrow1934), FK 73, Middle Albian, Early Santonian, × 200.
9. Marginotruncana pseudolinneiana Pessagno 1967, CG 173, Middle Turonian- EarlyCampanian, × 60.
11. Dicarinella imbricate (Monrod,1950), FK70d, Turonian- Coniacian, × 80.
12. Loblichella hessi (Pessagno 1962), CG176, Middle Albian- Turonian to Early Maastrichtian, × 100.
Plate 2
Rugotruncana aff subciromnodifer (Gandolfi1955), CG191, Late Campanian - Late Maastrichtian, X100. 2-Contusotruncana plummerae (Gondolfi1955), CG207, Late Campanian-Late Maastrichtian, X120.3. Globotruncana stuarti (deLapparent 1918), CG192, Late Campanian-Maastrichtian, X 60.4. Macroglobigerinelloides bolli(Pessagno 1967), CG208, Coniacian-earliest Maastrichtian, X 120.5-Rugoglobigerina pennyi Broennimann 1952, bFK9, Late Campanian- Maastrichtian, X100.6- Globotruncana aegyptiaca Nakady 1950 bFK12, Late Campanian –Maastrichtian, X80.7- Globotruncana cf minuta Caron & Gonzalez Donoso 1984, CG189, Campanian- Maastrichtian, X160. 8- Macroglobigerinelloides messinae (Broennimann 1952), CG191, Campanian- Maastrichtian, X200. 9- Murichohedbergella aff monmouthensis (Olsson 1960), bFK, Middle Campanian- Maastrichtian to Paleocen, X200. 10- Globotruncana havanensis (Voorwijk 1937), CG192, Late Campanian, Maastrichtian, X140. 11- Macroglobigerinelloides prairihilenseis (Pessagno 1967), bFK9, Santonian – Late Maastrichtian,X120. 12- Macroglobigerinelloides subcarinatus (Bronnimann 1952) CG194, Latest conacian- Maastrichtian, X200. 13- Murichohedbergella planispira (Tappan1940), CG167, Albian – Early Campanian, X200.14. Globotruncana mariei (d'Orbigny1839), CG194, Campanian- Late Maastrichtian, X16015-Contusotruncana fornicata (Plummer 1931) CG194, Santanian-Middle Maastrichtian X80.

Plate 3
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Plate 3

1- Albathamphalus mayaronensis (Bolli 1951), bFK12, Late Maastrichtian, X60. 2- Globotruncan ca arca (Cushman 1926), CG196, Middle Santonian- Maastrichtian, X60. 3- Globotruncan ca ventricosa White1928, CG196, Middle Campanian- Middle Maastrichtian, X80. 4- Archaeoglobigerina cretacea (d' Orbigny 1840), CG196, Coniacian- Early Maastrichtian, X100. 5- Contusotruncan ca contusa (Cushman 1926) CG196, Late Maastrichtian, X60. 6- Globotruncan dupeublie, Caron et. al. 1984, CG204, Latest Campanian- Maastrichtian, X80. 7- Contusotruncan waalfishensis (Todd 1970), CG197, Latest Campanian- Maastrichtian, X80. 8- Globotruncan ipparenti, Brotzen 1936, Late Coniacian- Early Maastrichtian, X80. 9- Globotruncan rosetta (Carsey 1926), CG200, Middle Campanian-Maastrichtian, X80. 10- Globotruncan bulloides Vogler 1941, CG184, Latest Santonian- Middle Maastrichtian, X80. 11- Whitenella archaeoeretacea Pessagno 1967, FK70b, Turonian- Middle Coniacian X100. 12- Globotruncan falsostuarti Sigal 1952, CG189, Latest Campanian- MaastrichtianX6013- Racemigumembelina frectoica, Egger 1902, CG196, Late Maastrichtian, X80. 14- Gansserina gansseri (Bolli 1951) CG208, Late Maastrichtian, X80. 15. Radotruncan calcarata (Cushman 1927) CG186, Late Campanian X60.

Plate 4
Plate 4

1- Globotruncanita stuartiformis (Dalbiez 1955), CG200, Campanian- Maastrichtian, X60.2- Rugoglobigerina macrocephala Broennimann, 1952, Late Companian- Maastrichtian, X60.3- Contusotruncana patelliformis (Gandolfi, 1955), CG202, Middle Campanian- Late Maastrichtian, X80.4- Globotruncanita conica (White 1928) CG201, Late Maastrichtian, X80.5- Heterohelix globulosa (Ehrenberg 1840), CG188, Middle Turonian- Maastrichtian, X100.6- Murichohedbergella delroensis (Carney 1926) FK70b, Albian- Coniacian X140.7- Marginotruncanita sigali (Reichel, 1950), FK70d, Middle Turonian- Early Santonian X80. 8- Laffiteina cf marsicana (Farinacci 1976), CG 205, Late Maastrichtian, X20.9- Marsonella oxycona Reuss 1960, Early to Late Cretaceous, X20.10- Lenticulina sp

Scale bar:

Age: Late Campanian.
Definition: Interval zone between first occurrence (FO) of Radotruncana calcarata (Cushman, 1927) and first occurrence (FO) of Globotruncanita stuarti (de Laparent, 1918).
Remarks: In the Guraj section, this zone contains first occurrence (FO) of Murichohedbergella monmothensis (Olsson, 1960), first occurrence (FO) of Rugoglobigerina macrocephala Bronnimann, 1952, dominant taxa is from genera Globotruncanina (e.g. G. lapparenti, G. linneiana, G. bulloides, G. hilli, G. mariei) and Rugoglobigerina (e.g. R. rugosa, R. macrocephala) and so, this zone in Guraj section includes: L. hessi, H. globulosa, M. bolli, Globotruncanita dupeubliei, C. fornicata, M. alvarezi, M. holmdolensis, M. prairihilensis.

Age: Early Maastrichtian.
Definition: Interval zone between first occurrence (FO) of Globotruncanella minuta Caron & Gonzalez Donoso, 1984 and first occurrence (FO) of Gansserina gansseri (Bolli, 1951).
Remarks: This zone is characterized by the presence of G. minuta, Kuglerina rotundata (Bromnimann, 1952), G. linneiana, G. arca, G. hilli, G. rosetta and M. monmothensis.
In this zone dominant genus is Globotruncanina (e.g. G. linneiana, G. hilli, G. arca, G. rosetta and G. ventricosa), last occurrence (LO) of M. prairihilensis and last occurrence of Globotruncanita lapparenti is fall within this zone too.
This zone in Firuzkuh Section includes: M. alvarezi. And hence this zone in Guraj Section is called Globotruncanata stuarti zone that is interval zone between first occurrence (FO) of G. stuarti and first occurrence (FO) of Globotruncanita conica (White, 1928). This zone characterized by dominance of genus Globotruncanina (e.g. G. linneiana, G. arca, G. bulloides, G. hilli, G. mariei, G. ventricosa, G. rosetta, Globotruncanina falsotuari Sigal, 1952 and Globotruncanina aegyptiaca (Nakkady, 1950) and presence of Contusotruncana patelliformis (Gandolfi, 1955), Contusotruncana plumperae (Gondolfi, 1955)
Conclusions:

Part of two section. Minoxia sp have been seen in many samples in some Textularid forms such as Marsonella oxycona and Calcisphaerula inominata lata and Pitonella ovalis and The Lenticulina sp, Oligosteginid species such as alvarezi, G. gansseri, R. rugosa. M. monmothensis, M. holmolensis, M. in the Firuzkuh section includes: G. mariei, G. stuartiformis, R. macrocephala, G.falsostuarti, G. rosetta and G. aegyptiaca is seen in this zone too.

Age: Early late Maastrichtian.
Definition: First occurrence (FO) of G. gansseri and first occurrence (FO) of Contusotruncanacontusa (Cushman, 1926) is fall within this zone.
Remarks: This zone in Firuzkuh section, is characterized by the disappearance of G. linneiana, G. ventricosa and G. mariei in the upper layer of section.
In this zone, dominant genus is Globotruncana (e.g. G. linneiana, G. arca, G. bulboides, G. hilli, G. mariei, G. falsostuarti, G. rosetta, G. aegyptiaca) and so includes: H. globulusa, M. holmdolensis, R. rugosa M. monmothensis, M. alvarezi, Racemiguembelina fracticosa (Egger, 1902), C. contusa. This zone in Guraj section represents diversity and has different characteristics from Firuzkuh section.
Last occurrence (LO) of G. apparenti, last occurrence (LO) of C. fornicata and M. praesihilensis is observed in the beginning of this zone, and last occurrence (LO) of G. ventricosa in the middle part of this zone confirms that this zone in Guraj section has moved to the upper most of Maastrichtian.
Dominant genus in this zone in Guraj section is from Globotruncana (e.g. G. linneiana, G. arca, G. bulboides, G. hilli, G. ventricosa, G. rosetta and G. falsostuarti) and so, this zone in Guraj section includes: H. globulusa, M. holmdolensis, G. stuartiformis, R. rugosa, C. patelliformis, C. planmerae, G. stuarti, M. monmothensis, R. macrocephala, Globotruncanatapetessi (Gondolfi, 1955), G. havanensis, R. fracticosa.
Further more, Laffiteina mariosoni is observed in this zone too.

Age: Latest Maastrichtian.
Definition: This zone in Firuzkuh section contain bed no bFk1: at the top of section. Presence of first occurrence (Fo) of Abathamphalusmayaroensis (Bolli, 1951) and first occurrence of R. fracticosa are seen in this zone.
Remarks: This zone is not present in Guraj section and in the Firuzkuh section includes: G. mariei, G. aegyptiaca M. monmothensis, M. holmdolensis, M. alvarezi, G. gansseri, R. rugosa.
The Lenticulina sp, Oligosteginid species such as Calcisphaerula inominata lata and Pitonella ovalis and so Textularid forms such as Marsonella oxycona and Minoxia sp have been seen in manysamples insome part of two section.

Planktonic foraminifera assemblage of Upper Cretaceous sedimentary rocks of studied area has been analyzed in detail and the following conclusions have been drawn:
1. Fifty-eight planktonic species belonging to twenty genera have yielded nine biozones. They are in ascending order: Dicarinella primitiva and Whiteinella archacocratae assemblage zone, (Biozone A), Dicarinella concavata zone, (Biozone B), Marginotruncana pseudolinneiana and Globotruncana bulboides assemblage zone, (Biozone C), Globotruncana mariei zone, (Biozone D) Globotruncana ventricosa zone, (Biozone E) Macroglobigerinelloides bolli and Globotruncanarosseta assemblage zone, (Biozone F) (In the Guraj section this biozone was called Radotruncanacalcarata zone) Globotruncanella minuta zone (Biozone G) (In the Guraj section this biozone was called Globotruncanta stauri zone), Gansserina gansseri zone, (Biozone H) and Abathamphalus mayaroensis zone (Biozone I) (This zone was been presented just in Firuzkuh section).
2. The planktonic foraminifera from the Upper Cretaceous of studied area belong to the Tethyan bio province which is characterized by diverse keeled associations rich in thick-walled species. This assemblage is composed of representatives of the genera Marginotruncana, Dicarinella, Globotruncana, Globotruncanita, Contosotruncana, Rugoglubigerina and etc.
3. The succession of planktonic formifineral assemblages in the East Dorbak area shows a continuity of the sedimentation during late cretaceous from coniacian to late Maastrichtian.
4. A distinct unconformity has been identified in lower boundry with Tizkuh formation (Barremian-Albian) This unconformity is here correlated with a major tectonic acativity of the Austrian Orogeny.
5. Palaeogen volcanosediment and volcanic rocks overly late Cretaceous sedimentary rocks with unconformatbale contact. This unconformity is here correlated with a major tectonic activity of the Laramian Orogeny.

Acknowledgments
A part of the field work was supported by Islamic Azad University of Rasht branch. We are gratefully acknowledged for their help during the intense field work. Library works were supported by Islamic Azad University Science and Reserch Branch we are acknowledged for their helps. H.Babayi are thanked for their constructive editing of this paper.

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