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 Nothern Iran(within Gorgan-Rasht region). The Upper Cretaceous sequence in this region comprises three lithostratigraphic unites (K_2^{SLm}, K_2^{1}, K_2^{mL}). Two stratigraphic sections have been investigated in this area and outcrope 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, Globotruncana, Globotruncanita, Globotruncanella, Contusotruncana, Macroglobigerinelloides, Marginotruncana, Radotruncana, Rugoglobigerina, Racemiguembelina, Heterohelix, Abathamphalus 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 Maastrichtain demonstrated the largest diversity faunal. 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.
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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, $10^/$ langitude and 36^0, $47^/$ to 36^0, $51^/$ 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.

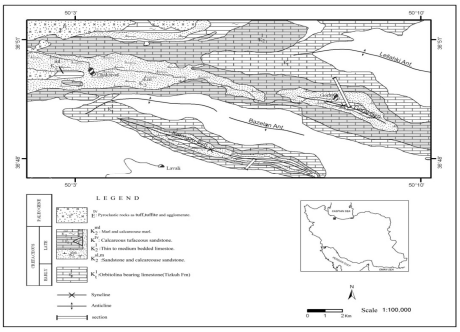


Fig . 1 . Geological map of studied area (East of Dorfak . Guilan . Iran)

The aim of this paper is to present Upper Cretaceous biostratigraphic data that allows reconstruction of the micropalaeontology 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 (K^1_2); and thin to meddium bedded clayey hemiplegic to plagic limstone (K_2^{ml}) and thin to medium bedded arenaceous limestone (K_2^{slm}) of Upper Cretaceous lithostratigraphic 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 presenc 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), Wonders (1979), Fleury (1980), Sliter (1989), Robaszynski and others (2000) and Permulisilvea and Verga (2004) were usefull refrences, as they include illustrations of thin sections of Planktonic foraminifera.

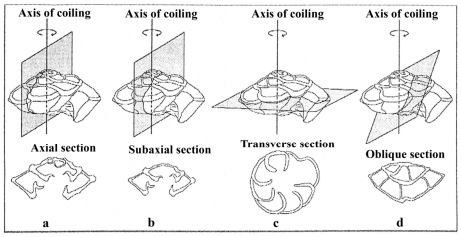


FIGURE 2. Principal sections through a planktonic foraminiferal test . a) Axial section : section passing through the axis of coiling . b)subaxial section : section passing parallel to the axis of coiling but not passing through the prolocculus. c) Transverse section: section passing perpendicular to the axis of coiling. d) Oblique section: section passing neither parallel nor perpendicular to the axis of coiling.

3. Regional Setting

The studid area (East Dorfak) which is aproximately 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,1979; Wensink and Varekamp, 1980; Soffel and Forster, 1980; Davoudzadeh and Schmidt, 1982).

In the Late Cretaceous, Iran again enjoined 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 greate montain chain that is oriented W-E and extend from Azarbaidjan in West to Kopet Dagh in East. It is a part of Alpine-Himalayaian orogenic belt. This montain 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 Caucasous from Azarbaidjan. Concerning tectonical and stratigraphical characteristics Alborz is subdivided in few subzones just like the: Eastern Alborz and Kopetdagh, Central Alborz; and Western Alborz & Azarbaidjan (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 abroadly Late Cretaceous volcanic rocks is presented. The Cenozonic is distinguished by absence of Paleocen-Eocen and Oligocen in a great compartment of this region and Miocen Sedimentary rocks directly but unconformatable overly Cretaceous rocks.Yet in the studied area Cretaceous sedimentary rocks are covered by Eeocen volcano- sediment and volcanic rocks.

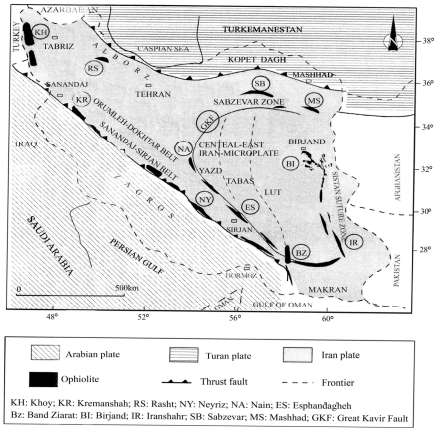


Fig. 3. Modified sketch map of Iran showing the major tectonic units, the inner nucleus and the positions of the main ophiolites (Lensch et al., 1984; Sengor et al., 1988; Stocklin, 1977; Dilek and Delaloye, 1992; Babazadeh, 2003).

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 gluconite (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 planktone 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^{l}). 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 of Chakrud (South Malakut- North of studied area) is contacted with Paleogen volcanic and volcanoclastic rocks (Annels; Arthurton; Bazeley & Davis , 1972; in this study, 2010)

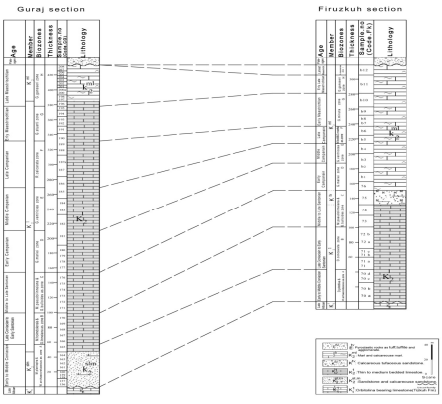
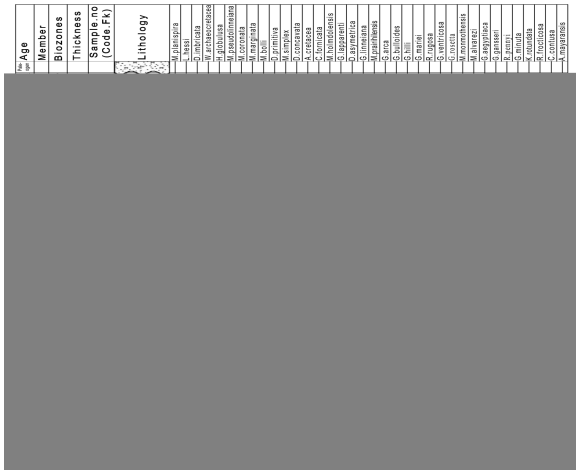


Fig.4.corelation chart for the two studied section in the East Dorfak .

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^{Slm}). The middle part was 367.9m in thickness and contained fine graine limstones of varying colors (Plagic mudstone to wackstone, (Dunham1962)) (K_2^{l}). 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 enviroment 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 resercher 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).

The definition of the biozones is given, following the works of Caron (1985) Sliter (1989), Permulisilva and Sliter (1994) Robaszynski and Caron (1995) and Permulisilva and Verga (2004)

1. **Biozone A:** Dicarinella primitiva and Whiteinella archacocretacea assemblage zone.

Age: Early to Middel coniacian.

Definition: This zone in the two studied sections is a assemblage zone.

Remarks: The diversification of Marginotruncana and presence of two very index Dicarinella fall within this zone.

In the Firuzkuh section this zone includes: Dicarinella primitiva (Dalbiez, 1995) Dicarinella imbricate (Monard, 1950) Whteinella archaeocretacea Pessagno, 1967, Murichohedbergella planispira (Tappan, 1940), Marginotruncana marginata (Reuss, 1850), Marginotruncana pseudolinneiana Pessagno, 1967, Marginotruncana coronata (Bolli, 1945).

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

2**. Biozone B:** Dicarinella concavata zone.

Age: Late Coniacian to Early Santonian

Definition: Interval zone between first occurence (FO) of Contusotruncana 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 Globotruncana lapparenti Brotzen, 1936, and first occurrence (FO) of Murichohedbergella holmdolensis (Olsson,1964). In this zone the dominant taxa belong to the genera Marginotruncana (e.g.M.pseudolinneiana, M.marginata, M.coronata) and Murichohedbergella, (e.g. M. planispira, and M. holmdolensis).

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

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

This zone in Gurag section is called Murichohedbergella holmdolensis and Globotruncana linneiana assemblage zone and contains, first occurence (FO) of G. lapparenti, first occurence (FO) of G.linneiana and first occurrence (FO) ofM. holmdolensis, and includes: M. planispira, H. globulusa, M. pseudolinneiana, M. bolli.

3. Biozone C: Marginotruncana pseudolinneiana and Globotruncana bulloides assemblage zone.

Age: Middele to Late Santonian.

Definition: This zone is characterized by theassemblage of first occurence (FO) of Globotruncana bulloides Vogler, 1941 and last occurence (LO) of M.pseudolinneiana 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, Globotruncana (e.g.G.bulloides, G.linneiana, G. lapparenti) and so this zone contains last occurence (LO) of M.planispira,and M.coronata and first occurence (FO) of Globotruncana hilli (Pessagno, 1967).

In the Firuzkuh section, upper part of biozone consists of 19.5m tuffaceous calcareous sandstone (K_2^{tv}) dose not exsist any fossils.

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

4. BiozoneD: Globotruncana mariei zone.

Age: Early Campanian.

Definition: Interval zone between first occurence (FO) of Globotruncana mariei (Banner&Blow,1960) and first occurrence (FO) of Rugoglobigerina rugosa (Plummer,1926).

Remarks: In this zone, dominat taxa are from genus Globotruncana (e.g. Globotruncana lapparenti, Globotruncana linneiana, Globotruncana bulloides and Globotruncana hilli) and so this zone in Firuzkuh section includes: C.fornicata, 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: Globotruncana ventricosa zone.

Age: Middle Campanian.

Definition: Interval zone between first occurence (FO) of Globotruncana ventricosa White,1928, and first occurrence (FO)of Murichohedbergella monmothensis (Olsson,1960).

Remarks: This zone contains first occurrence (FO) of Macroglobigerinelloides prairihilensis (Pessagno1967), first occurence (FO) of Globotruncana rosetta (Carsey, 1926) and first occurence (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 occurence (FO) of G. ventricasa and first occurence (FO) of M. alvarezi. In this section first occurence (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.

6. Biozone F: Macroglobigerinelloides bolli and Globotruncana rosetta assemblage 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 occurence of M. prairihilensis and last occurence 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

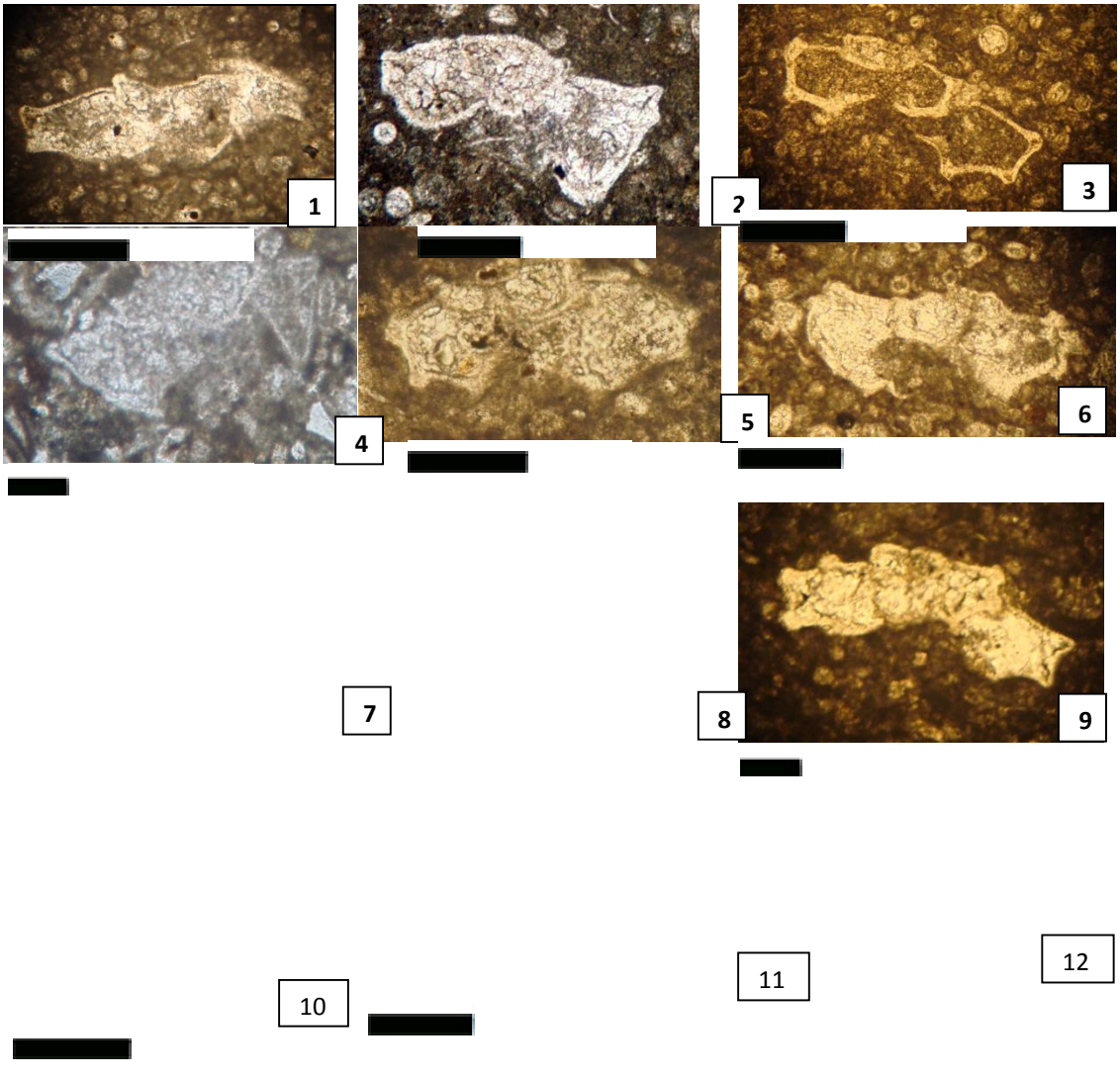
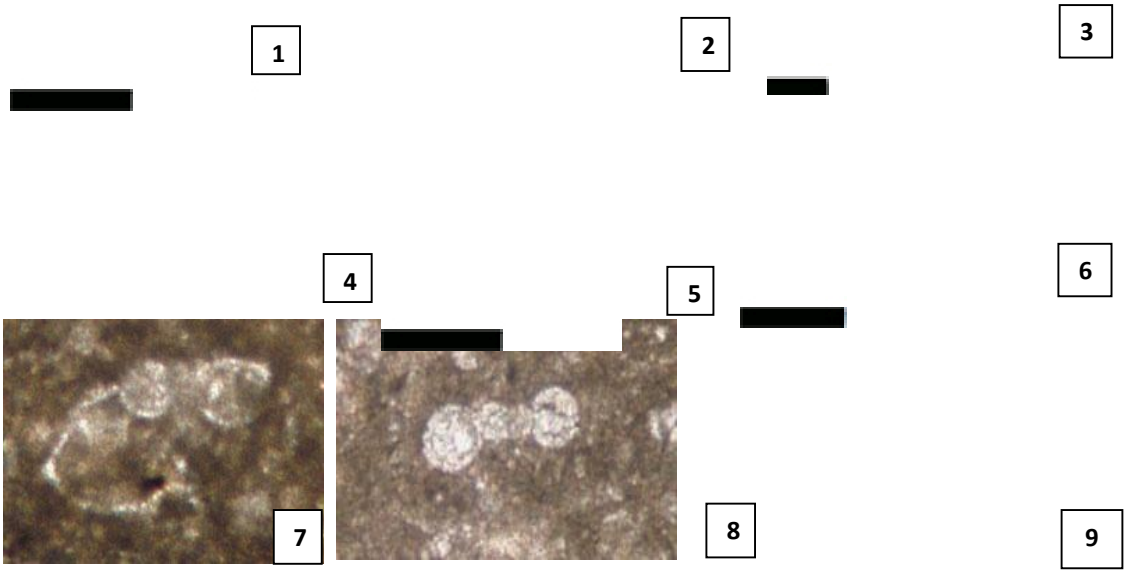


Plate 1

1. Marginotruncana coronata (Bolli 1945), FK 7od, Middle Turonian–Early Campanian ×, 100. 2.Dicarinella asymetrica (Sigal 1952), FK 72a, Lastest Coniacian–Earliest Campanian,×,80.3. Globotruacana linneiana (d'Orbigny 1939), FK74, Santonian- Beginnig of Late Maastrichtian,× 80. 4 Globotruncanita peterssi (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 (Olsson1964), 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,×60.10. Kuglerina rotundata (Broennimann 1952), bFK8, Latest Campanian- Maastrichtian,×100.11. Dicarinella imbricate (Monrod,1950), FK70d, Turonian- Coniacian,×80.12. Loblichella hessi (Pessagno 1962), CG176, Middle Albian- Turonian to Early Maastrichtian,×120.13. Rugoglobigerina rugosa (Plummer,1926), CG195, Campanian- Maastrichtian,×100.14. Dicatinella primitiva(Dalbiez 1955), CG176, Coniacian – Beginning of Santonian,×80.15. Globotruncana hilli (Pessagno 1967), CG182, Late Santonian- Maastrichtian×160.

Plate 2



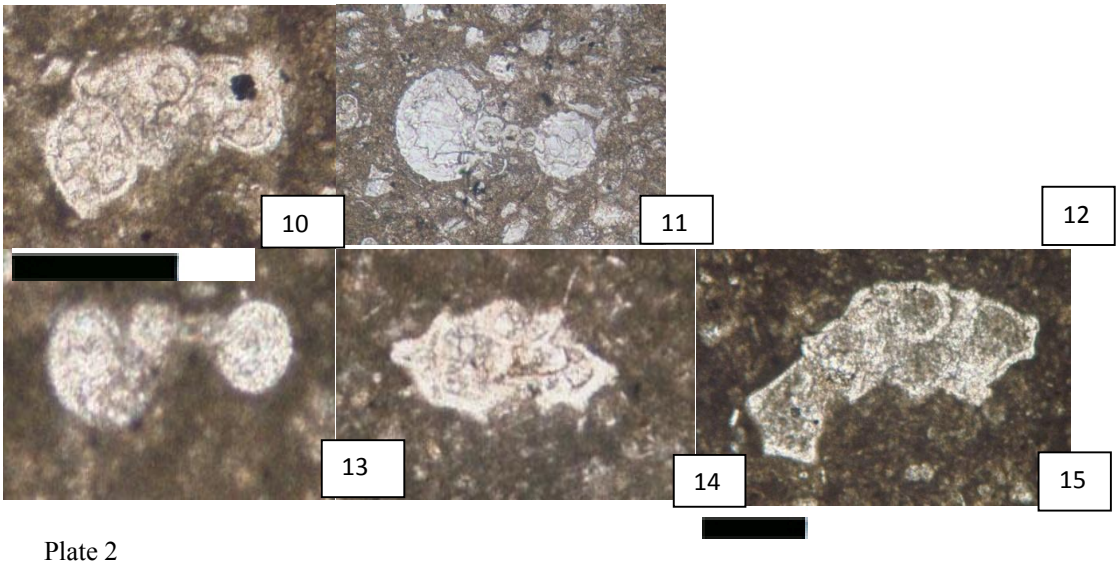
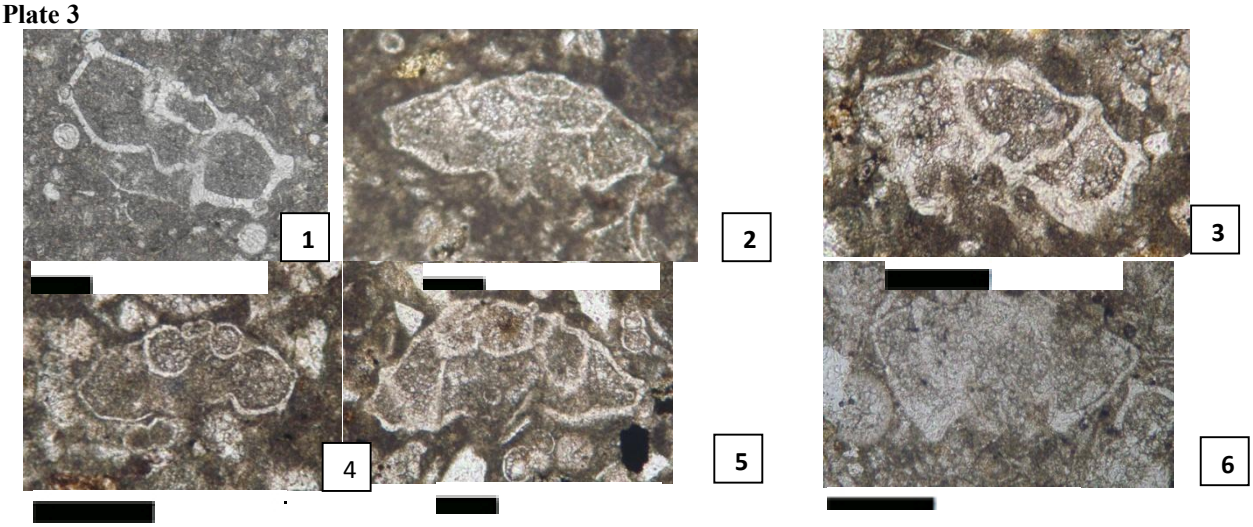


Plate 2

Rugotruncana aff subciromnodifer (Gandolfi1955), CG191, Late Campanian - Late Maastrichtian, X100. 2- Contusotruncana plummerae (Gondolfi1955), CG207, Late Campanian-Late Maastrichtian, X120.3. Globotruncanita 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 Nakkady 1950 bFK12, Late Campanian –Maastrichtian, X80.7- Globotruncanella 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- Globotruncanella havanensis (Voorwijk 1937), CG192, Late Campanian, Maastrichtian, X140. 11- Macroglobigerinelloides prairihilensesis (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



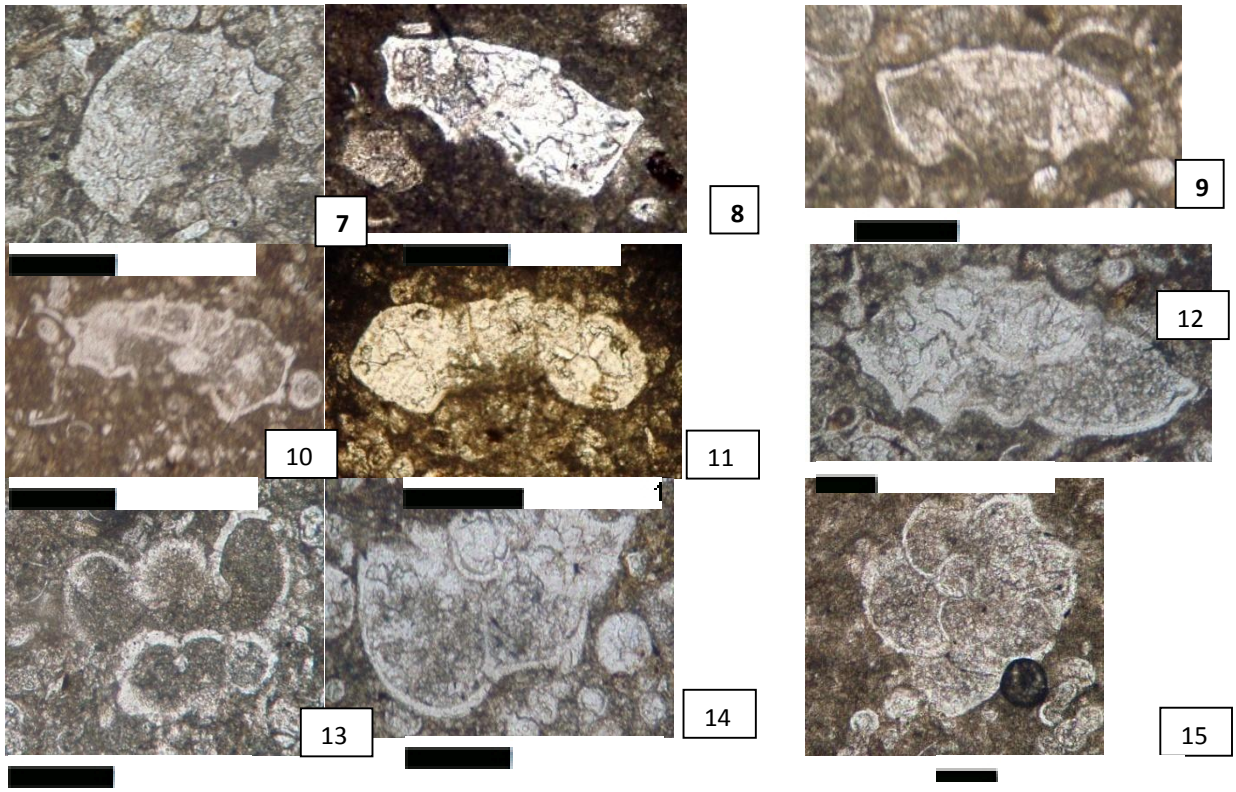
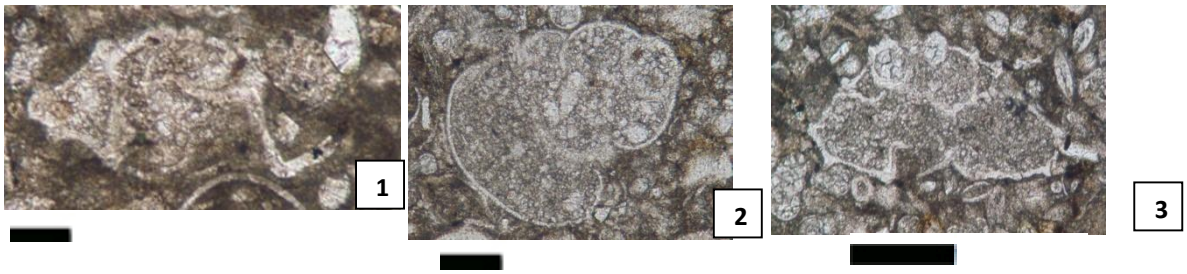


Plate 3

1- Albathamphalus mayaronesis (Bolli 1951), bFK12, Late Maastrichtian, X60.2- Globotruncana arca (Cushman 1926), CG196, Middle Santonian- Maastrichtian, X60.3. Globotruncana ventricosa White1928, CG196, Middle Campanian- Middle Maastrichtian, X80. 4- Archaeoglobigerina cretacea (d' Orbigny 1840), CG196, Coniacian- Early Maastrichtian, X100.5- Contusotruncana contusa (Cushman 1926) CG196, Late Maastrichtian, X60. 6- Globotruncana dupeublie, Caron et, al. 1984, CG204, Latest Campanian- Maastrichtian, X807- Contusotruncana walfishensis (Todd 1970), CG197, Latest Campanian- Maastrichtian, X80.8- Globotruncana lpparenti, Brotzen 1936, Late Coniacian- Early Maastrichtian,X80.9- Globotruncana rosetta (Carsey 1926), CG200, Middle Campanian-Maastrichtian, X80. 10-Globotruncana bulloides Vogler 1941, CG184, Latest Santonian- Middle Maastrichtian,X8011-Whitienella archaeocretacea Pessagno 1967, FK70b, Turonian- Middle Coniacian X10012- Globotruncana falsostuarti Sigal 1952, CG189, Latest Campanian-MaastrichtianX6013- Racemigumembelina frocticosa, Egger 1902, CG196, Late Maastrichtian,X8014- Gansserina gansseri (Bolli 1951) CG208, Late Maastrichtian, X80. 15. Radotruncana calcarata (Cushman 1927) CG186, Late Campanian X60.

Plate 4



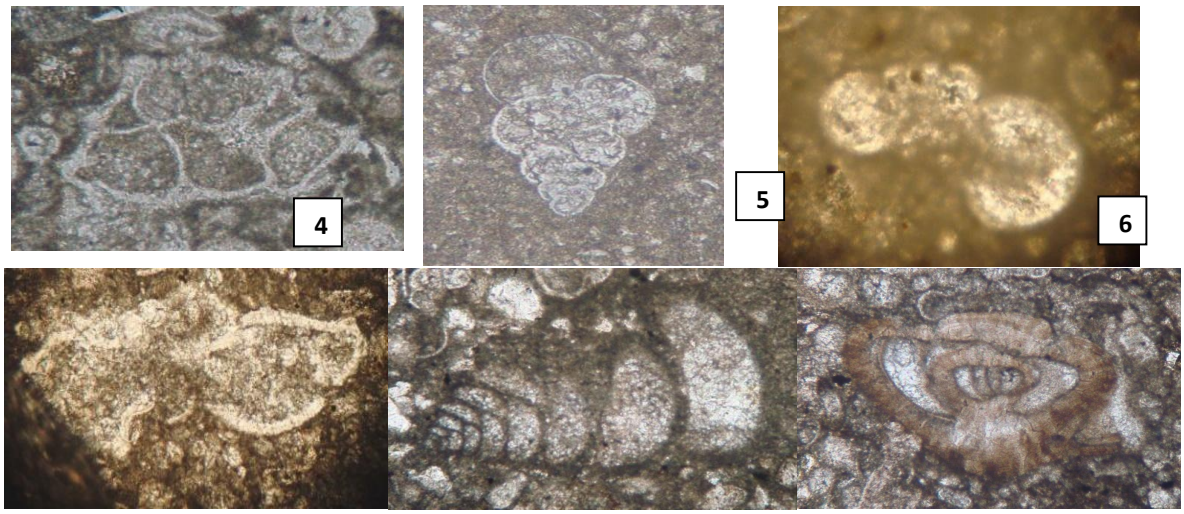


Plate 4

1- Globortruncanita stuartiformis(Dalbiez 1955), CG200, Campanian- Maastrichtian,X60.2- Rugoglobigerina macrocephala Broennimann, 1952, LateCompanian- Maastrichtian, X60.3- Contusotruncana patelliformis (Gandolfi,1955), CG202, Middle Campanian- Late Maastrichtian, X80.4- Globortruncanita conica (White 1928) CG201, Late Maastrichtian, X80.5- Heterohelix globulusa (Ehrenberg 1840), CG188, Middle Turonian- Maastrichtian, X100.6- Murichohedbergella delroensis (Carsey 1926) FK70b, Albian- Coniacian X140.7- Marginotruncana 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:

7. Biozone G (in the Guraj section):Radotruncana calcarata zone.

Age: Late Campanian.

Definition: Interval zone between first occurence (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 occurence (FO) of Murichohedbergella monmothensis (Olsson, 1960), first occurence (FO) of Rugoglobigerina macrocephala Bronnimann, 1952, dominant taxa is from genera Globotruncana (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, globulusa, M. bolli, Globotruncana dupeublei, C.fornicata, M.alvarezi, M. holmdolensis, M. prairihilensis.

8. Biozone H: Globotruncanella minuta zone.

Age:EarlyMaastrichtian.

Definition: Interval zone between first occurence (FO) of Globotruncanella minuta Caron & Gozalez Donoso, 1984 and first occurence (FO) of Gansserina gansseri (Bolli,1951).

Remarks: This zone is characterized by the presence of G, minuta, Kuglerina rotundata (Bronnimann, 1952), G. linneiana, G. arca, G. hilli, G. rosetta and M.monmothensis.

In this zone dominant genus is Globotruncana (e.g. G. linneiana, G. hilli, G. arca, G. rosetta and G. ventricosa), lastoccurence (LO) of M. prairihilensis and last occurence of Globotruncana lapparenti is fallwithin this zone too.

This zone in Firuzkuh Sectionincludes: M.alvarezi.And hence this zonein Guraj Section is calledGlobotruncanita stuarti zone that is interval zone between first occurence (FO) of G. stuarti and first occurence (FO) of Globotruncanita conica (White, 1928). This zone characterized bydominance of genus Globotruncana (e.g. G. linneiana, G. arca, G. bulloides, G. hilli, G. mariei, G. ventricosa, G. rosetta, Globotruncana falsostuarti Sigal, 1952 and Globotruncana aegyptiaca (Nakkady, 1950) and presence of Contusotruncana patelliformis (Gandolfi, 1955), Contusotruncana plummerae (Gondolfi, 1955)

,M.monmothensis, M.holmolensis, Rugotruncana subcircomndifer (Gondolfi, 1955), Globotruncanella havanensis (Voorwijk, 1937), R.macrocephala, G.falsostuarti, M.alvarezi and G.aegyptiaca is seen in this zone too.

9. Biozone I: Gansserina gansseri zone.

Age: Early late Maastrichtian.

Definition: First occurence (FO) of G. gansseri and and first occurence (FO) of Contusotruncanacontusa (Cushman, 1926) is fall within this zone.

Remarks: This zone in Firuzkuh section, is charactrized 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. bulloides, G. hilli, G. mariei, G. falsostuarti, G. rosetta, G. aegyptiaca) and so includes:H.globulusa, M.holmdolensis, R. rugosa M. monmothensis, M. alvarezi, Racemiguembelina frocticosa (Egger, 1902), C. contusa.

This zone in Guraj section represents diversity and has different charactristics from Firuzkuh section.

Last occurrence (LO) of G.lapparenti, last occurrence (LO) of C. fornicata and M. prairihilensis 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 fromGlobotruncana (e.g. G linneiana, G. arca, G. bulloides, 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.plammerae, G.stuarti, M.monmothensis R. macrocephala, Globotruncanitapeterssi (Gandolfi, 1955), G. havanensis, R. frocticosa.

Further more, Laffiteina mariosoni is observed in this zone too.

10. Biozone JI: Abathamphlus mayaroensis zone.

Age: Latest Maastrichtian.

Definition: This zone in Firuzkuh section contian bed no bFk_{12} at the top of section. Presence of first occurrence (Fo) of Abathamphalusmayaroensis (Bolli, 1951) and first occarence of R. frocticosa are seen in this zone.

Remarks: This zone is not present in Guraj section and in the Firuzkuh section includes: G. mariei, G. aegyptiacaM. 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.

Conclusions:

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 genra have yielded nine biozones. They are in ascending order: Dicarinella primitiva and Whiteinella archacocretacea assemblage zone, (Biozone A), Dicarinella concavata zone, (Biozone B), Marginotruncana pseudolinneiana and Globotruncana bulloides assemblage zone, (Biozone C), Globotruncana marieizone, (Biozone D) Globotruncana ventricosa zone, (Biozone E) Macroglobigerinelloides bolli and Globotruncanarosetta 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 stuarti 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 keelled associations rich in thick-walled species. This assemblage is composed of representatives of the genera,Marginotruncana, Dicarinella, Globotruncana, Globotruncanita, Contusotruncana, Rugoglobigerina and etc.
3. The succession of planktonic forminiferal assemblages in the East Dorfak 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. Palaogen volcanosedimeut and volcanic rocks overly late Cretaceous sedimentary rocks with unconformatable contact. This unconformity is here correlated with a major tectonic activity of the Laramian Orogeny.

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Refrences:

1. Babazadeh.S.A.2006.New biostratigraphic data from Cretaceous planktic foraminifera in Sahlabad province, eastern Iran.
2. Carsey,D.O.,1926,Forminifera of the Cretaceous of Central Texas: Texas University Bulletin, no.26122,p.1-56.
3. Chungkham, P., and Caron, M., 1996, Comparatives study of a Late Maastrichitain (A.mayaroensis zone) formininferal assemblage from two distant parts of the Tethys Ocean: Semsales Wildflysch Zone, Switzerland and Ukhrul Melange Zone, India: Revue de Paleobiologic, v. 15, no. p. 499-517.
4. Davoudzadeh, M., Schmidt, K., 1981. Contribution to the paleogeography and stratigraphy og the Upper Triassic to Middle Jurassic of Iran. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 162, 137-163.
5. Davoudzadeh, M., Schmidt, K., 1982.Zur Trias des Iran. Geologische Rundschau 71, 1021-1039.
6. Dilek, Y., Delaloye, M., 1992.Structurae of the Kizildag ophiolite, a slow spread Cretaceous ridge segment north of Arabian promontory. Geology 20, 19-22.
7. Dupeuble, P. A., 1969, Forminiferes planctoniques (Globotruncanidès et Heterohelicidae) du Maestrichtien Supèrieur en Aquitaine occidentale, in Brönnimann, P., and Renz, H. H. (cds.), Proceedings of the First International Conference on Plank tonic Mocrofossils, Geneva: E.J. Brill, Leiden, v. p. 153-161.
8. Lensch, G., Schmidt, K.,Davoudzadeh, M.,1984. Introduction to the geology of Iran.Neues Jahrbuch für Geologic und Paläontologie, Abhandlungen 165, 155-164.
9. Loeblich, A. R., JR., and Tappan, H., 1988, Foraminiferal Genera and Their Classification: Van Nostrand Reinhold Company, New York, 970 p.
10. Lowe, D.R., 1979. Sediment gravity flow: their classification and some problems of application to natural floes and deposits. Society for Sedimentary Geology Special Publication 27, 75-82.
11. Meischner, K.D., 1964. Allodapisxhe kalke, turbidite in riff-nahen sedimentations- becken. In: Bouma, A.H., Brouwer, A. (Eds.), Turbidites. Elsevier, Amsterdam, pp. 156-191.
12. Nakkady, S. E., 1950, A new foraminifera fauna from the Esna shales and Upper Cretaceous Chalk of Egypt: Journal of Paleontology, v. 24, no. 6, p. 675-692.
13. Özkan, S., 1985, Maastrichtain Planktonic Forminifera and Stratigraphy of the Germav Formation, Gercüs Area, Southeast Turley: unpublished M.Sc. Thesis, Middle East Technical University, Ankara, Turkey, 219 p.
14. Özkan,S, and Koyluoglu, M., 1988, Campanian-Maastrichtain planktonic forminiferal biostratigraphy of the Beydağlari Autochthonous Unit, Western Taurids, Turkey: Middle East Technical University Journal of Pure and Applied Scienccs, v. 21, p. 377-388.
15. Pessagno, E. A., JR., 1962, The Upper Cretaceous Stratigraphy and Micropaleontology of South- central Puerto Rico: Micropaleontology, v. 8, no. 1, p. 349-368.
16. Postuma, J. A., 1971, Manual of Planktonic Foraminifera: Elsevier Publishing Company, Amsterdam, 420 p.
17. Permoli Silva, I., and Verga, D., 2004, Practical manual of Cretaccous planltonic forminifera. International School on planktonic forminifera, 3nd Course: Cretaceous, in Verga, D., and Rettori, R. (eds.), Universities of Perugia and Milan, Tiporafia Pontefelcino, Perugia (Italy),283 p.
18. Premulisilva , and Sliter , W. V., 1994, Cretaccous planktonic forminiferal biostratigraphy and evolutionary trends from the Bottacionc section, Gubbio, Italy: Palaenotographia Italica, v. 82, p. 1-89.
19. Robaszynsky, F. (coordinator)., 1998, Planktonic forminifera- Upper Cretaceous, Chart of Cretaceous Biochronostratigraphy, in de Graciansky, P.C., Hardenbol, J., and Vail, P. R. (eds.), Mesozoic and Cenozoic Sequence Stratigraphy of European Basins: Society For Sedimentary Geology (SEPM), Special Publication, no . 60, 782, p.
20. Robaszynski, and Caron, M. (coordinators), 1979, Atlas de Foraminifers planctoniques du Cretace moyen. Parts 1-2: Cahiers de Micropaleontologie, v. 1 and 2, p. 1-185, 1-181.
21. Robaszynski, and Caron, M.1995, Cretaceous planktonic forminifera: comments on the Europe- Mediterranean zonation: Bulletin de la Societe Geologique de France, v. 166, p. 681- 692.
22. Robaszynski, and Caron, M., Gonzales Donoso, J. M., and Wonders, A.A.H. (eds.) 1984, Atlas of Late Cretaceous Globotruncanids: Revue de Micropaleontologie, v. no. 3-4, p. 145- 305.
23. Rosales, I., Fernandez- Mendiola, P. A., and Garcia-Mondejar, J., 1994, Carbonate depositional sequence development on active fault blocks: the Albian in the Castro Urdiales area, northern Spain: Sedimentology, v. 41, p. 861-82.
24. Sari,B.2006.Upper Cretaceous planktonic foraminiferal biostratigraphy of the Beydaghlari autochthon in the Korkuteli area, westernTaurides,Turkey. Sari, B. 1999, Biostratigraphy of the Upper Cretaceous Sequences in the Korkuteli Area (Western Taurides): unpublished M. Sc. Thesis Dojuz Eylül University, Izmir, 162 p.
25. Sengor, A.M.C., Altiner, D., Cin, A., Ustomer, T, Hus, K.J., 1988. The origin and assembly of the Tethyside orogenic collage at the expense of Gondwana land. In:Audley- Charles, M.G.A. (Ed.), Hallam Gondwana and Tethys. Geological Society of London Special Publications 37, pp. 119-181.
26. Sengor, A.M.C., Kidd, W.S.F., 1979. Postcollisional tectonics of the Turkish- Iranian plateau and a comparison with Tibet. Tectonophysics 55, 361-376.
27. Sengor, A. M. C., and Yilmaz, Y., 1981, Tethyan evolution of Turkey: a plate tectonic approach: Technophysids, v. 75, p. 181-241.
28. Sigal, J., 1977. Essai de zonation du Crètacè Mèditerranèen á l'aide desforminifères planctoniques. Gèologie Mèditerranèenne 4, 99-108.

29. Sliter, W.V., 1989. Biostratigraphic zonation for Cretaceous planktonic foraminifers examined in thin section. Journal of Forminiferal Research 19, 1-19.

30. Sliter, W.V., 1992. Cretaceous planktonic forminiferal biostratigraphy and paleoceanographic events in the Pacific Ocean with emphasis on indurated sediment, In: Ishizaki, K., Saito. T. (Eds.). Centenary of Japanese Micropaleontology. Terra Scientific Publishing Company, Tokyo, pp. 281-299.

31. Sliter, 1999, Cretaceous planktonic forminiferal biostratigraphy of the Calera Limestone, Norhern California, USA: Journal of Foraminiferal Research, v. 29, no. 4, p. 318-339.

32. Soffel, H., Forster, H., 1980. Apparent polar wander path of Central Iran and its Geotectonic interpretation . Journal of Geomagnetism Geoelectricity 32 (suppl. III), 117-135.

33. Stocklin, J., 1968. Structural history and tectonics of Iran: A review American Association of Petroleum Geologists Bulletin 52, 1229-1258.

34. Stocklin, J., 1974. Possible ancient continental margin in Iran. In: Burk, C.A., Drake , C.L. (Eds.) The geology of continental margins. Springer Verlag, Berlin, pp. 873-887.

35. Stocklin, J., 1977. Structural correlation of the Alpine ranges between Iran and Central Asia.Memoire de la Sociètè gèologique de France hors sèrie 8, 333-353.

36. Stocklin, J., Eftekhar- nezhad, J., Hushmanzadeh.A., 1972.Central Lut reconnaissance, East Iran. Geological Survey of Iran 21, 1-62.

37. Wensink, H., Varekamp, J.C., 1980. Paleomagnetism of basalts from Alborz: Iran part of Asia in the Cretaceous. Tectonophysics 68, 113-129.

38. WHITE, M. P., 1928, Some index Forminifera of the Tampico embayment area of Mexico, part 2: Journal of Paleontology, v. 2, no. 4, p. 280- 313.

39. Hallam Gondwana and Tethys. Geological Society of London Special Publications 37, pp. 119-181.

40. Sengor, A.M.C., Kidd, W.S.F., 1979. Postcollisional tectonics of the Turkish- Iranian plateau and a comparison with Tibet. Tectonophysics 55, 361-376.

41. Sengor, A. M. C., and Yilmaz, Y., 1981, Tethyan evolution of Turkey: a plate tectonic approach: Technophysids, v. 75, p. 181-241.

42. Sigal, J., 1977. Essai de zonation du Crètacè Mèditerranèen á l'aide des forminifères planctoniques. Gèologie Mèditerranèenne 4, 99-108.

43. Sliter, W.V., 1989. Biostratigraphic zonation for Cretaceous planktonic foraminifers examined in thin section. Journal of Forminiferal Research 19, 1-19.

44. Sliter, W.V., 1992. Cretaceous planktonic forminiferal biostratigraphy and paleoceanographic events in the Pacific Ocean with emphasis on indurated sediment, In: Ishizaki, K., Saito. T. (Eds.). Centenary of Japanese Micropaleontology. Terra Scientific Publishing Company, Tokyo, pp. 281-299.

45. Sliter, 1999, Cretaceous planktonic forminiferal biostratigraphy of the Calera Limestone, Norhern California, USA: Journal of Foraminiferal Research, v. 29, no. 4, p. 318-339.

46. Soffel, H., Forster, H., 1980. Apparent polar wander path of Central Iran and its Geotectonic interpretation . Journal of Geomagnetism Geoelectricity 32 (suppl. III), 117-135.

47. Stocklin, J., 1968. Structural history and tectonics of Iran: A review American Association of Petroleum Geologists Bulletin 52, 1229-1258.

48. Stocklin, J., 1974. Possible ancient continental margin in Iran. In: Burk, C.A., Drake , C.L. (Eds.) The geology of continental margins. Springer Verlag, Berlin, pp. 873-887.

49. Stocklin, J., 1977. Structural correlation of the Alpine ranges between Iran and Central Asia. Memoire de la Sociètè gèologique de France hors sèrie 8, 333-353.

50. Stocklin, J., Eftekhar- nezhad, J., Hushmanzadeh. A., 1972. Central Lut reconnaissance, East Iran. Geological Survey of Iran 21, 1-62.

51. Wensink, H., Varekamp, J.C., 1980. Paleomagnetism of basalts from Alborz: Iran part of Asia in the Cretaceous. Tectonophysics 68, 113-129.

52. WHITE, M. P., 1928, Some index Forminifera of the Tampico embayment area of Mexico, part 2: Journal of Paleontology, v. 2, no. 4, p. 280- 313.

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