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BIOSTRATIGRAPHY AND FORAMINIFERAL BIOEVENTS OF THE ABDERAZ FORMATION (MIDDLE TURONIAN-LOWER CAMPANIAN) IN KOPEH-DAGH SEDIMENTARY BASIN, NORTHEASTERN IRAN

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ABSTRACT

In order to use the foraminiferal contents for biostratigraphy and age dating, chronostratigraphy and explanation of some evolutionary trends the well-known foraminifera rich Abderaz Formation of the Kopeh-Dagh basin in northeastern Iran was sampled at the type section. The 300 meters thick section is mainly made up of grey shales and marls with two units of chalky limestone in the upper part. The lower contact of the formation with Aitamir Formation is disconformable while the upper contact with Abtalkh Formation is continuous. Fifty nine species belonging to 18 genera were identified and four biozones identical to those established more recently for the Tethyan were erected and compared with the existing biozonation. The biozones are quite correlatable through with minor changes in the boundaries. Based on these, an age of middle Turonian-early Campanian is quoted to the formation. The *Neoflabellinids* can be used to mark the Coniacian-Santonian boundary. Neoflabellinids has world-widely been distributed during the Coniacian-Santonian time. Four species of *Neoflabellina* including *N.suturalis, N.praerugosa, N.gibbera, N.praecursor* were identified. The *N.gibbera* and N.praecursor appear at the very base of the Santonian stage differentiating therefore, the Coniacian-Santonian boundary. The findings of this study is quite correlatable with those from the Global Standard Stratotype Section and point (GSSP).

Key words: Abderaz Formation, Upper Cretaceous, Foraminifera Biozonation, *Neoflabellina*, Tethyan, Kopeh-Dagh basin.

INTRODUCTION

The Kopeh Dagh sedimentary basin formed after the Middle Triassic orogeny in north-east Iran. The basin started to sink along the major faults aligned approximately NW–SE. Four of these major active basement faults have been recognized in the central and western part of the basin. The block to the north of these basement faults subsided more rapidly than those on the southern side (Afshar-Harab, 1979; Berberian & King, 1981). Sedimentation was more or less continuous throughout Middle Jurassic–Oligocene in the eastern part of the basin, where five major transgressive-regressive sequences have been identified (Afshar-Harb, 1979, 1982). Moussavi-Harami & Brenner (1992) concluded that subsidence in the eastern part of the basin was predominantly a result of sediment loading. There is no evidence of major tectonic activity in this region; all formations are conformable, except for a few disconformities within the Cretaceous succession.

These can be related to epeirogenic movements in the basin. All formations thin out from north-west to the south-east. They were folded during the Late Alpine Orogeny and formed the structural traps of the Khangiran and Gonbadli gas fields. The Cretaceous sediments in the Kopet Dagh Basin are divided into nine different formations (Fig.1), composed mainly of sandstones, conglomerates, mudstones, limestones and dolomites with minor amounts of evaporites. The thickness of these sediments is normally more than 4000 m, but only about 2500 m in the eastern part of the basin. Mohajer (1976) and Afshar-Harb (1979) believed that the reduction in sediment thickness confirms that the Sarakhs area was more stable than other areas in the basin. The aims of the present study are:

1- Systematic study of planktonic foraminifera in isolated form for biozonation and precise age dating of the Abderaz Formation in Kopeh-Dagh basin, northeastern, Iran.
2- Determination of Coniacian-Santonian boundary by using benthic foraminifer group Neoflabellinids.

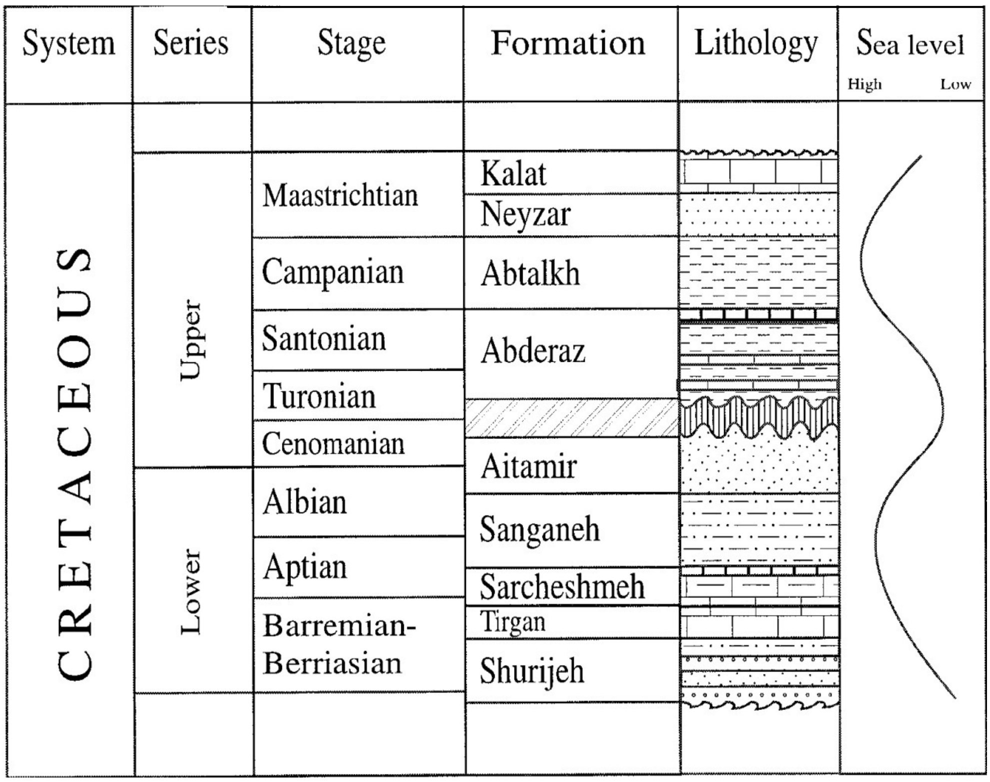


Fig. 1: General stratigraphical column of the Cretaceous of the Kopet Dagh Basin (modified from Kalantari, 1987, and Immel et al., 1997).

Geological settings and lithostratigraphy

The Abderaz Formation is one of the Upper Cretaceous rock units in the Kopeh-Dagh sedimentary basin in northeastern Iran. This basin stretches hundreds of killometers from north to northeast Iran and into Qazaqistan and Afghanistan. The type section of the formation with a thickness of 300m (E: 60^{o} $33^{/}$ $00^{//}$ N: 36^{0}, $10^{/}$ $40^{//}$) is located on the Mashhad-Sarakhs road, some 90 km to the east of Mashhad (Fig.2) and contains 11 lithological units mainly made up of light grey shales bearing *Inoceramus* and ammonites. At the type section alike all other regions the lower contact of the formation with Aitamir Formation is disconformable, but the upper contact with Abtalkh Formation is continuous.

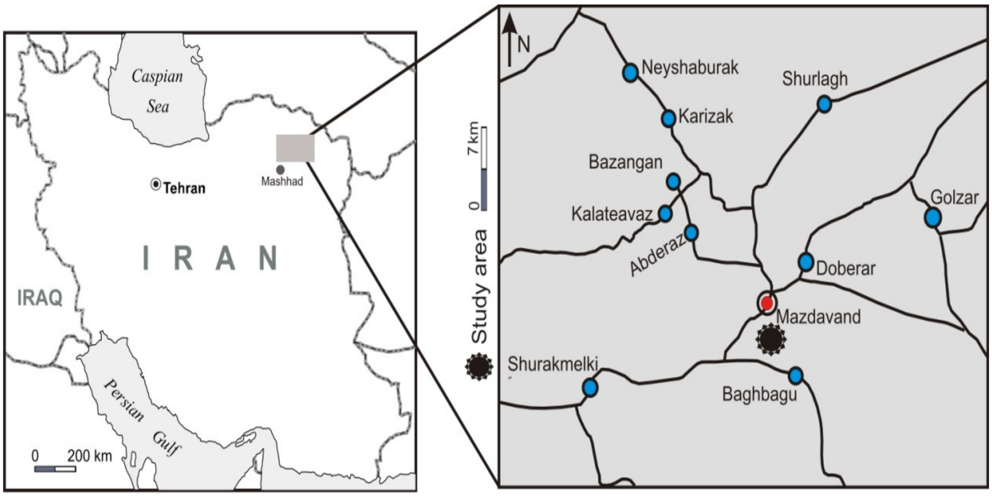


Fig.2. Location map of the studied area.

MATERIAL AND METHODS

One hundred and thirty rock samples were collected and prepared for foraminiferal studies. Of these, one hundred and thirty samples gathered only 102 samples were included in this study. Twenty one samples were excluded, due to the evidences indicating reworking and seven more due to the dissolving. Depending on their lithology, the samples were washed in two methods. The shale and marl samples were put in H_2O_2 10% for a day after being crushed into small pieces. The residue was then washed with water on the screeners assigned with 125 and 63µm meshes (Zepeda 1998). Chalky limestone were grid and boiled in Na_2SO_4 solution then washed with water on the screeners assigned with the above mentioned meshes (Peryt and Lamolda 2002). Fifty nine species of planktonic foraminifera belonging to 18 genera were identified. The well-preserved forms were photographed using SEM model VEGA TESCAN. A sum of 126 SEM images were also obtained and presented here in three plates. The specimens are housed at the Museum of the Geology Department of the Ferdowsi University of Mashhad, Iran.

BIOSTRATIGRAPHY

Planktonic foraminiferal assemblages from the studied sequence are abundant and diverse. Based on the indice species recorded four biozones were differentiated indicating an age of Middle Turonian-Early Campanian for the Abderaz Formation. The established biozones for the studied interval are shown to be comparable and correlatable with those previously erected for Tethyan realm [Table 1. (Wonders1980; Caron1985; Sliter1989; Robaszynski and Caron1995; Premoli Silva and Verga, 2004].

Table 1: Comparison of the erected biozones in this study with those of other parts of Tethys.

<table>
<tr><th>Age</th><th>Wonders (1980)</th><th>Caron (1985)</th><th>Sliter (1989)</th><th>Robaszynski & Caron (1995)</th><th>Premoli Silva & Verga (2004)</th><th>This study</th></tr>
<tr><td>M.y</td><td>Tethys</td><td>Tethys</td><td>Tethys</td><td>Tethys</td><td>Tethys</td><td>Muzduran</td></tr>
<tr><td rowspan="2">Campanian 83/5±0/5 M.a</td><td></td><td rowspan="2"></td><td rowspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>G. elevata</td><td rowspan="2">Dicarinella asymetrica</td><td rowspan="2">Dicarinella asymetrica</td><td rowspan="2">Dicarinella asymetrica</td></tr>
<tr><td rowspan="3">Santonian
85/8±0/5 M.a</td><td></td><td rowspan="2">Dicarinella asymetrica</td><td rowspan="2">Dicarinella asymetrica</td></tr>
<tr><td>carinata</td><td rowspan="6">Dicarinella concavata</td><td rowspan="5">Dicarinella concavata</td><td rowspan="5">Dicarinella concavata</td></tr>
<tr><td>Dicarinella concavata</td><td rowspan="2">Dicarinella concavata</td><td rowspan="2">Dicarinella concavata</td></tr>
<tr><td rowspan="2">Coniacian
89±0/5M.a</td><td>Dicarinella primitiva</td></tr>
<tr><td></td><td>Dicarinella primitiva</td><td rowspan="6">Marginotruncana sigali</td></tr>
<tr><td rowspan="5">Middel Turonian</td><td>M. sigali</td><td>Marginotruncana sigali</td></tr>
<tr><td rowspan="4">Helvetoglobotruncana helvetica</td><td rowspan="4">Helvetoglobotruncana helvetica</td><td rowspan="3">Marginotruncana sigali-Dicarinella primitiva</td><td rowspan="3">Marginotruncana sigali-Dicarinella primitiva</td></tr>
<tr><td>Marginotruncana schneegansi</td></tr>
<tr><td rowspan="2">Helvetoglobotruncana helvetica</td></tr>
<tr><td>H.helvetica</td><td>H.helvetica</td></tr>
</table>

1-*Helvetoglobotruncana helvetica* Total Range Zone of Sigal (1955)

Definition: Total range of the index species *Helvetoglobotruncana helvetica.*

Associations: Some of the accompanied species recorded are as follows: *Archaeoglobigerina blowi* Pessagno 1967*, A. cretacea* (d'Orbigny)*, Dicarinella algeriana* (Caron)*, D. hagni* (Scheibnerova), *D. imbericata* (Monrod)*, Globigerinelloides ultramicra* (Subbotina)*, Guembeliteria cretacea,* Cushman *Helvetoglobotruncana helvetica* (Bolli), *Heterohelix globolusa* (Ehrenberg), *H. moremani* (Cushman)*, Hedbergella delrioensis* (Carsey)*, H. planispira* (Tappan), *Marginotruncana renzi* (Gandolfi*), M. sinuosa* Porthault, *M. schneegansi* (Sigal)*, M. sigali* (Reichel)*, Praeglobotruncana delrioensis* (Plummer)*, P. stephani* (Gandolfi), *Schackoina multispinata*, Cushman *Ventilaberella eggeri* Cushman, *Whiteinella aprica* (Loeblich & Tappan), *W. baltica* Douglas & Rankin, *W. praehelvetica* Trujillo*, W. paradubia* (Sigal).

Remarks: Some authors (e.g. Keller et al 2004 and Keller and Pardo, 2004 believed that the species *Helvetoglobotruncana helvetica* is diachoronous. So the precise age of this species is questionable. However, this zone was introduced from Atlantic realm (McNulty, 1976; Premoli-Silva and Sliter 1981) and W. Tethys (Wonders, 1979, 1980) and central Tethys (Fleury, 1980; Sigal, 1977) and Pacific realm (Gradstein et al*,* 1978; Pessagno and longorria ,1973a ,b) from the Middel Turonian.

Thickness: 65m of light grey marls and grey shales from the base of the formation.

Estimated age: Middle Turonian.

***2-Marginotruncana sigali-Dicarinella primitiva* Partial Range Zone of Premoli-Silva & Sliter (1999)**

Definition: Biostartigraphic interval from the LA of *Helvetoglobotruncana helvetica* to the BA of *Dicarinella concavata* (Premoli-Silva and Verga 2004).

Associations: Accompanied species recorded are: *Dicarinella canaliculata* (Reuss), *D. hagni* (Scheibnerova) *D. primitiva* (Dalbiez), *Globigerinelloides* sp*, G. ultramicra* (Subbotina), *Hedbergella delrioensis* (Carsey), *H. flandrini* (Porthault), *H. planspira* (Tappan), *Heterohelix globolusa* (Ehrenberg), *Marginotruncana marginata* (Reuss), *M. praconcavata* Porthault*, M. pseudolinneiana* Pessagno*, M. renzi* (Gandolfi), *M. sigali* (Reichel), *M. schneegansi* (Sigal), *M. undulata* (Lehmann), *Praeglobotruncana gibba* Klaus *,P. stephani* (Gandolfi), *Schackoina multispinata,* Cushman*, Ventilabrella eggeri* (Cushman), *Whiteinella aprica* (Loeblich & Tappan), *W. brittonensis* (Loeblich & Tappan), *W. baltica* Douglas & Rankin*, W. paradubia* (Sigal).

Remarks: This zone was reported from many places such as: Atlantic realm (Mc Nnulty, 1976; Premoli-Silva and Sliter1981), W. Tethys (Wonders, 1979, 1980) , C. Tethys (Fleury, 1980; Sigal, 1977) , E. Tethys (Gorbachik, 1971a,b; Maslakova, 1971) Pacific realm (Gradstein et al*,* 1978; Pessagno and longorria , 1973a , b) where it has been given the same age.

Thickness: This zone is represented by 37m of light grey shales and yellow grey marls (Fig.2).

Estimated age: Late Middle to Late Turonian.

3- Dicarinella concavata Interval Zone of Sigal, 1955

Definition: Biostratigraphic interval from the FA of *Dicarinella concavata* to the FA of *Dicarinella asymetrica* (Caron, 1985).

Associations: The following index species are recorded: *Archeoglobigerina bousquensis* Pessagno, *A. cretacea* (d'Orbigny), *Dicarinella canaliculata* (Reuss), *D. concavata* (Brotzen), *D. hagni* (Scheibnerova), *D. primitiva* (Dalbiez), *Globigerinelloides caseyi* (Bolli, Loeblich & Tappan), *Guembelitera cretacea*, Cushman, *Hedbergella delrioensis* (Carsey), *H. flandrini* (Porthault), *H. planispira* (Tappan), *H. simplex* (Morrow), *Heterohelix globolusa* (Ehrenberg), *Marginotruncana marginata* (Reuss), *M. praconcavata* Porthault, *M. renzi* (Gandolfi), *M. sigali* (Reichel), *M. schneegansi* (Sigal), *M. sinuosa* porthault, *Praeglobotruncana gibba* Klaus, *P. stephani* (Gandolfi), *Ventilabrella eggeri* Cushman, *Whiteinella archeocretacea* Pessagno, *W. baltica* Douglas & Rankin, *W. brittonensis* (Loeblich & Tappan), *W. aumalensis* (Sigal), *W. paradubia* (Sigal).

Remarks: This zone was introduced by Sigal in 1955, who indicated an age of Late Coniacian- Early Santonian for this zone. But some other authors such as Premoli-Silva and Verga (2004) quoted an age of Late Turonian to Early Santonian for this zone. It has been introduced from Atlantic realm (McNnulty, 1976; Premoli-Silva and Sliter 1981) , W. Tethys (Wonders, 1979, 1980) , C. Tethys (Fleury, 1980, Sigal, 1977) and Pacific realm (Gradstein et al, 1978; Pessagno and Longorria ,1973a ,b).

Thickness: This zone is 55m thick. and contains green grey to yellow grey marl.

Estimated age: Late Turonian- Early Santonian.

4-Dicarinella asymetrica Total Range Zone of Postuma, 1971

Definition: Biostratigraphic interval characterized by the total range of the nominate taxon *Dicarinella asymetrica.*

Associations: The accompanied species recorded in this zone are as follows:
Archeoglobigerina bosquensis Pessagno, *A. cretacea* (d'Orbigny), *Contusotruncana fornicata* (Plummer) , *C. pateliformis* (Gandolfi), *Dicarinella asymetrica* (Sigal), *D. canaliculata* (Reuss), *D. concavata* (Brotzen), *D. hagni* (Scheibnerova), *Globigerinelloides alvarezi* (Eternod olvera), *G. bolli* (Pessagno), *G. escheri, G. prarihellensis* (Pessagno), *Globotruncana arca* (Cushman), *G. bulloides* Vogler, *G. linneiana* (d'Orbigny), *Globotruncanita elevata* (Brotzen), *Guembelietria cretacea*, Cushman *Hedbergella flandrini* (Porthault), *H. holmdelensis* (Olsson), *H. simplex* (Morrow), *Heterohelix globolusa* (Ehrenberg), *H. carinata* Cushman, *Leaviheterohelix pulchera* (Brotzen) ,*Marginotruncana coronata* (Bolli), *M. marginata* (Reuss), *M .pseudolinneiana*

Pessagno*,* *M. praconcavata* Porthault, *M. renzi* (Gandolfi)*, M. schneegnasi* (Sigal), *M. sigali* (Reichel), *Pseudoguembelina costelifera* Masters, *Pseudotextularia nuttalli* (Voorwijk)*, Praeglobotruncana gibba* Klaus, *P. Stephani* (Gandolfi)*, Schackoina multispinata,* Cushman*, Rugoglobigerina rugosa* (Plummer).

Remarks: This zone was introducted for the first time by Postuma 1971 who gave it an age of Early Santonian- Late Santonian. However recent studies showed that the zone has an age of Santonian- Early Campanian(Robaszynski and Caron, 1995; Premoli-Silva and Sliter, 1995;Petrizzo, 2001; Premoli-Silva and Verga, 2004) .

This zone is 144m thick and contains grey marls and chalky limestone. All Marginotruncanids disappear at the top of this zone and none were observed in the overling Abtalkh Formation. This zone was introduced from Atlantic realm (McNnulty, 1976; Premoli-silva and Sliter1981), W. Tethys (Wonders, 1979, 1980), C. Tethys (Fleury, 1980; Sigal, 1977), pacific realm (Gradstein et al*,* 1978; Pessagno and Longoria, 1973a, b) Caribbean (Grandstein, 1978) with an age of Santonian- Early Campanian.

Thickness: this zone encompasses a thickness of 144m.

Estimated age: Early Santonian-Early Campanian.

Coniacian-Santonian boundary:

The Coniacian/Santonian boundary is traditionally placed at the first appearance of the inoceramid species *Platyceramus undulatoplicatus* (Roemer) (Kannenberg, 1985; Lamolda and Hancock, 1996) which falls within the lower part of the *D. asymetrica* Zone in the studied section (Fig. 3). *Platyceramus undulatoplicatus* (Roemer) is the index species for the Coniacian-Santonian boundary following the criterion suggested for the definition of the Coniacian-Santonian boundary by the Santonian working group (Lamolda & Hancock, 1996). Using the calcareous nannofossils the Coniacian/Santonian boundary falls between the FO of *Reinhardtites anthophorus* and the FO of *Lucianorhabdus cayeuxii* (Perch Nielsen, 1985). According to the international commission on stratigraphy website the candidates for the Global Standard Stratotype Section and Point (GSSP) for the Coniacian/Santonian boundary are Olazagutia (Spain) and Ten-Mile Creek (Texas) (Lamolda and Hancock, 1996; Blair and Watkins, 2009). In the study section applying biostratigraphy based on globotruncanids proposed by Permoli-Silva and Verga (2004) the section comprises an interval of 53m thick which encompasses the upper most Coniacian-Lower Santonian strata represented by the upper part of the *Dicarinella concavata* (sigal) and lower part of the *Dicarinella asymetrica* (Postuma) zones (Fig. 3).

Neoflabellinids bioevent:

Benthic foraminifers are very common in Upper Cretaceous marine sediments. The evolution during the Late Cretaceous of *Gavelinella*, *Stensioeina*, *Bolivinoides* and *Neoflabellina* is of great value for biostratigraphic purposes. They have been used for subdivision of the Upper Cretaceous and for inter-regional correlation (e.g. Koch, 1977; Hart et al., 1989; King et al., 1989). The Neoflabellinid bio-events in the Coniacian/ Santonian boundary interval in Abderaz Formation at type section are as follows:

Neoflabellinids are rare components of the benthic foraminifer's assemblages. The genus *Neoflabellina* Bartenstein ,1948, is a benthic foraminifer with a large test, up to 5 mm in length and 1.8 mm in breadth, palmate to rhomboid in outline, flattened, with subparallel sides and truncate margins; early chambers are planispirally coiled, later chambers are uniserial and rectilinear, chevronlike, with plate-like, raised sutures and aperture terminal (Loeblich and Tappan, 1987). It is stratigraphically distributed from Upper Turonian to Paleocene and has a wide geographical distribution, recorded mostly in outer shelf upper bathyal deposits (e.g. Peryt and Lamolda, 2007; Peryt et al., 2003; Speijer, 1994; Youssef, 2003; Youssef, 2004). *Neoflabellina* had been interpreted as an infaunal form and resistant to low oxygen concentrations also preferring meso- to eutrophic paleoenvironments (cf. Jorissen et al., 1995). During Late Cretaceous times the species of *Neoflabellina* have been used for subdivision of the upper part of the Upper Cretaceous (e.g. Salaj and Samuel, 1966; Koch, 1977; Salaj, 1980). The most common species of *Neoflabellina* at the Coniacian/Santonian boundary interval are *Neoflabellina suturalis, N. praerugosa, N. gibbera, and N. praecursor.* These species was recorded from the Coniacian/Santonian boundary interval of Europe (Germany) and North Africa (Tunisia, Egypt) (e.g. Hiltermann, 1952; Salaj and Samuel, 1966; Salaj and Samuel, 1966; Ohmert, 1969; Koch, 1977; Salaj, 1980; Koch, 1977; Luning et al, 1998).

In the present study the Neoflabellinides are represented by *N.suturalis, N. praerugosa, N. gibbera, N. praecursor* and some unidentified forms. The first occurrences of *N. gibbera, N. praecursor* are significant proxies for the Coniacian/Santonian boundary. In the lowermost part of the *Dicarinella concavata* Zone *Neoflabellina* is not recorded, probably owing to rarity of this genus in the sediments (Fig. 3). *N. suturalis* and *N. praerugosa* appear first and are present in both the Upper Coniacian and Lower Santonian. In the topmost Coniacian, about 2.94 m below the Coniacian/ Santonian boundary, *N. gibbera* occurs for the first time and is recorded in the following 4 meters higher in the section, in the basal part of Santonian followed by the first appearance of *N. praecursor*. Indeterminate Neoflabellinids are present in most of samples in which *Neoflabellina* is recorded (Fig. 4).

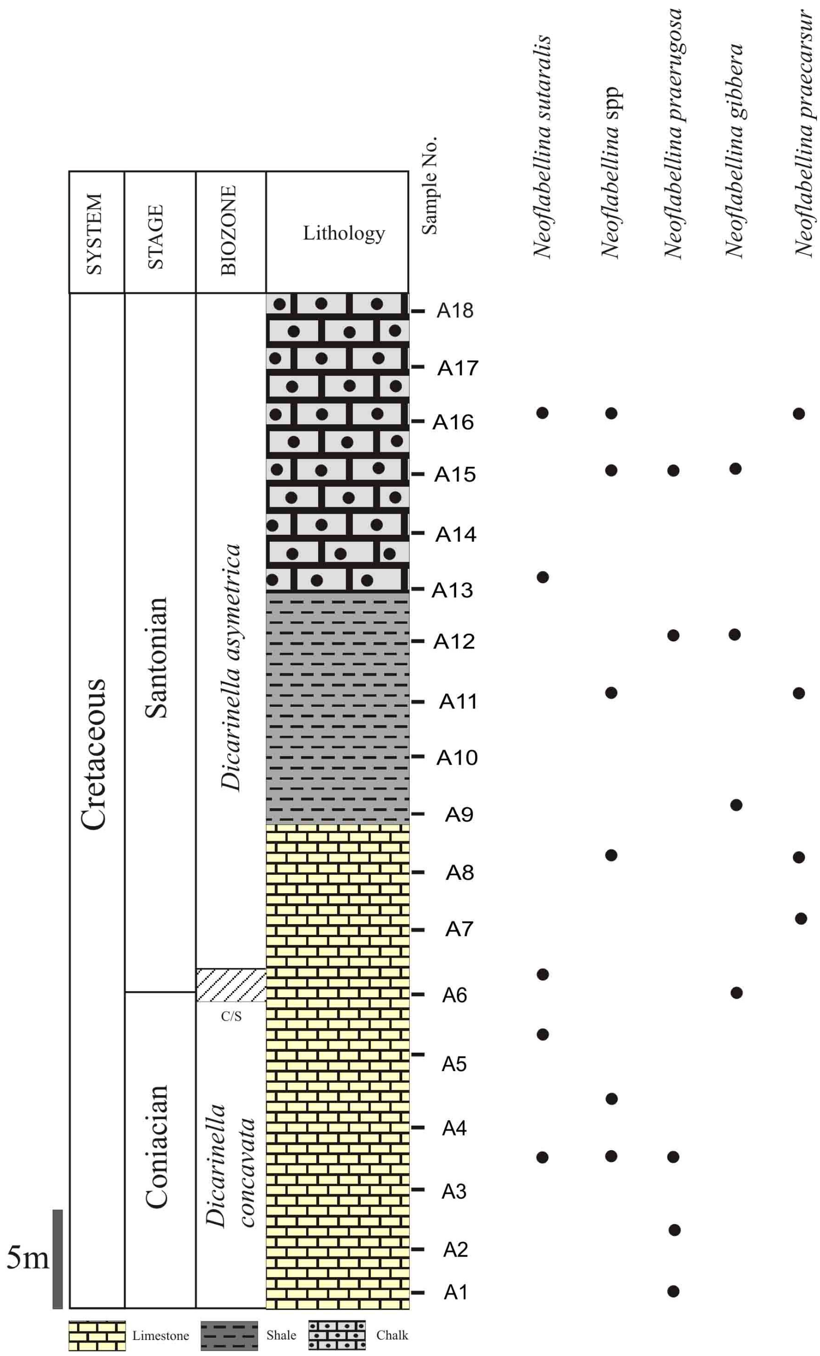
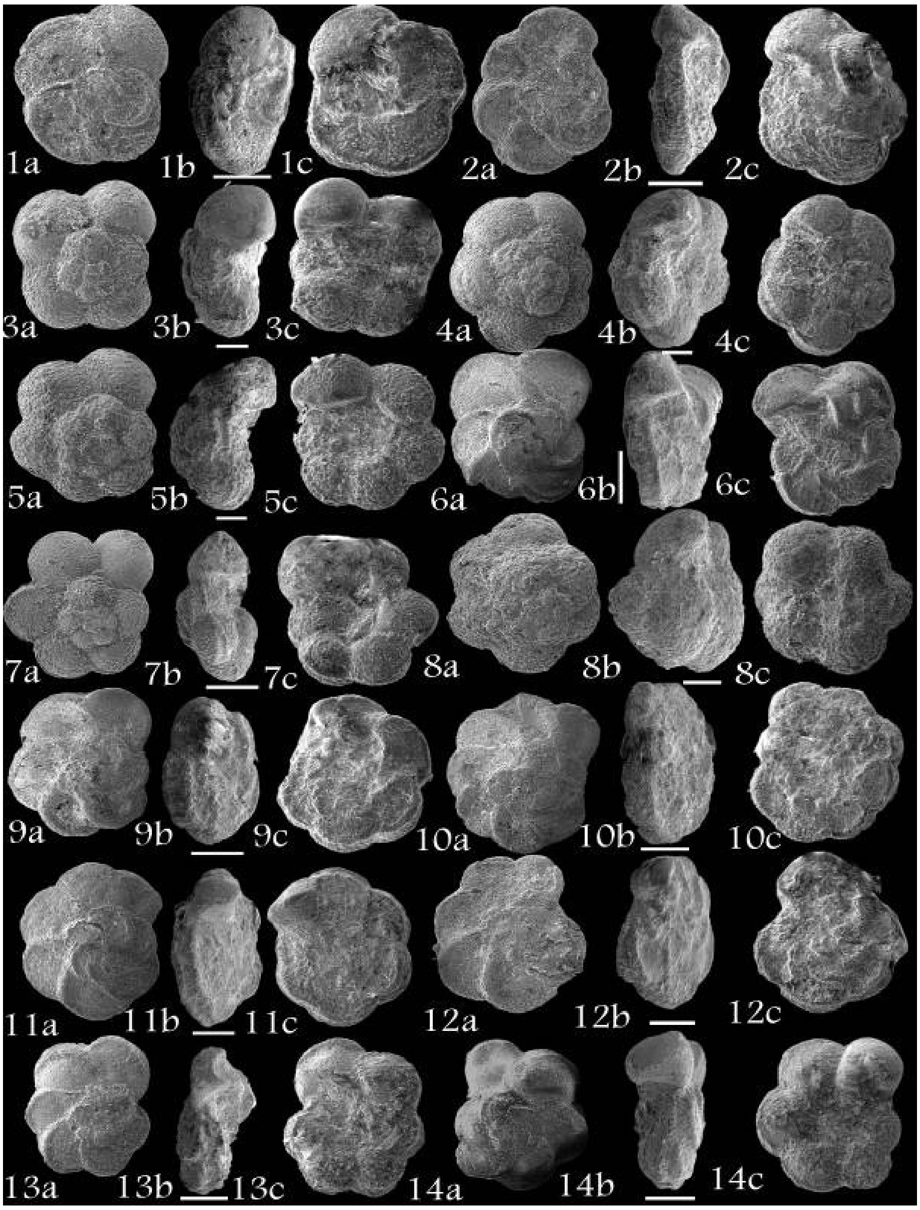


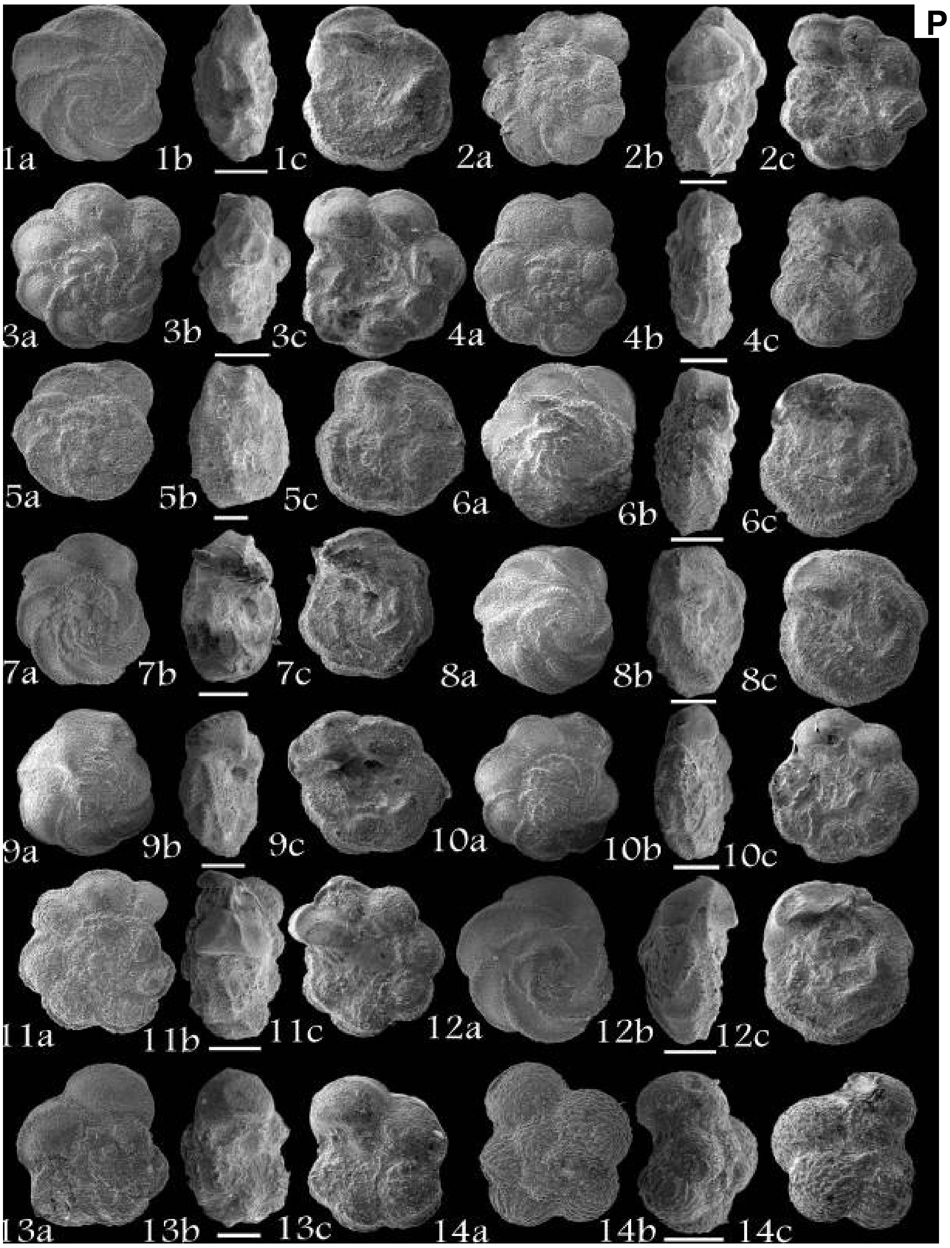
Fig. 3. Range chart of the recorded *Neoflabellina* species. C/S=Coniacian/Santonian boundary differentiated by using Neoflabellinids.

Pl-1



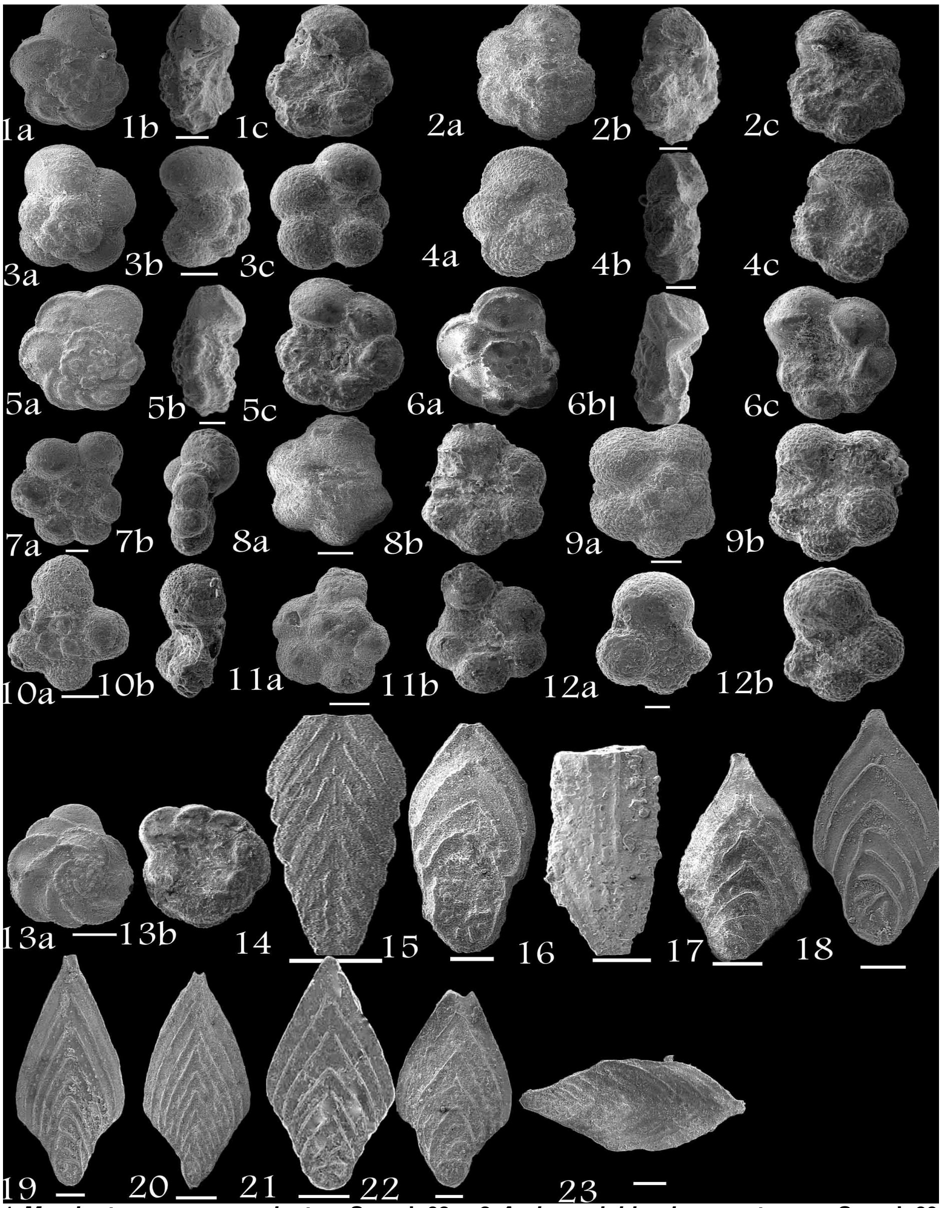
1-*Dicarinella canaliculata*, Sample13. 2-*Dicarinella concavata*, Sample36. 3-*Whiteinella baltica*, Sample2. 4-*Praeglobotruncana* cf *stephani*, Sample4. 5-*Whiteinella brittonensis*, Sample2. 6-*Marginotruncana pseudolinneiana*, Sample5. 7-*Praeglobotruncana* cf *stephani*, Sample22. 8-*Archaeoglobigerina bosquensis*, Sample42. 9- *Marginotruncana pseudolinneiana*, Sample11. 10-*Marginotruncana coronata*, Sample31. 11-*Dicarinella hagni*, Sample7. 12,13- *Marginotruncana pseudolinneiana*, Sample25,39. 14-*Dicarinella imbericata*, Sample23. Scale bar represents 200µm except for Samples3,4,5,8 which represents 100µm.

Pl-2



1-*Marginotruncana sinuosa*, Sample21. 2,3,4-*Globotruncana bulloides*, Samples55,56. 5-*Dicarinella canaliculata*, Sample51. 6,7-*Marginotruncana pseudolinneiana*, Samples48,52. 8-*Marginotruncana coronata*, Sample53. 9-*Dicarinella imbericata*, Sample38. 10-*Marginotruncana marginata*, Sample54. 11- *Globotruncana bulloides*, Sample69. 12-*Marginotruncana sinuosa*, Sample53. 13- *Marginotruncana marginata*, Sample59. 14-*Rugoglobigerina rugosa*, Sample60. Scale bar represents 200µm except for Samples 5,6,13,14 which represents 100µm.

Pl-3



1-*Marginotruncana marginata*, Sample68. 2-*Archaeoglobigerina cretacea*, Sample69. 3-*Archaeoglobigerina bosquensis*, Sample69. 4-*Dicarinella canaliculata*, Sample58. 5,6-*Marginotruncana marginata*, Samples71,74. 7-*Hedbergella planspira*, Sample6. 8-*Dicarinella* sp, Sample10. 9-*Whiteinella aprica*, Sample6. 10-*Hedbergella flandrini*, Sample36. 11-*Hedbergella planispira*, Sample22. 12-*Whiteinella baltica*, Sample21. 13-*Marginotruncana coronata*, Sample26. 14-,*Neoflabellina praecursor*, Sample9. 15-,*Neoflabellina gibbera*, Sample7. 16-*Neoflabellina* sp, Sample6. 17-*Neoflabellina praerugosa*, Sample3. 18-, *Neoflabellina praerugosa*, Sample4. 19-,*Neoflabellina praecursor,* Sample13. 20-*Neoflabellina praerugosa*, Sample5. 21- *Neoflabellina praecursor*, Sample9 22-, *Neoflabellina suturalis*, Sample7. 23-*Neoflabellina gibbera*, Sample17.. Scale bar represents 200µm except for Samples1,2,3,4,6,9,10,12which represents 100µm and Samples7,14,16,21,25 which represents 500µm.

CONCLUSION

Planktonic foraminiferal contents of the Abderaz Formation in Kopeh-Dagh sedimentary basin of northeastern iran lead to identification of 59 species belonging to 18 genera. Based on these four biozones identical to those erected by Permoli-Silva & Verga (2004) for the Tethyan and correlatable with those established by Robaszynski & Caron (1995), Sliter (1989), Caron (1985) and Wonders (1980) with only minor modifications in their boundaries were differentiated. These include: *Helvetoglobotruncana helvetica* Zone of Sigal 1955, *Marginotruncana sigali-Dicarinella primitiva* Zone of Premoli Silva and Sliter 1999, *Dicarinella concavata* Zone of Sial, 1955, *Dicarinella asymetrica* Zone of Postuma, 1971 . These zones span Middle Turonian-Early Campanian sediments. A sedimentation gap encompassing Late Cenomanian- Middle Turonian was also recorded. *Helvetoglobotruncana helvetica*, the index species for Middle Turonian, was recorded at the base of the Abderaz Formation while, *Rotalipora appenninica*, the index species for the Middle Cenomanian was recorded in a sample taken from layers immediately below the base of the formation belonging to the Aitamir Formation. Therefore, lack of the index species for Late Cenomanian- Early Turonian shows a gap spanning this period between the Aitamir and Abderaz formations. The presence of such planktonic foraminifera *Contusotruncana pateliformis*, *Rugoglobigerina rugosa,Globotruncanita elevata* are in accordance Early Campanian age for the top of the Abderaz Formation. At the cross link of the Abderaz Formation to the overlying Abtalkh Formation all Marginotruncanids have been disappeared and replaced with Globotruncanids. This study shows that also benthic Neoflabellinids could indicate Coniacian- Santonian boundary. Hence the appearance of *Neoflabellina gibbera,* and *Neoflabellina praecursor* mark the beginning of the Santonian stage. The appearance of these two species is simultaneous with that of inoceramid *Platyceramus undulate- plicatus* which is an index for the Coniacian- Santonian boundary.

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