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Study of main planktonic foraminifera(Turonian-Santonian) in Kopeh-Dagh sedimentary environment, NE Iran

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ABSTRACT

In order to study the fossil contents of the Abderaz Formation for biostratigraphical purposes the 500 meters thick section was sampled at type section. The sequence is mainly made up of grey shales and marls with two units of chalky limestone in upper part. The lower contact of the formation with Aitamir Formation is disconform while the upper contact with Abtalkh is continuous. Fifty six species belonging to 16 genera were identified and four biozones were differentiated. These are: *Helvetoglobotruncana helvetica* (Sigal) total range Zone, 2- *Marginotruncana sigali - Dicarinella primitiva* (Premoli Silva and Sliter) Partial range Zone, 3- *Dicarinella concavata* (Sigal) interval Zone and 4-*Dicarinella asymetrica* (Postuma) total range Zone. Based on, these an age of Turonian-Late Santonian is quoted to the formation. Also it was shown that *Helvetoglobotruncana helvetica*, the index species for middle Turonian exists at the base of the formation while, in the samples immediately below this belonging to Aitamir Formation *Rotalipora appenninica*, the index for middel cenomanian was recorded. Therefore, lack of index species for late Cenomanian- early Turonian shows a gap spanning this period between the Aitamir and Abderaz formations. This could be a result of sub Hersinian orogeny.

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1. Introduction

The systematic study of foraminifera in isolated form in order to exact and precise age determining of the Abderaz Formation (Mashhad, Iran) was major aim of the research. 130 samples were selected, prepared and then studied respectively.

2. Material and Methods

2.1. Geography and study area

Type section of Abderaz Formation has 500m thickness (E: 60^0, 33, 00, N: 36^0, 10, 40) NE Mashhad (a city of Iran), placed in Mashhad-sarakhs road far about 1 km to the Muzduran (Figure 1).

2.1.1. Stratigraphy of the study area

Abderaz Formation is one of the upper cretaceous formations at the Eestern-North of Iran. This formation at the typical gap has 500 meters thickness and contains 11 lithological units (Figure 2). At the typical gap such as all regions under the surface sub-contact of Abderaz Formation are un-correlated with Aitamir Formation. But its upper layer with Abtalkh Formation is in continuous correlation. The upper layer has elected as chalk limestone upper border. The sub-border of the formation is the common border of silvery shale with olive shale of Aitamir Formation. This boundary is at good health distinguishable in the air plan images. This formation due to shale and marls lithology,the drainage outline at the formation has formed as dendrites and badland formations has observed into it frequently.

The main thickness of formation is composed from light grey shale at the typical gap that at the old surface is composed from the white grey. There are huge amounts of inoceramids and ammonite. In the chalk limestone bonds of this formation planktonic foraminifera with a lot of frequency and less diversity are exist.

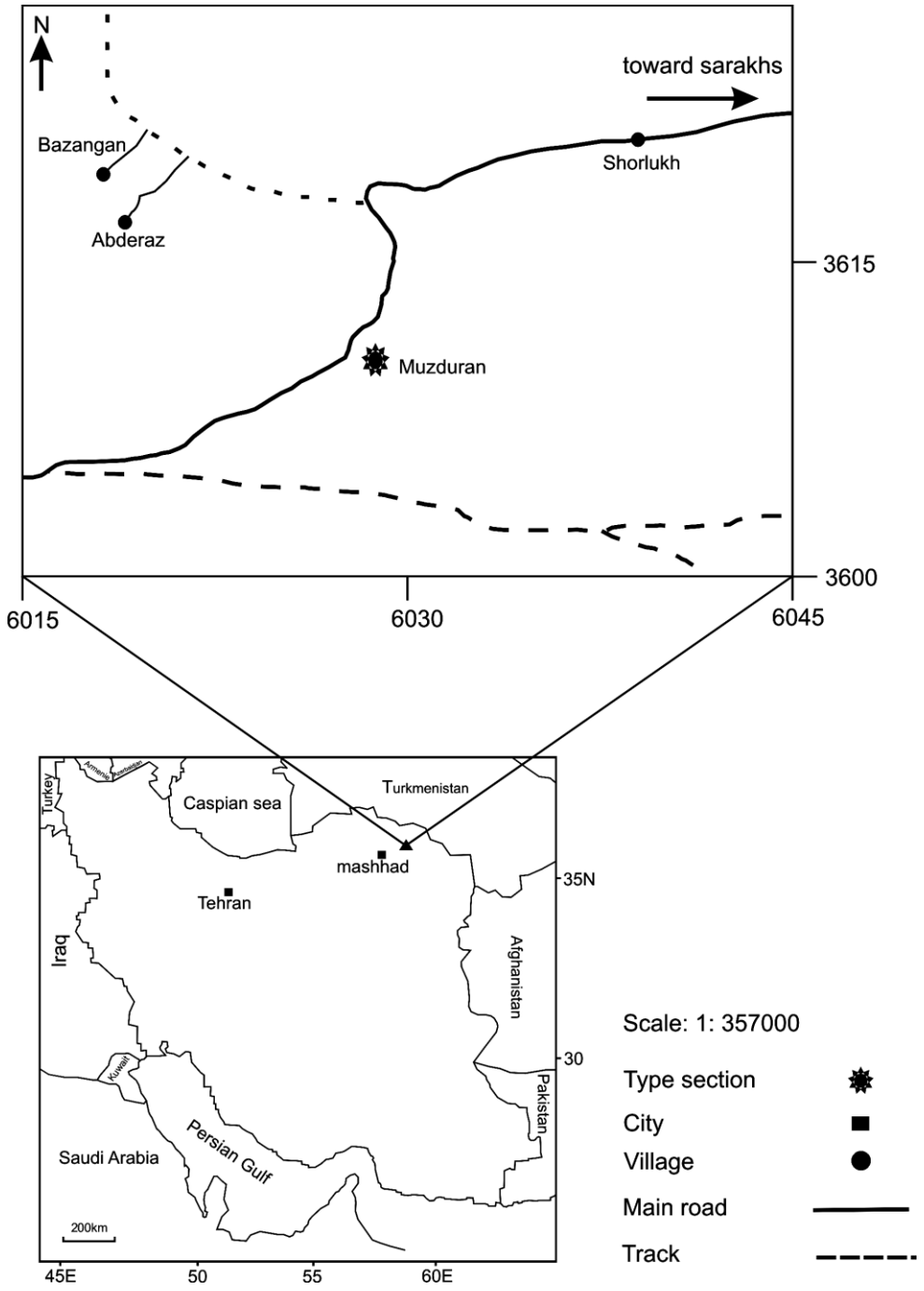

Fig. 1. The geographical map and the ways to the region of the study

2.2. Method

One hundred thirty samples in systematic from were gathered from the typical gap of Abderaz Formation with 500 m thickness. Only 102 samples were incluced in study 7 samples due to the existence of salvation effects and 21 samples resulting from reworking damages were excluded from the study. Hence at the demonstrated stratigraphic column from the region of study the mean of the samples 2/94m was reported. Depending on the kind of lithology the samples were subjected for washing employing two methods:

1- Shale and marls samples:
These samples were grid fully and then were included in the H_2O_2 10% daily, then with washing by water on the screeners assigned with meshes125 and 63µm (Zepeda, 1998).
2- Chalk limestone samples:
In this case the samples were also grid and the boiled in the Na_2So_4 solution and then washed with water on the screeners assigned with the above mentioned meshes (Peryt and Lamolda, 2002).

3. Results and discussion

In the study 56 species in frame of 16 genera from foraminifera based on the references were elucidated (Bolli, 1957; Postuma, 1971; Robaszynski & Caron, 1979; 1995; Premoli Silva & Sliter, 1995; Loeblich & Tappan, 1998; Ellis & Messina, 1999; Premolisilva & Verga, 2004). Planktonic fossils samples index is also exist cell A300-085m in Laboratory number 7 of Ferdowsi University of Mashhad. According to the assemblage planktonic foraminifera in Abderaz Formation distinguished 4 biozones were demonstrated which they show Early-Middle Turonian-Late Santonian for this formation.
1-*Helvetoglobotruncana helvetica* Zone
Category: Total range Zone
Age: Early-Middle Turonian
Author: Sigal (1955)
This biozone in belong to total range zone (taxon range zone) and contains all thickness of sediments with the presence of *Helvetoglobotruncana helvetica*. Some of the famous fossils of this zone are explained as following:
Dicarinella algeriana (Caron), *Dicarinella hagni* (Scheibnerova), *Dicarinella imbricata* (Monrod), *Globigerinelloides ultramicra* (Subbotina), *Helvetoglobotruncana helvetica*(Bolli), *Heterohelix globolusa* (Ehrenberg), *Heterohelix moremani* (Cushman), *Hedbergella delrioensis* (Carsey), *Hedbergella planispira* (Tappan), *Marginotruncana renzi* (Gandolfi), *Marginotruncana sinuosa* Porthault, *Marginotruncana schneegansi* (Sigal), *Marginotruncana sigali* (Reichel), *Praeglobotruncana delrioensis* (Plummer), *Praeglobotruncana stephani* (Gandolfi), *Ventilaberella eggeri* Cushman, *Whiteinella aprica* (Loeblich & Tappan), *Whiteinella baltica* Douglas & Rankin, *Whiteinella praehelvetica* Trujillo, *Whiteinella paradubia* (Sigal)
This zone contains about 65m from the base of formation (Samples A1-A22), and includes light grey marls of layer in association with grey shale (Fig. 2). Some researchers such as, (Keller et al., 2004; Keller & Pardo, 2004) believed the genus *Helvetoglobotruncana helvetica* is a diachoron genus. So with the unite theory cannot speak about that belonging to the middle Turonian index. This zone was introduced from Atlantic realm (Mucnulty, 1976; Premoli silva & Sliter, 1981) and W. Tethys (Wonders, 1979; 1980) and central Tethys (Fleury, 1980; Sigal, 1977) and pacific realm (Gradstein et al., 1978; Pessagno & longorria, 1973a, b) from the Middel Turonian.
2-Marginotruncana sigali-Dicarinella primitiva Zone
Category: Partial range Zone
Age: Late middle to late Turonian
Author: Premolisilva & Sliter (1999)
This zone is belong to partial rang zone and its region contains Last appearance *Helvetoglobotruncana helvetica* to First appearance *Dicarinella concavata* and other related fossils are mentioned as:
Dicarinella canaliculata (Reuss), *Dicarinella hagni* (Scheibnerova) *Dicarinella primitiva* (Dalbiez), *Globigerinelloides* sp., *Globigerinelloides ultramicra* (Subbotina), *Hedbergella delrioensis*(Carsey), *Hedbergella flandrini* (Porthault), *Hedbergella planspira* (Tappan), *Heterohelix globolusa* (Ehrenberg), *Heterohelix* sp,*Marginotruncana marginata* (Reuss), *Marginotruncana praconcavata* Porthault, *Marginotruncana pseudolinneiana* Pessagno, *Marginotruncana renzi* (Gandolfi), *Marginotruncana sigali* (Reichel), *Marginotruncana schneegansi*(Sigal), *Marginotruncana undulata* (Lehmann), *Praeglobotruncana gibba* Klaus ,*Praeglobotruncana stephani* (Gandolfi),*Ventilabrella eggeri* (Cushman), *Whiteinella aprica* (Loeblich & Tappan), *Whiteinella brittonensis* (Loeblich & Tappan), *Whiteinella baltica* Douglas & Rankin, *Whiteinella paradubia* (Sigal).
Thickness of this zone in purposed gap of the region of study is 37m and is demonstrated samples (A23-A35). This zone contains lithological units of layer of light grey shale to yellow grey marl (Fig. 2).

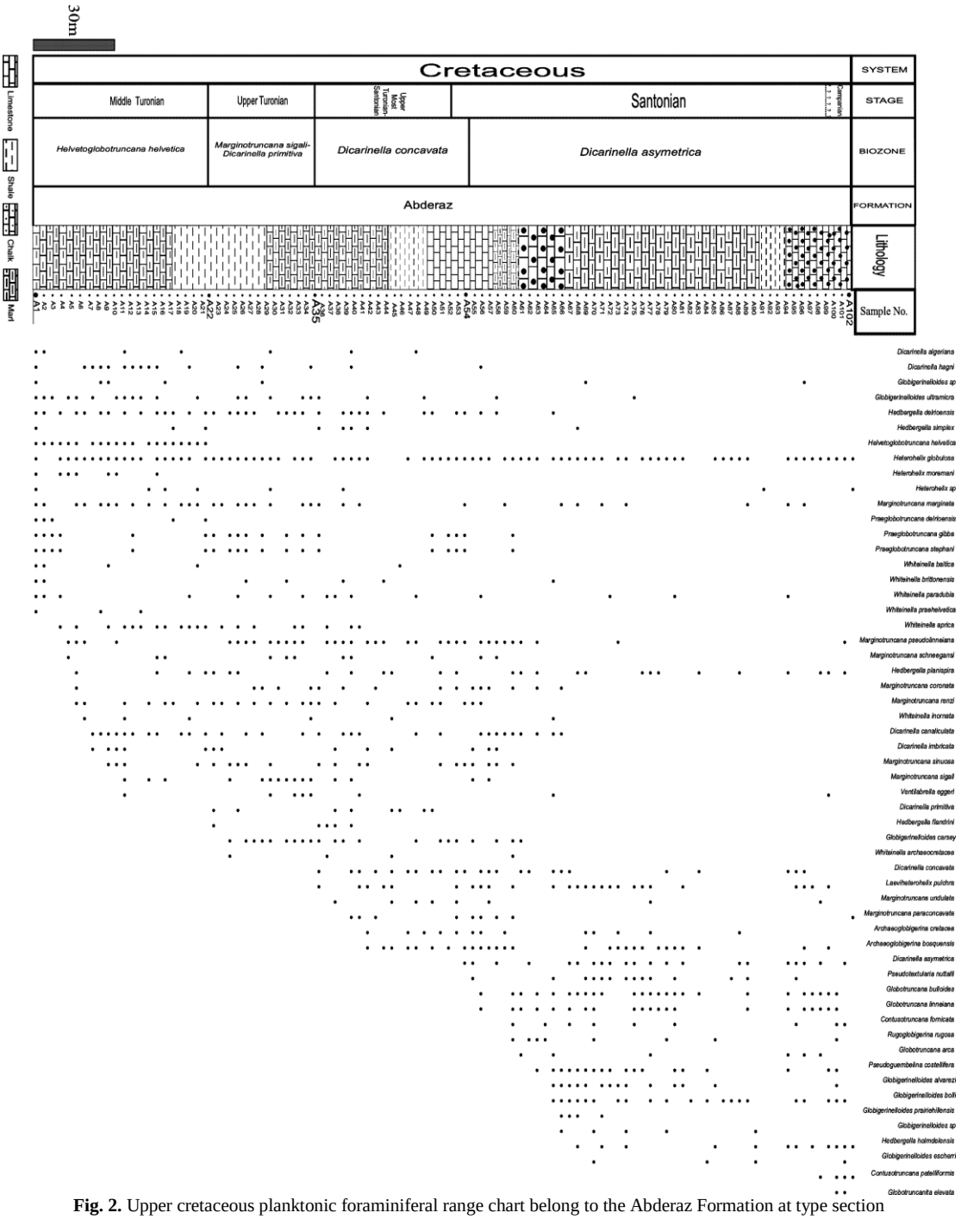

Fig. 2. Upper cretaceous planktonic foraminiferal range chart belong to the Abderaz Formation at type section

This zone was introduced from Atlantic realm (Mucnulty, 1976; Premolisilva & Sliter, 1981) and W. Tethys (Wonders, 1979; 1980) and central Tethys (Fleury, 1980; Sigal, 1977) and E. Tethys (Gorbachik, 1971a, b; Maslakova, 1971) pacific realm (Gradstein et al., 1978; Pessagno & longorria, 1973a, b) from the Late Turonian to Early Coniacian. Robaszynski and Caron, 1995 introduced *Marginotruncana schneegansi* Zone in Tethyan realm.

3- Dicarinella concavata Zone

Category: Interval Zone

Age: Late Turonian to Early Santonian

Author: Premoli silva & Verga, 2004

The development of this interval zone is starting from appearance of *Dicarinella concavata* to first appearance *Dicarinella asymetrica*. This zone was discovered by Sigal for the first time in 1955. Sigal showed the late coniacian- Early Santonian as the age-distinct of this zone. But some researcher such as (Premoli silva and Verga, 2004) believed to the Late Turonian to Early Santonian as the zone

age indexing. Such as the mention geniuses of this zone are mentioning as follows:
Archeoglobigerina bousquensis Pessagno, *Archeoglobigerina cretacea* (d'Orbigny), *Dicarinella canaliculata* (Reuss), *Dicarinella concavata* (Brotzen), *Dicarinella hagni* (Scheibnerova), *Dicarinella primitiva* (Dalbiez), *Globigerinelloides caseyi* (Bolli,Loeblich& Tappan), *Hedbergella delrioensis* (Carsey), *Hedbergella flandrini* (Porthault), *Hedbergella planispira* (Tappan), *Hedbergella simplex* (Morrow) ,*Heterohelix globolusa* (Ehrenberg), *Marginotruncana marginata* (Reuss), *Marginotruncana praconcavata* Porthault, *Marginotruncana renzi* (Gandolfi), *Marginotruncana sigali* (Reichel), *Marginotruncana schneegansi* (Sigal), *Marginotruncana sinuosa* porthault, *Praeglobotruncana gibba* Klaus, *Praeglobotruncana stephani* (Gandolfi) , *Ventilabrella eggeri* Cushman, *Whiteinella archeocretacea* Pessagno, *Whiteinella baltica* Douglas& Rankin, *Whiteinella brittonensis* (Loeblich& Tappan), *Whiteinella aumalensis* (*Sigal*), *Whiteinella paradubia* (Sigal).
Thickness of the zone at the gap of study is about 55m (Samples A36-A55) and contains the lithological units which compose from green grey marl to yellow grey marl at its head. This zone was introduced from Atlantic realm (Mucnulty, 1976; Premoli silva & Sliter, 1981) and W. Tethys (Wonders, 1979; 1980) and central Tethys (Fleury, 1980; Sigal, 1977) and pacific realm (Gradstein et al., 1978; Pessagno & longorria, 1973a, b) from the Coniacian-Early santonian.
4-Dicarinella asymetrica zone
Category: Total range zone
Age: Latest Coniacian-Late Santonian
Author: Robaszynski & Caron, 1995
This zone is a total range zone, contains all the sedimental thickness which *Dicarinella asymetrica* is found it. This zone for the first time was introduced by Postuma in year 1971 with time restrict covering from Early Santonian- Late Santonian but the recent studies show that it has the age of Santonian-Early Campanian (Robaszynski & Caron, 1995). Some of the main planktonic foraminiferal species in this zone are mentioned as following:
Archeoglobigerina bosquensis Pessagno, *Archeoglobigerina cretacea* (d'Orbigny), *Contusotruncana fornicata* (Plummer), *Contusotruncana pateliformis* (Gandolfi), *Dicarinella asymetrica* (Sigal), *Dicarinella canaliculata* (Reuss), *Dicarinella concavata* (Brotzen), *Dicarinella hagni* (Scheibnerova), *Globigerinelloides alvarezi* (Eternod olvera), *Globigerinelloides bolli* (Pessagno), *Globigerinelloides escheri*, *Globigerinelloides prarihellensis* (Pessagno), *Globigerinelloides* sp., *Globotruncana arca* (Cushman), *Globotruncana bulloides* Vogler, *Globotruncana linneiana* (d'Orbigny), *Globotruncanita elevata* (Brotzen), *Hedbergella flandrini* (Porthault), *Hedbergella holmdelensis* (Olsson), *Hedbergella simplex* (Morrow), *Heterohelix globolusa* (Ehrenberg), *Leaviheterohelix pulchra* (Brotzen), *Marginotruncana coronata* (Bolli), *Marginotruncana marginata* (Reuss), *Marginotruncana pseudolinneiana* Pessagno, *Marginotruncana praconcavata* Porthault, *Marginotruncana renzi* (Gandolfi), *Marginotruncana schneegnasi* (Sigal), *Marginotruncana sigali* (Reichel), *Pseudoguembelina costellifera* Masters, *Pseudotextularia nuttalli* (Voorwijk), *Praeglobotruncana gibba* Klaus, *Praeglobotruncana stephani* (Gandolfi) *Rugoglobigerina rugosa* (Plummer). Thickness of this zone at this gap is about 144m (Samples A56-A102) and contains the lithological unites of grey marl, chalk limestone, marl. Caron, 1985 believed the among the all Marginotruncanids only *Marginotruncana coronata* passed from the boundry biozone of *Dicarinella asymetrica* and incomed to *Globotruncanita* elevate zone. And other types have been extincted at the end of *Dicarinella asymetrica* zone (Premoli silva & sliter, 1995). In the region of the study was also the second theory observed because not any types of *Marginotruncana* were observed at the intermediate boundary of two mentioned Abderaz and Abtalkh formations. This zone was introduced from Atlantic realm (Mucnulty, 1976; Premoli silva & 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) Caribbean (Grandstein, 1978) from the Latest Coniacian-Late Santonian. The studied biozones in this research were compared with presented biozones in Tethyan (Barr, 1972; Premoli silva & Bolli, 1973; Vaptzarova, 1976; Sigal, 1977; Wonders, 1980; Salaj, 1980; 1997; Robaszynski et al., 1984; Caron, 1985; Sliter,

1989; Abdel-Kireem et al., 1995; Robaszynski & Caron, 1995; Premoli Silva & Verga, 2004; Dimitrova Valchev, 2007; Takashima et al., 2010). The result show that biozones of this research are in maximum correlation with the previous research (Table 1).

Table 1. Compansion of represented biozones of this study at type section. With other region in Tethys.

Turonian			Coniacian	Santonian	Campanian		stage
Helvetoglobotruncana helvatica	*Marginotruncana sigali*	*Globotruncana concavata*	*Globotruncana concavata concavata*	*Globotruncana elevata*		Lybia	Barr 1972
Not recognized		*Marginotruncana schneegansi*	*Dicarinella concavata*	*Globotruncana concavata carinata*	*Globotruncanita elevata*	Caribbean	Premoli-Silva & Bolli, 1973
Helvetoglobotruncana helvatica			*Marginotruncana renzi*	*Globotruncana concavata*	*Globotruncanita elevata*	NW Bulgaria	Vaptzarova; 1976
Rotalipora cushmani	*Helvetoglobotruncana helvatica*	*Marginotruncana sigali+ schneegansi*	*Dicarinella concavata*	*Globotruncana concavata carinata*	*Globotruncanita elevata+ stuartiformis*	Mediterranean	Sigal 1977
Whitinella archaeocretacea	*Helvetoglobotruncana helvatica*	*Marginotruncana sigali*	*Dicarinella primitiva* *Dicarinella concavata*	*Globotruncana carinata*	*Globotruncanita elevata*	Western Mediterranean	Wonders 1980
Ducrinella imbricata	*Helvetoglobotruncana helvatica* *Dicarinella hagni*	*Marginotruncana schneegansi*	*Dicarinella asymetrica+concavata* *G.renzi* *G.stuartiformis*		*Globotruncanita elevata*	Tunisia	Salaj 1980,1997
Whitinella archaeocretacea	*Helvetoglobotruncana helvatica*		*Marginotruncana schneegansi* *Dicarinella concavata*	*Dicarinella asymetrica*	*Globotruncanita elevata*	Generalized	Robaszynski et al, 1984
Whitinella archaeocretacea	*Helvetoglobotruncana helvatica*	*Marginotruncana sigali* *Dicarinella primitiva*	*Dicarinella concavata*	*Dicarinella asymetrica*	*Globotruncanita elevata*	Generalized	Caron 1985
	Marginotruncana sigali		*Dicarinella concavata*	*Dicarinella asymetrica*	*Globotruncanita elevata*	Generalized	Sliter 1989
Whitinella archaeocretacea	*Helvetoglobotruncana helvatica*	*Marginotruncana schneegansi* *Dicarinella primitiva*	*Dicarinella concavata*		*Globotruncanita elevata*	Egypt	Abdel-Kireem et al, 1995
Helvetoglobotruncana helvatica		*Marginotruncana schneegansi*	*Dicarinella concavata*	*Dicarinella asymetrica*	*Globotruncanita elevata*	Paris	Robaszynski & Caron 1995
Whitinella archaeocretacea	*Helvetoglobotruncana helvatica*	*Marginotruncana schneegansi* *Dicarinella primitiva*	*Dicarinella concavata*	*Dicarinella asymetrica*	*Globotruncanita elevata*	Generalized	Premoli-Silva & Verga 2004
Ducrinella imbricata	*Marginotruncana sigali* *Marginotruncana renzi*	*Marginotruncana schneegansi* *Dicarinella primitiva*	*Dicarinella concavata*	*Dicarinella asymetrica*	*Globotruncanita elevata*	S.Bulgaria	Dimitrova Valchev 2007
Whitinella archaeocretacea	*Helvetoglobotruncana helvatica*	*Marginotruncana pseudolinneiana*	*Marginotruncana sinuosa*	*Globotruncana arca* *Contusotruncana fornicata*		Yezo group Japan	Takashima et al 2010
	Helvetoglobotruncana helvatica	*Marginotruncana sigali* *Dicarinella primitiva*	*Dicarinella concavata*	*Dicarinella asymetrica*		NE of Iran	

4. Conclusion

The studies of isolated planktonic foraminifer's samples in the region of the study caused to identification and distinguish of 56 species and 16 genera. Kinds of development of these biozones are explained as following:

Helvetoglobotruncana helvetica Zone of Sigal, 1955, *Marginotruncana sigali-Dicarinella primitiva* Zone of Premoli Silva and Sliter, 1999, *Dicarinella concavata* Zone of Premoli silva and Verga, 2004, *Dicarinella asymetrica* Zone of Robaszynski and Caron, 1995 which totally cover Early-Middle Turonian-Late

Santonian. The study of planktonic foraminifera at the mentioned region implicates. The lack of sedimentation during within the Late cenomanian-Early Turonian because it was shown that *Helvetoglobotruncana helvetica*, the index species for middle Turonian exists at the base of the formation while, in the samples immediately below this belonging to Aitamir Formation *Rotalipora appenninica*, the index for middel Cenomanian was recorded. Therefore, lack of index species for Late Cenomanian-Early Turonian shows a gap spanning this period between the Aitamir and Abderaz Formations at the base of out and presence of planktonic foraminifera such as *Contusotruncana patelliformis*, *Rugoglobigerina rugosa, Globotruncanita elevata* are in confirmation with Late Santonian age for the end of Abderaz Formation at the region of the study. At the cross link of Abderaz Formation to Abtalkh Formation all the Marginotruncanids have been destroyed and replaced with Globotruncanids.

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