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Investigation of Main Planktonic Foraminiferal Bio-Events in Surgah Formation at Pol-e-Dokhtar Area, South Western of Iran

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Abstract

Surgah Formation at Male-kuh well section with 82 meters thickness has been studied at Pol-e-Dokhtar area. Surgah Formation at mentioned section was composed of limestone and shaly limestone. The lower and upper contacts of studied formation with Sarvak and Ilam formations are conformed. Based planktonic foraminifera study 37 species belonging to 10 genera in frame of two planktonic foraminiferal biozones were identified respectively as below: 1) *Dicarinella concavata* Interval Zone; 2) *Dicarinella asymetrica* Total Range Zone. Finally, based on recent investigation have been detected middle Turonian-Late Santonian age for studied section. According to (Robaszynski and Caron 1979), the first occurrence of *Dicarinella primitiva* has been shown base of the Coniacian stage. The first occurrence of *Di. primitiva* was placed under the Turonian-Coniacian boundary. Robaszynski and Caron 1995 recorded the first occurrence of *Dicarinella primitiva* and *Dicarinella concavata* were simultaneous and assigned to late Turonian which correlated with ammonite's species *Subprionocyclus neptuni*. In the correlation between ammonite and *Dicarinella primitiva* at Tethyan realm first occurrence of *Di. primitiva* was close to the Middle-Late Turonian sub stage. The base of Coniacian stage was identified based on the FODs of *Archaeoglobigerina cretacea* and *Dicarinella concavata* from planktonic foraminifera with FOD of *Cremnoceramus walterdorfensis walterdorfensis* from inoceramid group, while the base of Santonian stage recorded using LOD of *Dicarinella primitiva*, Whiteinellids group with FODs of *Dicarinella asymetrica* and *Inoceramus* aff. *vistulensis* (inoceramid species).

Keywords

Zagros Sedimentary Basin, Surgah Formation, Male-Kuh Section, Biostratigraphy,

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Planktonic Foraminifera

1. Introduction

The study area is located in the North East Zagros Basin. Zagros folded and thrust belt is considered as part of the Alpine-Himalaya Mountains [1]. It is 2000 km in length, from the northwest (southeast Turkey) to the southeast (Oman line) [2].

This tectonic zone is characterized by three regions: 1) Uremiah-Dokhtar magmatic assemblage; 2) Zagros imbricate zone; 3) Zagros folded and thrust belt [3]. Present-day Iran is part of the Alpine-Himalayan orogenic belt, which is bordered by the Arabian Shield to the southwest and the Turan Plate to the northeast (**Figure 1**).

The zagros orogenic belt of Iran, as part of the Alpine-Himalayan mountain chain, extends for about 2000 km in a NW-SE direction from the East Anatolian Fault of eastern Turkey to the Oman Line in southern Iran. The belt is considered to be a complex product of an early Mesozoic separation of the Iranian continental block from the rest of the Gondwana Indmass(es) followed by a NE-dipping subduction of the newly generated Neo-Tethyan oceanic crust below the Iranian microcontinent and subsequent collision between the Afro-Arabian and Iranian plates [4]-[12]. More than 65 percent (107.5 billion cubic meters) of the remaining proven oil reserves (159.6 billion cubic meters) and nearly 34 percent (49.5 trillion cubic meters) of the total gas reserves (146.4 trillion cubic meters) of the world have accumulated in numerous giant and supergiant hydrocarbon fields of the Middle East [3].

Zagros sedimentary basin with high quantity of oil and gas attracted many geologists many years ago. In spite of Shiraz district which deposition is combimused from jurassic bill cretaceous sea. All of Zagros crataceous rock have not same facies and deposited at various position [13]. Lorestan province has been existed deep condibion at Coniacian stage which was deposited Surgah Formation at lower contact of Ilam Formation [14]. At Zagros sedimentary basin in Albiat untill Companian stage has been deposited respectively Kajdomi, Sarvak, Surgah and Ilam Formation which mentianed Formations made a Bangestan group [15]. Type Locality of Surgah Formation was placed in Tang-e-Grab at southwestern Surgah montain and 12 km from southwestern of Ilam country. It has 175.5 meters thickness with main lithological units of lght to drak gray shales with intra-calted fine limestone [14]. Surgah Formation has been inreslcigated for many times.

Wynd in 1965 has recored Coniacian age for Surgah Formation in Zagros sedimentary basin. Also [19] have detected same age for it like Wynd. [20] have been detected Late Turonian-Late Santonian ages for Surgah Formation type section. [21] recognized Late Turonian-late Santonian ages for Surgah Formation at Kuh-e-Shah nakhjir section based on planktonic foraminifera. The main goal of this research work is precise stratigraphy of the Sourgah Formation at Maleh-Kuh section by using planktonic foraminifera.

Lithology and Geographical Position

The Surgah Formation was defined by [22] (**Figure 2**). The type section of the formation is at the north-western part of the KabirKuh Anticline at Tang-e Garab in Lurestan. In the type section, the Surgah Formation is composed of 176 m of grey to dark grey, pyritic, low-weathering shale with subordinate yellow-weathering, thin-bedded limestone of Turonian to Early Santonian age [15]. The Surgah Formation is well developed only in the Lurestan area. In the Dezful embayment, it is questionably represented in the Ab-e Teymur and Darquain oil welds by a thin interval of shale beds between the Sarvak and Ilam formations [23].

Maleh-kuh ohl field has been deposited in asymentrical surface anticline with NW-SE trend. Mentioned field has been placed at 130 km of Andimeshk.Maleh-kuh (well no.1) at Pol-e-Dokhtar country near the Kashkan river. For access to the mentioned section we must pass 7 km from the pol-e-dokhtar country to the Babazeyd road and after reached and passed of 4 km we reach to the studied section. This well has 33˚12'28" and 47˚42'17" geographical position. Sourgah Formation at type locality has 175.5 meters thickness and consists of dark to light grey shale with some fine limestone. This formation at Maleh-kuh section has 82 meters thickness with main lithological unites of shales, limestone and shaley limestone with pyrite and glaqunite. Also Sourgah Formation at studied section consists of 9 lithological unites respectively as follows:

1) Dark brown shaly limestone, 5 m thick.
2) Light gray lime stone, 2.5 m thick.

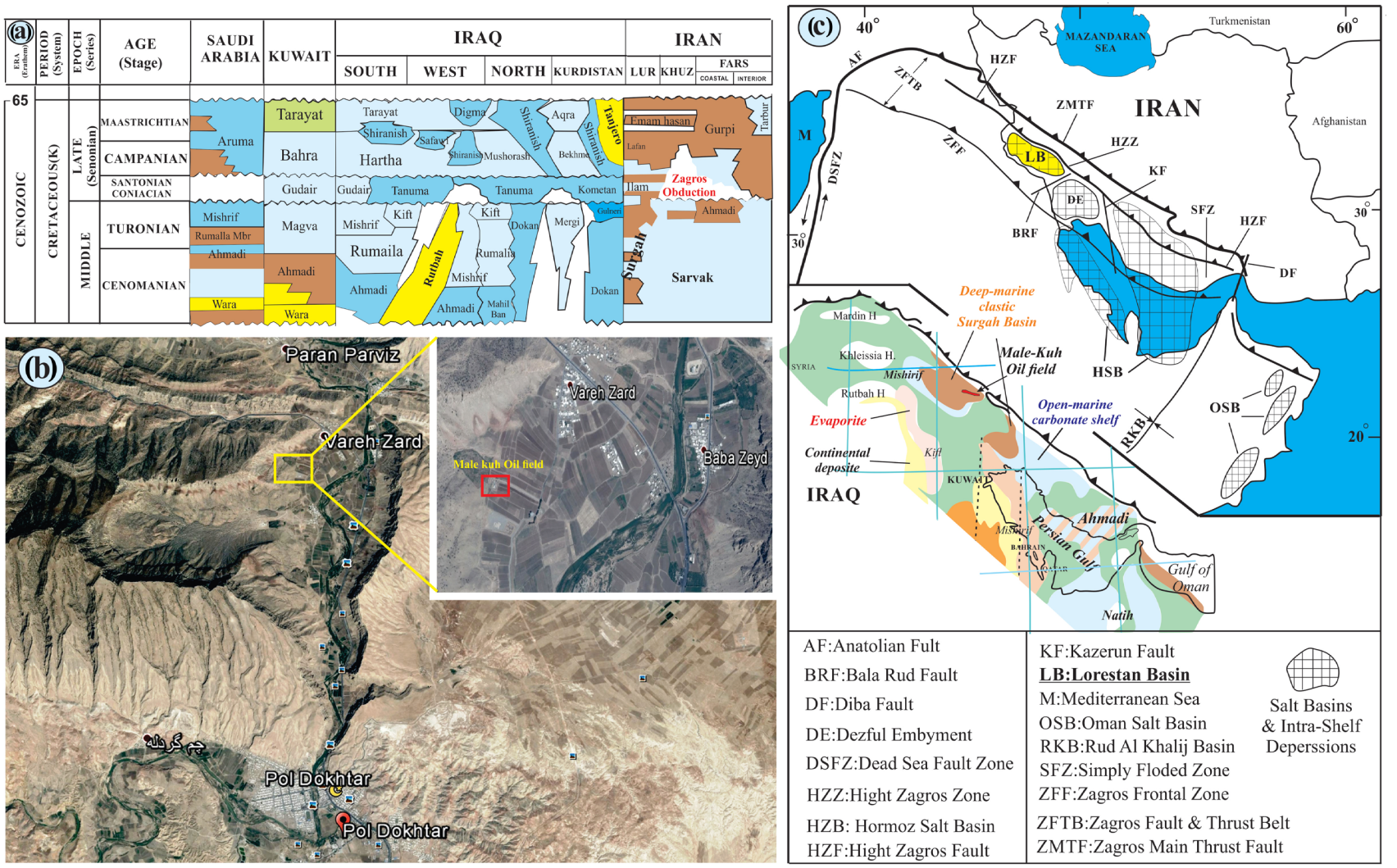

Figure 1. (a) Age range of the surgah Formation and its time-equivalents [16]. (b) North of Pol-Dokhtar and position of the BabaZeyd village, (c) Location of the Lurestan Basin, its surrounding faults [17], and the paleogeographical map for the early Cretaceous [18].

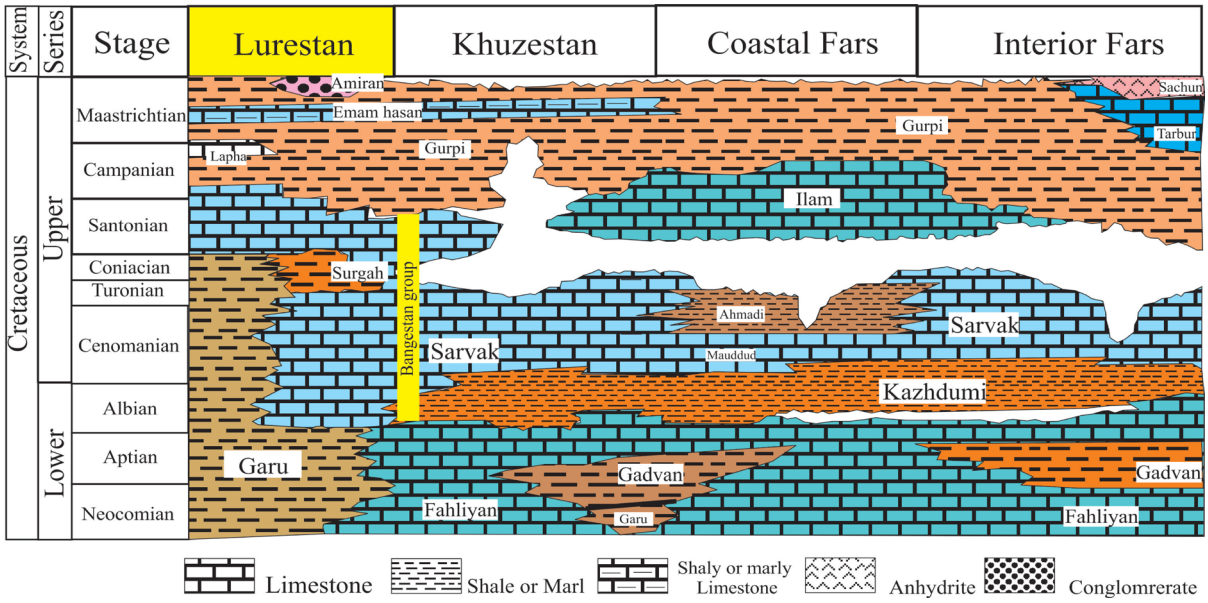

Figure 2. Correlation chart of Cretaceous strata, Zagros basin, Iran (adapted from [15]).

3) Brown shaly limestone, 12.5 m thick.
4) Dark brown to brown shale with accompany of pyrite and glaqunite, 37 m thick.
5) Dark brown shaly limestone, 3 m thick.
6) Brown shale, 5 m thick.
7) Gray to dark brown shaly limestone, 10 m thick.
8) Dark gray limestone, 2.5 m thick.
9) Dark brown shaly limestone, 4.5 m thick.

2. Material and Method

In this research 54 samples from the Male-Kuh section with 1.5 meters distances have been gathered. Ultimately after preparation and study of all thin sections 2 planktonic foraminiferal plates were made (**Plate 1** & **Plate 2**).

3. Discossion

Biostratigraphy

The planktonic foraminiferal zonation here used is compared in **Figure 3** with other Tethyan biozonations [22] [24]-[33]. This zonation is similar to that of Premoli-silva and Verga, 2004. Surgah Formation at Maleh-kuh section has 82 meters (1408 m - 1326 m) thickness and have been consist of shale with intracalated of limestone and shaly limestone with accompany of pyrite and glauconite. In this research 37 planktonik foraminiferal species have been identified belonging to 10 genera inframe of three biozones (**Figure 3**). In this research these references have been used for planktonic foraminifera recognition such as the below: [34]-[39] (**Figure 4**). Based of this study have been recorded Late middle Turonian-upper Santonian for mentioned section. According to the recent researches first occurrence of *Cremnoceramus deformis erectus* was shown base of the Coniacian stage in the world. Also heed to recently research which was ratified first occurrence were placed under the FO of *Cremnoceramus deformis erectus* (Meek 1918 [40]-[42]. Therefore has been considered late Turonian and up-permost Turonian ages respectively for FO of *Dicarinella primitiva* and *Dicarinella concavata*.

In this investigation have been used of composed biozonation of [33].

At this research were recognized of two biozones such as below:

***Dicarinella concavata* Zone**

Category: Interval Zone

Age: Late Turonian to earliest Santonian

Author: Sigal (1995)

This zone has been introduced for the first time by Sigal in 1955 and he assigned the Late Coniacian to Early Santonian for the *Dicarinella concavata* Interval Range Zone. According to Premoli-Silva and Verga, 2004 *D.concavata* biozone has been shown uppermost Turonian to earliest Santonian. [33] [43] [44] assigned the *Dicarinella concavata* Interval Range Zone to Upper Turonian. The range of the *Dicarinella concavata* is from the Upper Coniacian to Lower Santonian according to [30]-[37] assigned the Coniacian stage for this zone.

This biozone has been detected between 1393 m - 1365 m and has 27.5 meters thickness with main lithological units such as shale and shaley limestone and was begin from first occurrence of *Dicarinella concavata* to first occurrence *Dicarinella asymetrica*. All of planktonic foraminiferal species were found at this zone are as below:

Archaeoglobigerina cretacea (d'Orbigny), *Dicarinella algerina* (Caron), *Dicarinalla concavata* (Brotzen), *Globotruncana lapparenti* (Brotzen), *Heterohelix globulosa* (Ehrenberg), *Macroglobigerinelloides ultramicrus* (Subbotina), *Macroglobigerinelloides* sp., *Marginotruncana coronata* (Bolli), *Marginotruncana marginata*

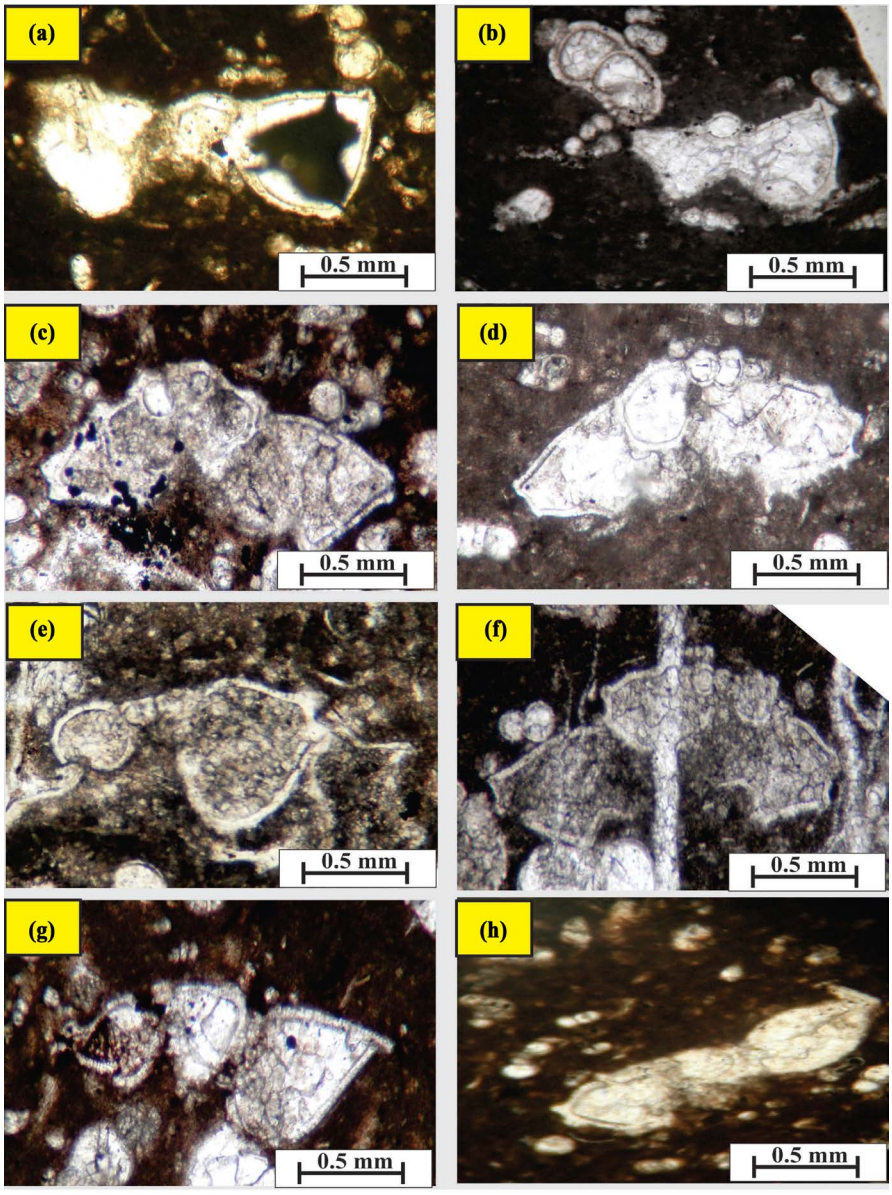

Plate 1. (a) *Dicarinella asymetrica* (Sigal, 1952); (b) *Dicarinella concavata* (Brotzen, 1934); (c) *Marginotruncana sigali* (Reichel, 1950); (d) *Globotruncana arca* (Cushman, 1926); (e) *lobotruncana hilli* (Pessagno, 1967); (f) *Marginotruncana schneegansi* (Sigal, 1952); (g) *Marginotruncana renzi* (Gandolfi, 1924); (h) *Dicarinella primitiva* (Dalbiez, 1955).

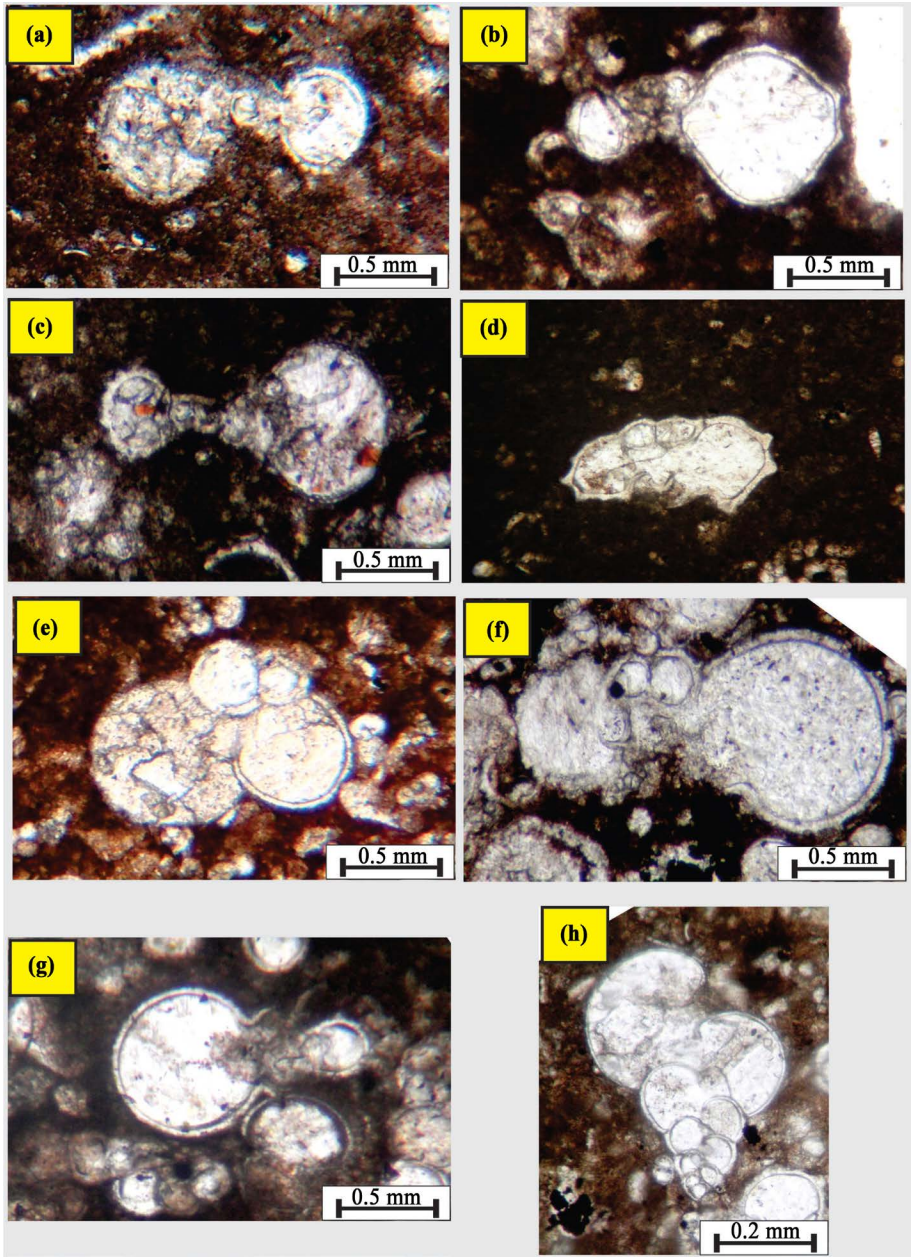

Plate 2. (a) *Muricohedbergella planispira* (Tappan, 1940); (b) *Archaeoglobigerina cretacea*.(d'Orbigny, 1840); (c) *Macroglobigerinelloides bolli* (Pessagno, 1967); (d) *Globotruncana lapparenti* (Brotzen. 1936); (e) *Whiteinella paradubia* (Sigal, 1952); (f) *Whiteinella baltica* (Douglas&Rankin, 1969); (g) *Macroglobigerinelloides caseyi* (Bolli, Loeblich & Tappan, 1957) (h) *Heterohelix globulosa* (Ehrenberg, 1840).

(Reuss), *Marginotruncana pseudolinneiana* (Pessagno), *Marginotruncana renzi* (Gandolfi), *Marginotruncana schneegansi* (Sigal), *Marginotruncana sigali* (Reichel), *Marginotruncana* cf *sinuosa*, (porthault), *Muricohedbergella planispira* (Tappan), *Whiteinella paradubia* (Sigal),

***Dicarinella asymetrica* Zone**

Category: Total Range Zone

Age: Early Santonian to earliest Campanian

Author: Postuma (1971)

This Zone has been introduced for the first time by [26] and was shown early Santonian-late Santonian age. Also mentioned biozone was detected from deep 1365.5 till 1326 meters and has 39.5 meters thickness with

Figure 3. Distribution and planktonic foraminiferal zonation of the Surgah Formations at Malehkuh oil field. (Well no. 1).

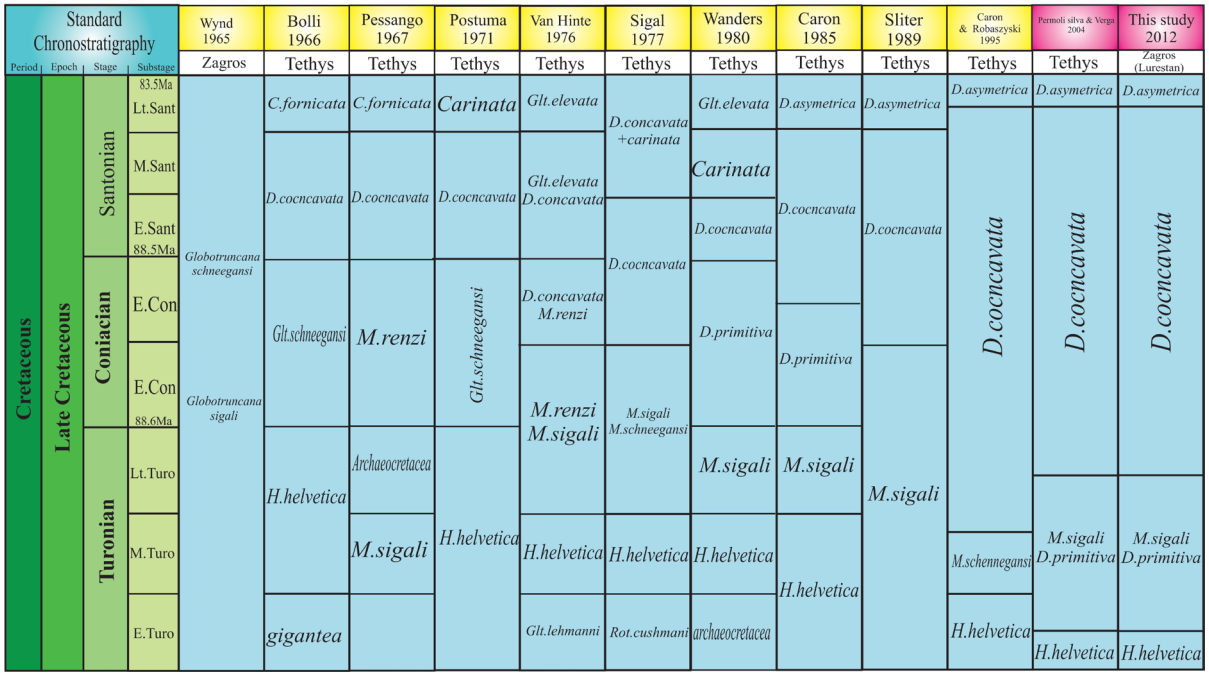

Figure 4. Correlation of the proposed biostratigraphic zonal scheme at this study with other accepted standard biozones of other parts of the world.

shale to shaley limestone lithological units. *Globotruncanita elevata* and *Globotruncanita stuartiformis* were not found at this zone and *Dicarinella asymetrica* was not extinct. Therefore age of this biozone is early-late Santonian in this area. All of the main planktonic foraminiferal species were found at this Zone are as below:

Archaeoglobigerina bosquensis (Pessagno), *Contusotruncana fornicate* (Plummer), *Dicarinella asymetrica*, (Sigal), *Dicarinalla concavata*, (Brotzen), *Globutruncana arca* (Cushman), *Heterohelix globulosa* (Ehrenberg), *Laeviheterohelix pulchra* (Brotzen), *Macroglobigerinelloides alvarezi* (Eternod olvera), *Marginotruncana coronata* (Bolli), *Marginotruncana marginata* (Reuss), *Muricohedbergella planispira* (Tappan), *Whiteinella baltica* (Douglas & Rankin), *Whiteinella* sp.

Turonian-Coniacian (T/C) boundary

[45] recorded the first occurrence of ammonite species *Prionocycloceras milticostatum* as index species for the Turonian-Coniacian boundary. The majority of planktonic foraminifera researchers have believed that Turonian-Coniacian boundary cannot be determined based on planktonic foraminifera, but some others believed that the first occurrence of *Marginotruncana sinuosa* has been shown in Turonian-Coniacian boundary [41] [46] [47]. Also [45] introduced a supplementary planktonic foraminifera specie with name of *Muricohedbergella flandrini* which was used if *Dicarinella primitiva* do not exist. Also some authors described last occurrence of some planktonic foraminifer's species such as *Muricohedbergella simplex* and *Dicarinella primitiva* took place before the first occurrence of *Dicarinella concavata* [48]. But today first occurrence of one inoceramids species, *Cremnoceramus deformis erectus* has been used for identification of the Turonian-Coniacian boundary [49]-[53]. In a major symposium about Cretaceous boundaries held in Brussels in 1995, FAD *C.deformis erectus* was used as the first marker species for of the base of the Coniacian stage. Also FAD *Cremnoceramus deformis deformis* were shown lower Coniacian stage in the world [54]. In studied area first occurrence of *Dicarinella primitiva* was shown the upper Turonian sub stage. Also first occurrence of *Marginotroncana paraconcavata* has been shown Coniacian-Santonian boundary [30], in the study area FO of *M. paraconcavata* took place at *Dicarinella primitiva* Interval Range Zone (upper Turonian). *Marginotruncana paraconcavata* and *Costellagerina pilula* indicate the Turonian-Coniacian boundary in Iran.

Recently the First occurrence of *Cremnoceramus rotundatus*, an inoceramid bivalve, was recommended for defining the Turonian-Coniacian boundary by the Coniacian working group (CWG) of the Cretaceous subcommission on stratigraphy [41]. First occurrence of *Cremnoceramus deformis erectus* was the primary marker for realizing Turonian-Coniacian boundary in the world [41] [51] [52]. According to recording FO of *Dicarinella*

concavata and Dicarinella primitiva below of the FO of *Cremnoceramus deformis deformis*, in the study section so, upper Turonian sub stage assigned to the *Dicarinella concavata* Interval Zone in the study area. Consequently Turonian-Coniacian and Coniacian-Santonian boundaries have been placed in this zone.

Coniacian-Santonian (C/S) boundary

The first occurrence of inoceramid species, *Cladoceramus undulatoplicatus* was index species for realized the Coniacian-Santonian boundary [55]-[62]. The Santonian Working Group (SWG) recommends the lowest occurrence of *Cladoceramus undulatoplicatus* as the marker for the Coniacian-Santonian boundary. As yet, the SWG cannot make a formal proposal for a Boundary Stratotype Section, because the biostratigraphy must be better known and integrate first. Three candidates for Boundary Stratotype Section, Olazagutia Quarry (Navarra, Spain), Seaford Head (Sussex, England) and Ten Mile Creek (Dallas, Texas, USA), were selected for further decision. Primary marker: The lowest occurrence of *Cladoceramus undulatoplicatus*. It is a taxon easily recognizable and widespread. It is known in N. America, Europe, Africa, Madagascar, and Central Asia.

Secondary marker: *Sigalia carpatica*. This planktonic foraminiferan is widespread in the Mediterranean Region of the Tethys. It is associated with *Inoceramus siccensis* and *Texanites* in Tunisia. In north Spain (Navarra) it is very close to the lowest occurrence of *Cladoceramus undulatoplicatus*. In the studied area *Cladoceramus undulatoplicatus* have not been recorded, therefore the first occurrence of *Echinocurys gr. scutata* as a secondary marker [56] used to realized C/S boundary and finally according to the Fos of *E. gr. scutata*, and pill box globotruncana linneiana (planktonic foraminifera) Coniacian-Santonian has been detected.

4. Conclusions

Surgah Formation has been studied at Male-Kuh section in southwestern of Iran. Thirty seven planktonic foraminifers of 2 biozones have been recorded as below:

1) *Dicarinella concavata* Interval Zone; 2) *Dicarinella asymetrica* Total Range Zone.

Based on this research, late middle Turonian-late Santonian ages were detected of mentioned studied section. Finally all of realized biozons in this research have been compared with main Tyetyan biozonation scheme in the world and all of zones which were identified for Surgah Formation at Maleh-Kuh section resembles with Permoli-Silva & Verga 2004 biozonation.

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