World Journal of Environmental Biosciences

Available Online at: **www.environmentaljournals.org**

Volume 6, Supplementary: 56-60

ISSN 2277- 8047

Paleoecology of benthic foraminifera in the Asmari Formation with regard to microfacies and sequence stratigraphy in Interior Fars (Zagros Basin, Iran)

Sara Karami[1], Vahid Ahmadi[1*], Hamzeh Sarooe[1], Mohammad Bahrami[2]

[1]*Department of Geology, Shiraz Branch, Islamic Azad University, Shiraz, Iran.*
[2] *Department of Geology, Payam-e-Noor University of Shiraz, Shiraz, Iran.*

ABSTRACT

This paper, paleoecological interpretations and sequence stratigraphy analysis of the Asmari Formation are presented. The Asmari Formation, which is mainly composed of carbonates, has been investigated in the Kharman Kuh section, Zagros Basin, Iran. Also, the thickness of Kharman Kuh is 240 m.
The study area of this Formation is Rupelian-Chattian and Aquitanian in age, based on the occurrence of 12 foraminiferal species belonging to 15 genera which led to an identification of three assemblage zones including (1) Nummulites vascus– Nummulites fichteli, (2) Archiaias asmaricuas – Archiaias hensoni, (3) Peneroplis evolutus– Austroterillina howchini. According to the sequence stratigraphy, two 3rd order sedimentary sequences (cycles) were identified, which the ages of them are Rupelian-Chattian and Aquitanian, respectively. The present analysis led to the recognition of 8 facies that are belonging to four depositional environments including open marine, barrier, lagoon, and tidal flat environments. Due to the Paleoecological investigations in the studied area, Biozone number (1) is in open marine, and Biozone number (2 and 3) are in lagoon and tidal flat.

Keywords: *Paleoecology; Asmari Formation; sequence stratigraphy; Biostratigraphy; Oligo-Miocene.*

Corresponding author: Vahid Ahmadi

INTRODUCTION

The Oligocene-Miocene Asmari Formation are the largest oil reservoir and a thick carbonate sequence in Iran and Zagros Basin, respectively. Also, is expanded in the Dezful Embayment Zone. The Kalhur evaporite sediments in the Ahvaz province sandstone and Lurestan province in southwest Dezful Embayment are two members of the Asmari Formation (Fig. 1).

The Asmari Formation at the representative section includes of 314 m of dolomitic limestones, argillaceous limestones and limestones(Motiei,1993). Furthermore, the thickness of the Asmari Formation is changing from area to area. Also, the Asmari Formation was deposited during the Oligocene (Rupelian)–Miocene (Burdigalian). The Asmari Formation is different base on various age (Motiei, 1993). For example, the age of Asmari Formation toward the coastal Fars area, is mainly Rupelian, but when we go toward the Dezful Embayment, the ranges of age are from Rupelian to Chattian (Fig. 1).

The Asmari Formation was embedded on the carbonate platform at the margin of a Northwest is trending in the Zagros Basin (Sepehr and et al , 2004).

There are several studies on the Asmari Formation biostratigraphy and stratigraphical properties (James and et al ,1965; Wynd and et al 1965; Adams and et al 1967; Adams and et al, 2007; Laursen and et al ,2009; Van Buchemand et al,2010), but a few investigations focused on the paleoecological aspects of Asmari Formation. The aims of present study are analysis paleoecology of benthic foraminifera with regard to microfacies and sequence stratigraphy of Asmari Formation.

Geological setting

The Zagros mountains are a fold and belt that thrust from southeastern Turkey through northern Syria and Iraq to western and southern Iran (Alavi, 2004). This orogenic belt is located in the middle part of the Alpine area. This belt is considered to be a passive eastern margin of the Arabian shield (Stocklin,1968; Berberian, 1981). The Zagros Basin was part of the stable Gowndwana supercontinent in the Paleozoic era and a passive margin in the Mesozoic era. It became a site of convergent orogeny in the Cenozoic era (Bahroudi, 2004). The Zagros mountains consist of three zones: (1) the Khozestan Plain, (2) the simply folded Zagros, (3) the imbricate thrust zone(Motiei,1993). Based on the structural style and sedimentary history, divided the simply folded Zagros into different zones (FALCON, 1961).

Fars, the Dezful Embayment, the thrust zone, the complex structure with metamorphic rocks, Lurestan, the Abadan Plain, and the Bandar Abas Hinterland are shown at Fig. 2. The study area is located on the south-eastern flank of the Kharman Kuh, next to the Shams Abad Village, about 160 km southeast of Shiraz and 86 km west of Estahban. The section was measured in detail at 29°12′N and 53°37′E that shown in Fig. 2. The study area is located in the folded thrust zone of the Zagros Basin (Fars Zone).

METHODS

The section of the Asmari Formation was measured bed by bed. Samples were analyzed in approximately 400 thin-sections. Also, all thin-sections were investigated under the microscope for facies and biostratigraphy. The classification of carbonate rocks were described based on Dunham (Dunham, 1962). and Embry and Klovan (Embry and et al, 1971). Facies definition is due to microfacies characters including: texture, grain composition, grain size, fossil content and depositional. Furthermore, paleo-ecological implications are due to (Flügel, 2004).

Biostratigraphy

The biostratigraphic framework of the Asmari Formation was reported by Wynd(Wynd, 1965). and developed by Adams and Bourgeois (Adams and et al ,1967). The age of the Asmari Formation was defined from Rupelian to Burdigalian and the Asmari Formation divided into lower (Oligocene), middle (Aquitanian) and upper (Burdigalian) parts (Fig. 3). Age determination was based on the following biozones: Nummulites fichteli – Nummulites intermedius – Nummulites vascus assemblage zone; Austroterillina howchini – Peneroplis evolutus assemblage zone; Archiaias asmaricuas – Archiaias hensoni assemblage-zone.

Biozone. 1

From base of the Asmari Formation upward 85 m of sequence, Nummulites vascus and Nummulites fichteli are present. Rotaliaviennoti, Spiroclypeus ranjanae, Operculina, Ditrupa sp., Pearhapydionina delicate are also associated within this interval. The faunal assemblage is time equivalent to Nummulites vascus- Nummulites fichteli assemblage zone (Laursen, 2009) and indicates the section age is Rupelian. This assemblage zones defined according to (Thomas, 1948). Lower Asmari.

Biozone. 2

From 86 to 168 m of sequence, Archiaias asmaricuas – Archiaias hensoni are identified. Peneroplis evolutus sp., Archaias sp., Elphidium sp., Miliolida, Valvulinid sp., Also, are associated within this interval. These benthic foraminifera indicate Chattian age and are time equivalent to Archaias asmaricus-Archaias hensoni-Miogypsinoides assemblage zone (Laursen ,2009).

Biozone. 3

From 169 to 240 m of sequence, Peneroplis evolutus, Austrotrillina howchini are identified. This assemblage is equivalent to assemblage zone of Laursen et al. (2009) indicate Aquitanian age. The lower boundary of the Aquitanian interval middle Asmari Formation was set due to presence of Peneroplis thomasi, Archaias sp., Pyrgo sp., Archaias krikukensis, Valvulinid sp., Spirolina cylindracea, Triloculina trigonula. This assemblage zone is described as the Aquitanian age(Wynd,1965).

As a result of this study, the Asmari Formation is Rupelian-Chattian-Aquitanian in age. The distribution of benthic foraminifera has been plotted on the biostratigraphic column (Fig. 7).

Based on Microfacies studies in the studied sections, the deposits of Asmari Formation include four subfacies of A (open marine), B (barrier), C (lagoon), D (tidal flats) that A, C and D facies are composed of two subgroups (Fig. 6).

Sequence Stratigraphy

Each sequence consists of a package of transgressive and regressive sedimentary facies (systems tracts or facies tracts) and is bracketed by two sequence boundaries(Pickford, 2008). In marine shelf homogeneous carbonate environments, it is often difficult to distinguish between the various system tracts of a depositional sequence (Van Wagoner, 1988). Hence, the different markers of low and high sea level phases, such as benthic foraminifera, it seems provide particularly reliable data as they are very sensitive to any change in the environment (Moghaddamand and et al,2006).

In our case study the facies distribution, stratal patterns, and sequence boundaries permit the identification of two separate Third-order depositional sequences, occurring to particular stages during the Oligocene–Miocene interval (Fig. 4). Each third order depositional sequence is composed of one transgressive systems tract (TST), one high stand systems tract (HST), and another one maximum flooding surface (MFS).

Our sequence stratigraphic interpretation was constructed by using an integrated dataset including: (1) Biozonation; and (2) the environmental interpretation of depositional facies based on sediment logical and micro paleontological observations.

Sequence 1 (Rupelian): Sequence 1 includes the upper part of the Jahrum Formation and the lower part of the Asmari Formation. TST was clearly recognized in this area. The thickness of this sequence is 100 m and includes HST and TST facies. Its lower boundary is made of SB1, which is deposited in the form of an inconsistent erosion boundary with Jahrum Formation and its upper boundary is made of SB2. Maximum Flooding Surface (MFS) is determined by wackestone facies of Nummulites bioclastic accompanied with fragments of Bryozoan shells. With respect to para sequences, TST facies is a process of progression and HST facies is a stable and growth process (Fig. 4).

Sequence 2 (Aquitanian): the thickness of this sequence is 105 m and the lower and upper boundaries are made of SB2. It includes TST and HST facies. With respect to para sequences, TST facies is a process of progression and HST facies first shows a stable or growth process and then a regressive one (Fig. 4.)

Paleo-ecological implications

According to sequence stratigraphy and identification of sequence facies in TST facies of sequence number one, the size of Nummulites, in comparison of HST facies, is increasing also this is the same noticeable sequence. In TST facies of sequence number one, torsion like shapes of Peneroplis is observed as more complex than HST facies and arms of these species are more open. The interesting relations of paleoecology changes have direct relation with local sequence facies whit changes of sedimentary environment, most of the physical biotope parameters and foraminifera's crust are changes. (Fig. 5). In frontward barrier and barrier environments, the most percentage of foraminifera Lagoon in environments, is observed with Hyalin crust, and the most percentage of foraminifera in tidal flat environments, is observed with Porcelanous crust, the most percentage of foraminifera in open marine environments, is observed with Agglutinate Crust (Fig. 5) (Fig. 6).

CONCLUSIONS

In general, according to lithostratigraphy, biostratigraphy and Microfacies and also with respect to principles and rules of sequence stratigraphy, two sedimentary sequences of the third order cycle for the studied sediments were recognized and introduced including the following sequences:

Sequence number one: thickness of this sequence is 100 m and it includes HST and TST facies. Its lower boarder is made of SB1 which is settled in the form of inconsistent boundary erosion with Jahrum Formation and its upper boarder is made of SB2. maximum progressive level of MFS is determined by Wackestone facies of Nummulites bioclastic accompanied with fragments of Bryozoa shell. With respect to para sequences, TST facies is a process of progression and HST facies is a stable and growth process.

Sequence number two; the thickness of this sequence is 105 m and the lower and upper boarder is made of SB2. It includes TST and HST facies. With respect to para sequences, TST facies is a process of progression and HST facies first shows a stable or growth process and then a regressive one.

The age of sequence number one is Rupelian- Chattian and the age of sequence number two is Aquitanian.

According to(James, 1965) the studied region is located in the interior Fars. Its lower boundary is observed discontinuous with Jahrum Formation and its upper boundary is observed with Razak Formation.

According to Paleoecology studies, although there is low diversity in the studied area of Biozone number one in open marine and frontward barrier, the abundance is high and it is called Eutrophic environment, while in Biozone number one there exists a high diversity but with regard to species, abundance is low that is related to environments of lagoon and tidal flat and it is indicator of Oligotrophic.

REFERENCES

1. Adams, T. and F. Bourgeois, Asmari biostratigraphy. Iranian Oil Operating Companies, Geological and Exploration, 1967.
2. Alavi, M., Regional stratigraphy of the Zagros fold-thrust belt of Iran and its proforeland evolution. American journal of science, 2004. 304(1): p. 1-20.
3. Bahroudi, A. and H.A. Koyi, Tectono-sedimentary framework of the Gachsaran Formation in the Zagros foreland basin. Marine and Petroleum Geology, 2004. 21(10): p. 1295-1310.
4. Berberian, M. and G. King, Towards a paleogeography and tectonic evolution of Iran. Canadian journal of earth sciences, 1981. 18(2): p. 210-265.
5. Cahuzac, B. and A. Poignant, Essai de biozonation de l'Oligo-Miocène dans les bassins européens à l'aide des grands foraminifères néritiques. Bulletin de la Société géologique de France, 1997. 168(2): p. 155-169.
6. Dunham, R.J., Classification of carbonate rocks according to depositional textures. 1962.
7. Ehrenberg, S., et al., STRONTIUM ISOTOPE STRATIGRAPHY OF THE ASMARI FORMATION (OLIGOCENE-LOWER MIOCENE), SW IRAN. Journal of Petroleum Geology, 2007. 30(2): p. 107-128.
8. Embry III, A.F. and J.E. Klovan, A late Devonian reef tract on northeastern Banks Island, NWT. Bulletin of Canadian Petroleum Geology, 1971. 19(4): p. 730-781.
9. FALCON, N.L., Major earth-flexuring in the Zagros Mountains of south-west Iran. Quarterly Journal of the Geological Society, 1961. 117(1-4): p. 367-376.
10. Flügel, E., Microfacies analysis of carbonate rocks. Analysis, interpretation and application. Springer, Berlin, 2004.
11. Heydari, E., Tectonics versus eustatic control on supersequences of the Zagros Mountains of Iran. Tectonophysics, 2008. 451(1): p. 56-70.
12. James, G. and J. Wynd, Stratigraphic nomenclature of Iranian oil consortium agreement area. AApG Bulletin, 1965. 49(12): p. 2182-2245.
13. Laursen, G., et al. The Asmari Formation revisited: changed stratigraphic allocation and new biozonation. in Shiraz 2009-1st EAGE International Petroleum Conference and Exhibition. 2009.
14. Motiei, H., Stratigraphy of Zagros. Treatise on the Geology of Iran, 1993(1): p. 60-151.
15. Pickford, M., et al., Humid conditions in the western desert of Egypt during the Vallesian (Late Miocene). Bulletin of the Tethys Geological Society, 2008. 3: p. 63-79.
16. Sepehr, M. and J. Cosgrove, Structural framework of the Zagros fold–thrust belt, Iran. Marine and Petroleum geology, 2004. 21(7): p. 829-843.
17. Stocklin, J., Structural history and tectonics of Iran: a review. AAPG Bulletin, 1968. 52(7): p. 1229-1258.
18. Thomas, A. The Asmari limestone of southwest Iran. in International Geological Congress, Report of the 18th Session, UK. 1948.
19. Van Buchem, F., et al., Regional stratigraphic architecture and reservoir types of the Oligo-Miocene deposits in the Dezful Embayment (Asmari and Pabdeh Formations) SW Iran. Geological Society, London, Special Publications, 2010. 329(1): p. 219-263.
20. Van Wagoner, J., et al., An overview of the fundamentals of sequence stratigraphy and key definitions. 1988.
21. Vaziri-Moghaddam, H., M. Kimiagari, and A. Taheri, Depositional environment and sequence stratigraphy of the Oligo-Miocene Asmari Formation in SW Iran. Facies, 2006. 52(1): p. 41-51.
22. Wynd, J., Biofacies of the Iranian Oil Consortium Agreement Area IOOC Rep. No. 1082. 1965, Unpublished.

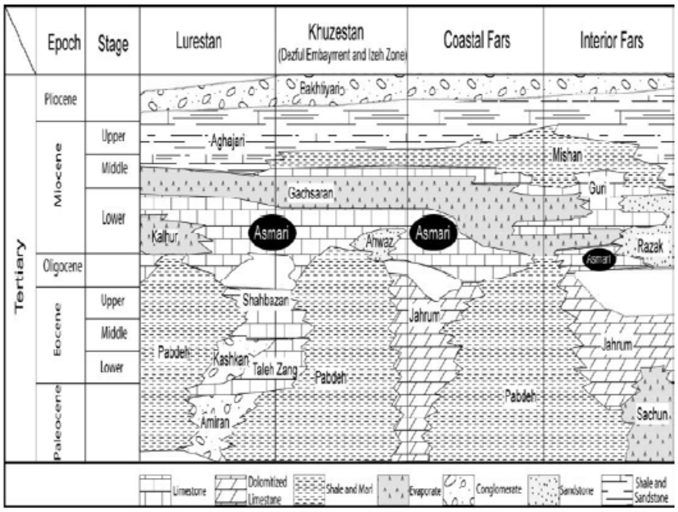

Fig. 1 Cenozoic stratigraphic correlation chart of the Iranian Sector of the Zagros Basin, adapted from (James, G. and J. Wynd,1965).

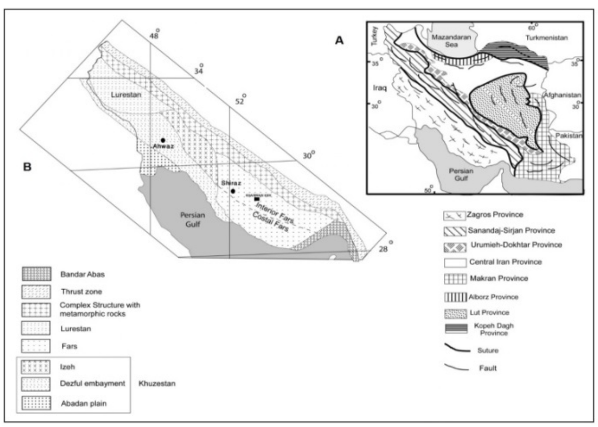

Fig. 2 (a) General map of Iran showing eight geologic provinces. The study area is located in Zagros Province (Heydari, E,2008) (b) Subdivisions of the Zagros province, after (Motiei, H ,2004).

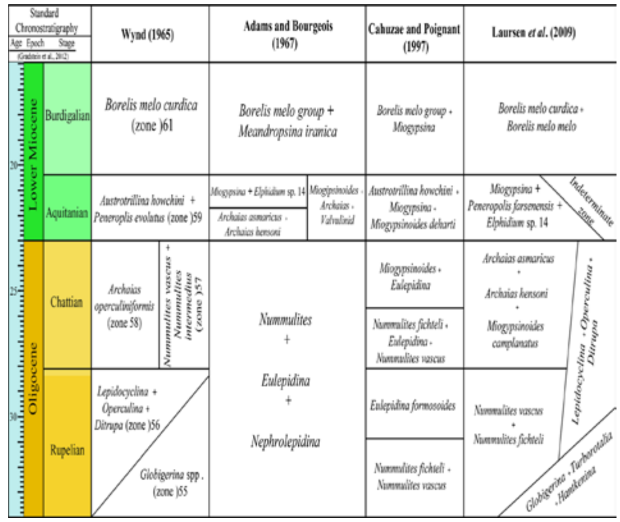

Fig. 3 Comparison of the Asmari Formation biozones of (Wynd, J,1965; Adams, T. and F. Bourgeois, Asmari biostratigraphy,1967; Laursen, G,2009; Cahuzac, B. and A. Poignant ,1997).

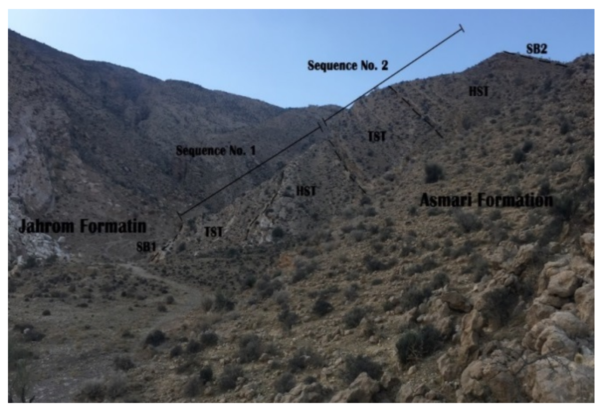

Fig. 4 A view of the Sequence Stratigraphy of the Kharman Kuh Section in the Asmari Formation.

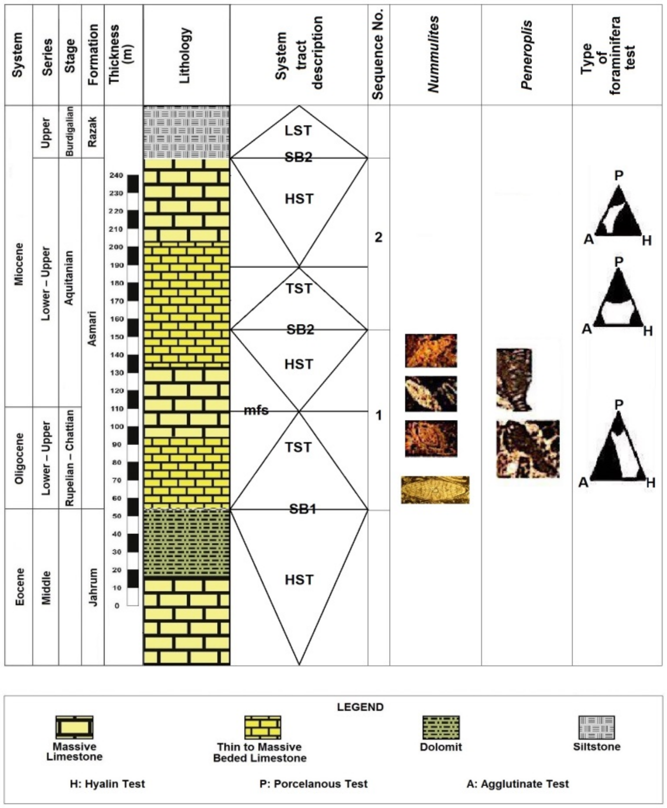

Fig. 5 Relationship between the underlying and Microfacies type of foraminifera and Microfacies the right sequence and facies sedimentary environment and changes in the form of twists and foraminifera shells Peneroplis family and diagram sizes Nummulites and facies changes in TST and HST sequence (1).

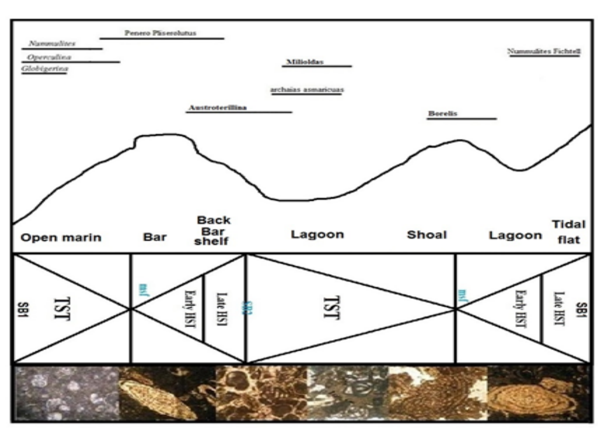

Fig. 6 The block diagram of Asmari Formation sedimentary basin in the studied stratigraphic sections, according to sedimentary facies condition and sequence facies sets condition and biozones.

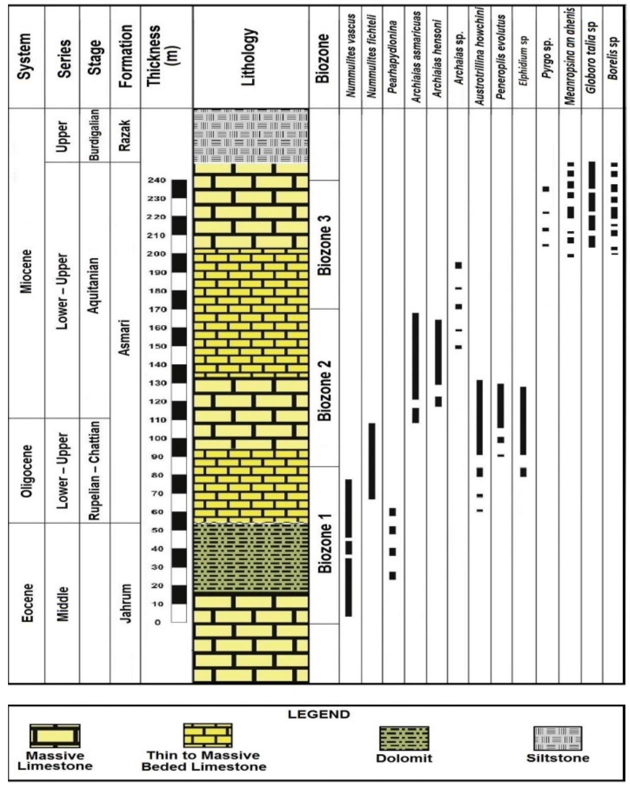

Fig. 7 Faunal distribution, biozonation and lithology of the Asmari Formation at Kharman kuh area**.**

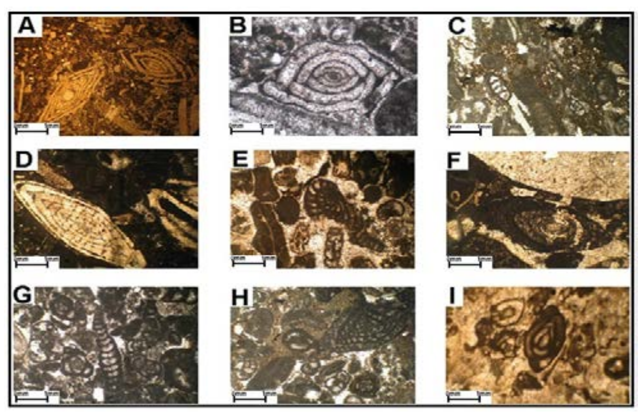

Fig. 8 Some selected foraminifera from studied Section (kharman kuh).

(A): Nummulites vascus, (B): Pyrgo sp., (C): Elphidium sp., (D): Nummulites fichteli, (E): Peneroplis evolutus, (F): Archias sp., (G): Phreyrapydionina sp., (H): Archias asmaricus, (I): Austroterillina howchini.