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Bio Stratigraphy and Lithostratigraphy of the Lower to Upper Eocene Sediments (Jahrum and Pabdeh Formations) in Zagros Basin, South-West Iran

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ABSTRACT

In this research, 3 stratigraphy sections were selected from the Jahrum and Pabdeh formations in the interior fars from Zagros foreland basin in South-West of Iran. The Jahrum and Pabdeh formations are included foure Rock units in stratigraphic sections. Twenty-eight foraminifer's genera and species are discovered in the study areas and have been scattered in five biozone. Based on biozones study, the age of the aforementioned sediments is from Lower to Upper Eocene. Totally which are as follow : Biozone No. 1 : *Morzovella formosa, Morzovella aragoensis* Assemblage zone, (Lower Eocene-Pabdeh formation). Biozone No. 2 : *Morzovella lehneri* zone, (Middle Eocene-Pabdeh formation). Biozone No. 3 : Dictyoconus – Coskinolina – Orbitolites complanatus assemblage zone, (Middle Eocene Jahrum formation). Biozone No. 4 : *Somalina stefaninii* subzone, (Middle Eocene–Jahrum formation). Biozone No. 5 : *Turborotalia cerroazulensis* zone, (Upper Eocene –Pabdeh formation). Also lower and upper bouandery lithostratigraphy of Jahrum and Pabdeh formations has been in the study areas.

Keywords Biozone, Jahrum and Pabdeh formations, Lower to Upper Eocene, Zagros.

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INTRODUCTION

The Zagros sedimentary basin with length of about 2000 km is one part of the Alpine Himalayan orogeny belt, which begins with the Northwest -Southeast trend of Turkey and extends to the Makran subduction zone in the South-East of Iran. The Zagros sedimentary basin consists of a thick sedimentary sequence that covers the Precambrian basement formed during the Pan African orogeny. The total thickness of the sedimentary column deposited above the Neoproterozoic Hormuz salt before the Neogene Zagros folding reach over 8 to 10 km (Maghfouri-Moghadam and Samiei 2015). The Ardel area, located in the South-

ern part of Chaharmahal va Bakhtiari Province and in terms of the Zagros structural land division is a general Northwest-Southeast direction. The study area is extended in a general Northwest-Southeast direction. The study area is a part of Zagros zone (Heydari 2008). The Jahrom formation has long been of particular interest due to its large extent, biostratigraphic and lithostratigraphic differences in different sections, stratigraphy and the existence of hydrocarbon mineral deposits (Monjezi et al. 2015). According to the studies conducted for the first time by Wynd (1965), the age of this formation is Paleocene-Eocene. The age of this formation based on Foraminifera identified in the studied stratigraphic section is Upper Paleocene to Middle Eocene. The lower boundary of this formation in the study area is considered as conformable with Sachun formation and its upper boundary is as erosional discontinuity with the Asmari formation. In terms of structural geology, the study area is located in folded Zagros. The Jahrum formation extends northward in the Fars platform between the two trough of Lengeh and Khuzestan. In this area, the formations were deposited at the early Paleocene and then deposited on the Jahrum coastal carbonates that developed around the Fars platform. At several sites in the inner Fars and in the Hinterland of Bandar Abbas, the Razak formation and the Sunni equivalent to the Asmari formation are located discontinuously on the Jahrum formation (Vaziri-Moghaddam et al. 2010). Pabdeh formation with Paleocene, Eocene, Oligomiocene and lithology marls and shales and Marl lime is found in different parts of Zagros. Pabdeh formation is a shale-marl unit related to marine area extended to South-West areas of Lorest, Khuzestan and Southern areas of Fars and is replaced by Jahrum formation at the Western and North-East end. Towards the South-East of the Pabdeh formation, it extends from Khuzestan to Fars, to Firoozabad (Ehrenberg et al. 2007). From this location to the South-East, a mixture of Pabdeh and Jahrum forms is seen; finally it is replaced in the Fars Pabdeh formation by the Jahrum formation.

MATERIALS AND METHODS

The main objective of this article reports on lithostratigraphy, biostratigraphic and sequence stratigraphy study to the determination of the Oligocene-Miocene benthic Foraminifera and distributions them in the 3 stratigraphic sections and introduction of biozone and the age detection. This results could contribute to the better understanding outcrop of the Asmari formation in the study areas and discuss about paleoenvironment.

Geological and geographical settings

The Zagros region is located to the South-West of Iran and divided into six major tectonostratigraphic domains : The Interior Fars, Coastal Fars provinces, Dezful embayment, The lzeh zone, The Lurestan province and The High Zagros zone (Fig. 1). The Zagros basin was associated to the Gondwana supercontinent during the Paleozoic. It was a site of passive margin and convergent orogeny in the Mesozoic and Cenozoic eras, respectively (Heydari 2008).

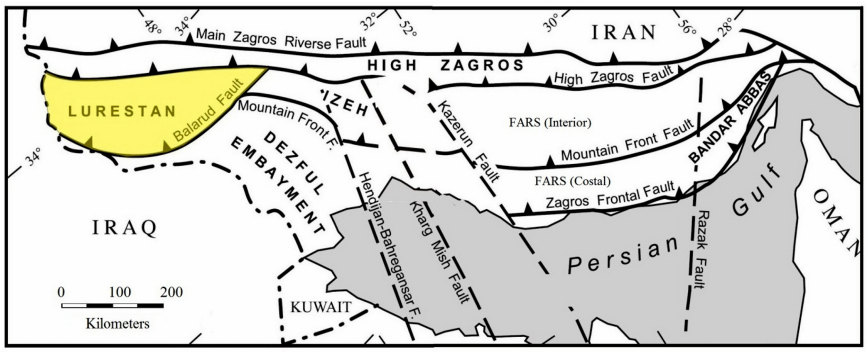

Fig. 1. Six major tectonostratigraphic domains of the Zagros basin (Motiei 1993). Tectonic subdivision of Zagros with the main structural trend (Sherkati and Letouzey 2004). The study areas are located in Interior fars.

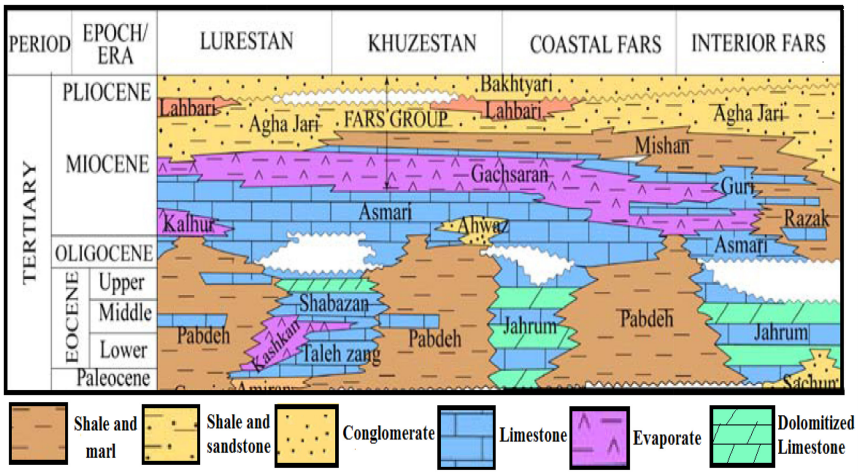

Fig. 2. Cenozoic stratigraphic correlation chart of the Iranian Sector of the Zagros basin, adopted from James and Wynd (1965).

In the most places of the Zagros basin, included Lurestan, Khuzestan and some parts of the Coastal Fars and Interior Fars provinces the Asmari formation lies conformably on the deeper facies of the Pabdeh formation (Paleocene—Oligocene). The upper contact of the Asmari formation with the Gachsaran formation is marked by an unconformity in most places (Fig.2). The Ahmadi anticline section is located (~± 65 km) South-West of Shiraz city from folded Zagros belt of International Fars.

Geographic coordination of Haji Abad section is described 31° 55´ N, 50° 54´ ´´E (Fig. 3 and Fig. 2). The Haji Abad section (Kuh-e Hamzeh Ali) is located (~ ± 45 km) North-West of Haji Abad village from folded Zagros belt of International Fars. Geographic coordination of Gusheh section is described 31° 58´ N, 50° 33´ E (Fig. 3 and Fig. 2).

Lithostratigraphy

The sampling section of the Jahrum formation has been measured by Jamsowind (1965) in theTang Ab on the Northern slope of the Jahrum Mountains South of the Jahrum city in Fars province. The name of this formation is derived from Jahrum Mountain in the South of Jahrum city about 200 km South-East of Shiraz in Fars province. This formation was also called Eocene Lime and Geishoon Lime. Lithology of Jahrum formation in the sample section consists

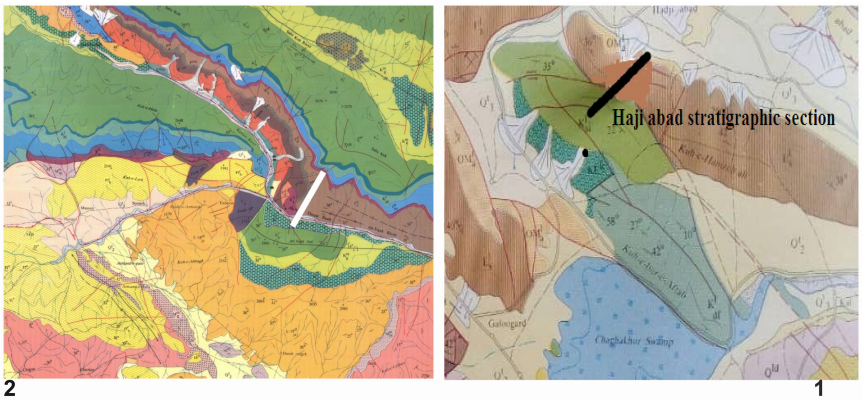

Fig. 3. Location of the study area. 1) Kuh-e Hamzeh Ali, Haji Abad section, is located (± ~ 45 km) North of West of Haji Abad Village. 2) Gusheh section is described 31° 58´ N, 50° 33´ E.

of 467.5 m dolomitic and dolomitic lime that is 35.5 m lower mass dolomitic as gray to brown weathered, 162 m middle dolomitic with deeper weathering with low to moderate layering and 270 m above lime, bulk dolomitic, coarse and prominent as pea-to-pale brown dolomites lay harmoniously on silty marls and dolomites of the Sachun formation, the upper boundary of which is characterized by erosional discontinuity with the Asmari formation (Laursen et al. 2009).

In general, the type section of the Jahrum formation is lithologically distinguishable from the following sections : The lower part (about 35 m) of brown dolomites and the mass of which the base part is shear. The middle section (161.5 m) contains thin-to-medium dolomites. The upper part (28.7 m) is dolomitic lime with numerous microfossils.

Its lower contact is conformable with the Sachun formation. Its upper contact with the Asmari formation is erosional disconformity. Many fossils are found in the Jahrum formation and according to them , the age of the Jahrum formation has been determined Paleocene to Middle Eocene. In the Coastal Fars region, the age of the upper part of the Jahrum formation is Late Eocene (Figs. 4 and 5).

Geographically, Jahrum formation is found in inner Fars and Coastal Fars. In Khuzestan, excavations have been only observed in the South-Western Zagros. In the central and North-East of Lorestan, the Jahrum formation is divided into Tele-Zang formation and the Shahbazan formation via the Kashkan conglomerate. In other areas of Zagros (South-West of Lorestan, Khuzestan and Kazeroon - Firouzabad), instead of Jahrum formation, shale-Marl formation and clayey limestones of Pabdeh are observed. As mentioned, a regional unconformity is found between the Jahrum formation and the Asmari formation, but in some parts of the inner Fars Razak formation is lo-

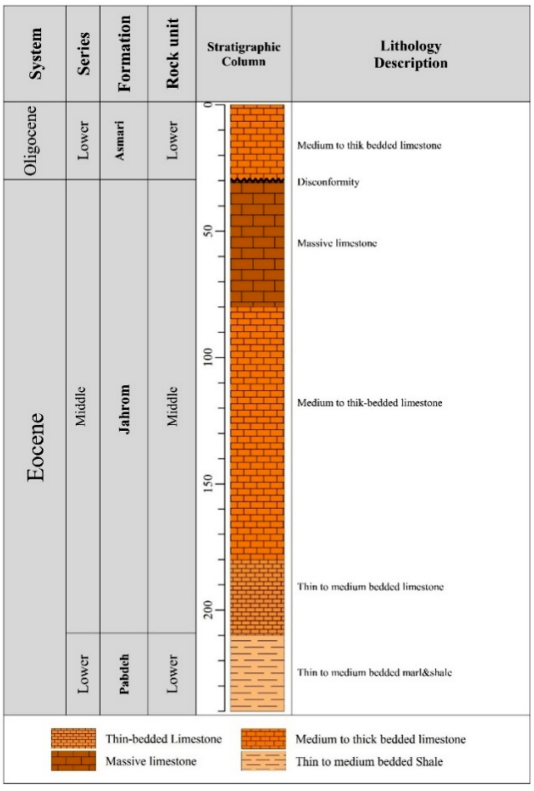

Fig. 4. Image of stratigraphic column of Haji Abad section.

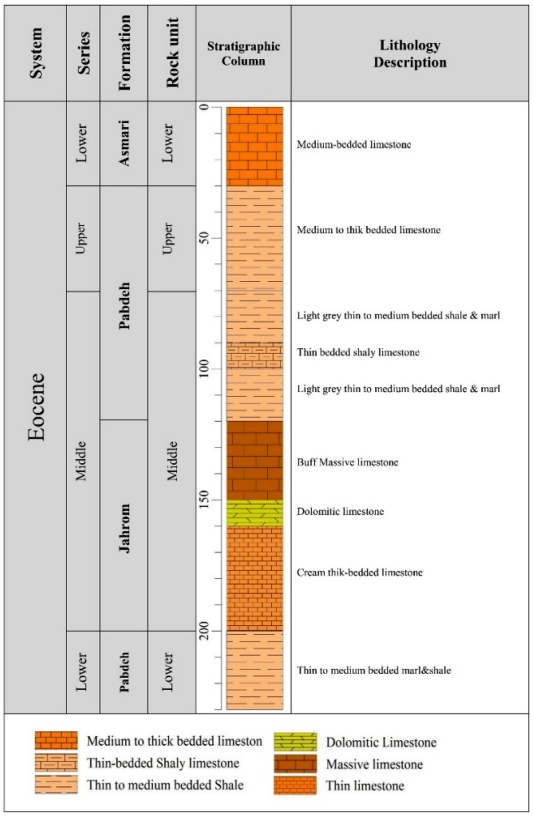

Fig. 5. Image of the stratigraphic column of Gushe section.

Fig. 6. View of the gradual boundary of the Jahrum formation with the Pabdeh formation in the Gushe stratigraphic section (North-West view).

cated unconformably on the Jahrum formation. Where there is no Sachun formation, the Jahrum formation is located on two Pabdeh and Gurpi formations. Pabdeh sample section is located in the most South-Eastern part of Pabdeh Mountain. This formation is composed of shale and gray clay lime and consists of two parts : The lower part of the purple shale and the upper part called theTelezang section from red to grey silt shael and sand and thin clay lime. The purple shale section contains purple shales and marls that are the lowest stratigraphic unit of the Pabdeh formation and where present, constitute an important row in the separation of the Pabdeh and Gurpi formations. This section extends well into central Lorestan and South-West of Lorestan and is found locally to Fars.

In general, in the studied areas, in terms of litho-stratigraphy, the Jahrum formation is characterized by

Fig. 7. Image of thick to medium limestone of the Jahrum formation in Gushe stratigraphic section (North-West view).

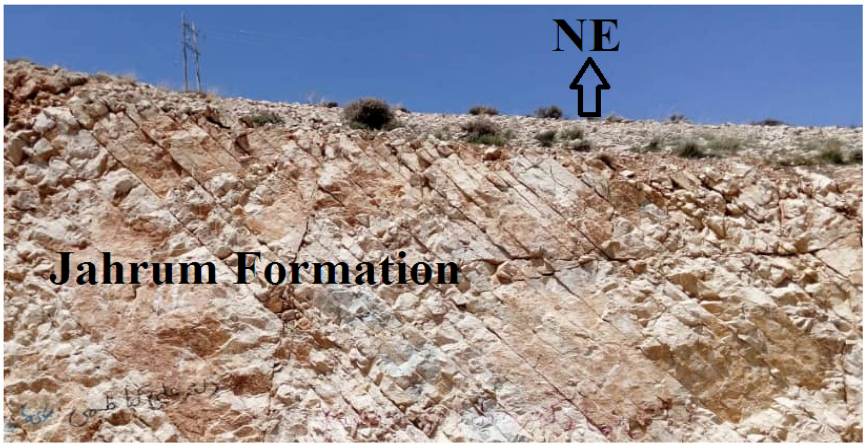

Fig. 8. Image of thick to medium limestone of Jahrum formation in Haji Abad stratigraphic section (North-East view).

interfingering with Pabdeh formation. In other words, the studied sections are located in the lateral facies of Jahrum and Pabdeh formation. In the stratigraphic sections are located in the areas of the boundary of changing lateral facies of Jahrum and Pabdeh formations. In Haji Abad and Gushe stratigraphy sections, this issue is visible (Figs. 2—4). Eocene sediment thickness in Haji Abad stratigraphic section is 225 m with 40 m base including shale and dark gray marl (thin) (Pabdeh formation) to Lower Eocene age and 185 m remaining of light yellow to light gray mass (Jahrum formation) to Middle Eocene. The upper boundary in this section is observed as an erosional discontinuity with the Asmari formation. The absence of sediments to the Upper Eocene indicates a sedimentary absence at this boundary, this discontinuity can be equivalent to the orogenic phase function of Pyrenean. The thickness of Eocene sediments in the stratigraphic section of the Gushe is 200 m, of which 120 m are alternately thin shale dark gray shales (Pabdeh formation) and the rest includes thin limestone to creamy to light gray mass (Jahrum formation). It is noteworthy that this section is located on the lateral facies of the Pabdeh and Jahrum formations. In other words, the facies of the two formations are interfingered or alternating on each other, indicating depth and topographic changes of the sedimentary basin (Figs. 6—8).

Biostratigraphy

In biostratigraphy analysis of the Jahrum and Pabdeh formation 32 genera and 23 species of benthic and planktonic Foraminifera, as well as bryozoans, algal, radiolaria and sponge spicules were recognized. Based on the planktonic Foraminifera and biozones of Premolisilva and Verga (2004), Loeblich and Tappan (1987). Also 6 biozones were (planktonic and benthic Foraminifera) identified. The images of the recognized Foraminifera have been shown in (Fig. 4). Also, the distribution of planktonic and benthic Foraminifera was presented in Fig. 4. The presented biozones in this study from base to top are as following : Biozone No. 1 : *Morzovella formosa, Morzovella*

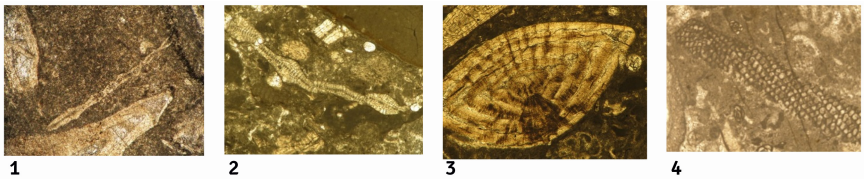

Fig. 9. *Actynocyclina* sp. (Lower Eocene) 1 & 2, *Nummulites* cf. *globulus* (Middle Eocene), *Orbitolites* cf. *complantus* (Middle Eocene).

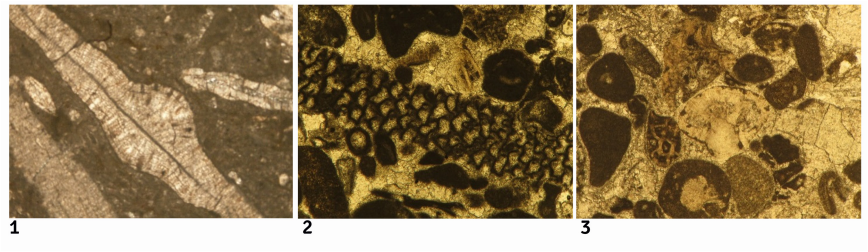

Fig. 10. *Discocyclina* sp. (Lower Eocene), *Orbitolites* cf. *complantus* (Middle Eocene), *Rotalia* sp. (Lower to Middle Eocene).

aragoensis Assemblage zone. Lower Eocene—Pabdeh formation. Biozone No. 2 : *Morzovella lehneri* zone. Middle Eocene —Pabdeh formation. Biozone No. 3 : *Dictyoconus —Coskinolina—Orbitolites complanatus* Assemblage zone. Middle Eocene—Jahrum formation. Biozone No. 4 : *Somalina stefaninii* subzone. Middle Eocene —Jahrum formation. Biozone No. 5 : *Turborotalia cerroazulensis* zone. Upper Eocene —Pabdeh formation.

Biozone No. 1

Morzovella formosa, Morzovella aragoensis Assemblage zone

This biozone is related to the Pabdeh formation and is observed at the base of both studied stratigraphic sections. The thickness of this biozone is 40 m in Haji Abad stratigraphic section and 30 m in stratigraphic section of Gushe. The beginning of this biozone is consistent with the presence of Foraminifera. *Morzovella gracilis, Morzovella graveli, Morzovella formosa, Morzovella aragoensis, Hastigerina bolivariana, Globigerina aspensis.* This zone is with the age of the biozone (Fig. 9). Lower Eocene.

Biozone 2

Morzovella lehneri zone

This biozone was observed in the middle part of the stratigraphic section of Gushe and the thickness of this zone is 50 m. At the beginning of this zone, species such as *Morzovella soldadoensis, Globigerina primitiva* and *Morzovella formosa* have become extinct; and the presence of species such as : *Pseudohastigerina micra Morzovella aragoensis, Globigerina aspensis, Truncorotaloides topilensis, Morzovella lehneri, Hastigerina bolivariana* have been observed. But the study of pelagic microfossils in this area indicates that the beginning of this zone is accompanied by the emergence of species of *Globigerina senni, Globigerina boweri, Morzovella spinulosa, Hastigerina bolivariana* and *Acarina bulbruki* and are extinct at the end of it. This is consistent with Bolli. The age of this zone is Middle Eocene (Fig. 9).

Biozone 3

Nummolites —Alveolina Assemblage zone

This biozone was observed in both studied strati-

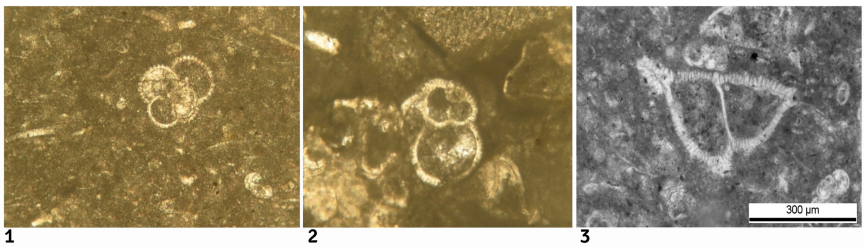

Fig. 11. *Morzovella quetra* (Early Eocene), *Truncorotaloides toplinensis* (Middle eocene), *Morzovella* cf. *subbotinae* (Early Eocene).

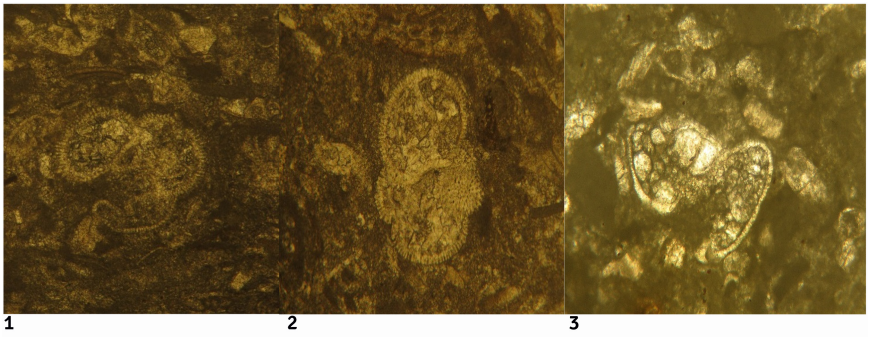

Fig. 12. *Globigerinatheka* sp. (Eocene), *Globigerinatheka mexicana* (Early Eocene).

graphic sections. The thickness of this biozone is 80 m in Gushe stratigraphic section and 150 m in Haji Abad stratigraphic section. The funestic accumulation of this zone includes : This is the age of this zone is Middle Eocene biozone, which can be equal to Biozone introduced at No. 51, 1965 of Wind (Figs. 10 and 11).

Biozone 4

Somalina stefaninii subzone

This subzone was observed only in the Haji Abad stratigraphic section. The thickness of this biozone is 40 m, located on biozone No. 2 . It is of Middle Eocene age and corresponds to biozone No. 48 introduced by Wind (1965). The bioaccumulation of this biozone includes (Fig.12).

Biozone 5

Turborotalia cerroazulensis zone

This biozone was observed in Gushe stratigraphic section and is 40 m thick. The aforementioned biozone is continuously located beneath the limestones of the akitanin sediments (Asmari formation). Bioaccumulation of this biozone includes : The age of this biozone is Upper Eocene and is consistent with the biozone introduced No. 52 of Wind (1965) (Fig. 13).

CONCLUSION

In this research, 2 stratigraphy sections were selected from the Jahrum and Pabdeh formations, based on the investigation of foraminifers of the studied sections, there are these biozones that have been identified which includes : Biozone No. 1 : *Morzovella formosa, Morzovella aragoensis* Assemblage zone. Biozone No. 2 : *Morzovella lehneri* zone. Biozone No. 3. *Dictyoconus — Coskinolina—Orbitolites complanatus* Assemblage zone. Biozone No . 4 : *Somalina stefaninii* subzone. Biozone No. 5 : *Turborotalia cerroazulensis* zone.

According to the introduced biozones, the age

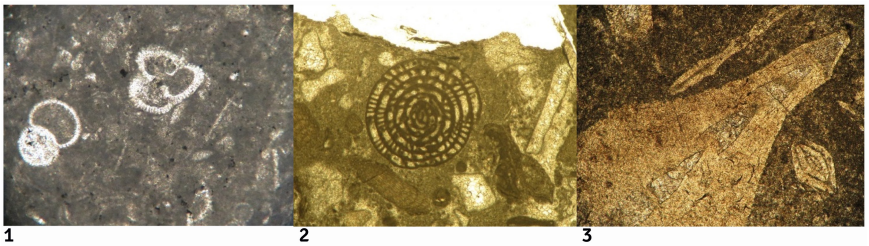

Fig. 13. *Globigeriatheka* sp. (Middle Eocene), *Alveolina* sp. *Rhapydionina malatyaensis* (Middle Eocene), *Assilina* sp. , *Nummulites praelucasi* (Middle Eocene).

of the studied sediments is considered from Lower Eocene to Upper Eocene. Totally in the study area in terms of lithostratigraphic, the status of Jahrum formation with Pabdeh formation is as interfingering. In other words, the studied sections are located in the lateral facies boundary of Jahrum and Pabdeh formation. In the stratigraphic sections of Haji Abad and Gushe, this issue is clearly visible. Eocene sediments thickness in Haji Abad stratigraphic section is 225 m with 40 m base including shale and dark gray marl (thin) (Pabdeh formation) to Lower Eocene age and 185 m remaining of light yellow to light gray mass (Jahrum formation) to Middle Eocene. The upper boundary in this section is observed as an erosional discontinuity with the Asmari formation. The absence of sediments to the Upper Eocene indicates a sedimentary absence at this boundary, this discontinuity can be equivalent to the orogenic phase function of Pyrenean. The thickness of Eocene sediments in the stratigraphic section of the Gushe is 200 m, of which 120 m are alternately thin shale dark gray shales (Pabdeh formation) and the rest includes thin limestone to creamy to light gray mass (Jahrum formation). It is noteworthy that this section is located on the lateral facies of the Pabdeh and Jahrum formations . In other words, the facies of the two formations are interfingered or alternating on each other, indicating depth and topographic changes of the sedimentary basin.

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