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Microbiostratigraphy of Middle Eocene Shahbazan Formation at the southeastern flank of Chenar Anticline, Lorestan Basin, Sw Iran

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Abstract

In this research, biostratigraphy related to the carbonate succession of the Shahbazan Formation at the southeastern flank of Chenar anticline, Lorestan Basin, is discussed. A study of large benthic foraminifera from the 294 m-thick Shahbazan Formation led to the identification of two Middle Eocene biozones: *Somalina* sp. Zone, *Nummulites-Alveolina* Assemblage Zone. The age of the Shahbazan Formation in the study area is determined as Middle Eocene. The Shahbazan Formation overlies the Pabdeh Formation and underlies Asmari Formation in the studied stratigraphic section. The lower part of Asmari Formation is characterized by thick – bedded of limestone, with *Nerpherolepidina* sp., which reflects deposition during Chattian age. In this study, we introduced a paraconformity between Shahbazan and Asmari Formations which is attributed to the Priabonian- Chattian.

Keywords: Eocene, Benthic Foraminifera, Biostratigraphy, Lorestan Basin, SW Iran.

1. Introduction

The Zagros Mountain is southern part of an Alpine orogenic belt [11]. It extends from southeastern Turkey through the northern Syria and Iraq to western and southern Iran [2] & [4]. Post tectonic and sedimentary events in Zagros resulted in formation of several definable basins Fig.2: Thrust Zone, Lorestan, Izeh, Dezful Embayment, Abadan plain, Fars, Bandar Abbas Hinterland [10]. By the end of Mesozoic time, the principle palaeogeographic features of southwestern Iran were the main trough of the Tethys to the north and the smaller minor trough which run from eastern Iraq southwestward trough southwest Lorestan and Khuzestan towards Central Fars province with an elongate ridge between these two troughs [9]. Pelagic sedimentation continued during the Paleogene time in this subsidiary trough with the deposition of marls and shales intercalated with subordinate argillaceous limestones which form the present day Pabdeh Formation. On the southwestern side of this trough, carbonate sedimentation continued during the Paleogene conformably onto the Arabian shield forming the Radhuma and Dammam formations. These two formations were separated by an evaporite unit called the Rus Formation, but this evaporitic sequence dies out towards southwest Iran where the entire carbonate sequence is called the Jahrum Formation.

In interior Fars province and between the two troughs, the evaporites of the Sachun Formation accumulated during the Paleocene, and were followed by shelf carbonates of the Jahrum Formation. In central and northeastern Lorestan, the uplift and then erosion of the radiolarites produced a great quantity of detritus that was carried southwestward, accumulated as flysch-type sediments forming the present Amiran and Kashkan formations during Late Maastrichtian-Eocene time.

These two units are separated by the carbonates of the Taleh Zang Formation. The Kashkan is also overlain by the dolomites of the Shahbazan Formation. East of Shiraz in interior Fars province, a tongue of carbonates materials with radiolarian cherts is present and has been correlated with the Sachun Formation. By the end of Eocene time, the widespread regression caused the greater portion of the region except the central parts of the troughs to emerge. The resulting disconformity is present over the entire area where Jahrum and Shahbazan formations are developed [12]. The Shahbazan Formation has been deposited in flanking shelves of the Lorestan Basin (Fig.1). Its name is after the village of Shahbazan in Lorestan province. The type section of the Shahbazan Formation was measured in the Thaleh-Zang rail road station in Khuzestan province by James & Wynd (1965) [7]. It consists of 332.8 m of white and brown weathering, bedded, porous, dolomite, dolomitic limestone and limestone at the type section [3]. The Kashkan Formation underlies the Shahbazan Formation, with

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apparent conformity. The contact is gradational. The upper contact with the limestone of the Asmari Formation is disconformable. At the contact, a leached brecciated zone marks the disconformity [12]. In the most places of the Lurestan basin, the Shahbazan Formation lies conformably on the elastic facies of the Kashkan Formation (Fig.2). In south and southwest Lurestan the Shahbazan Formation interfingers with marl of the Pabdeh Formation. In north and northeastern Lurestan, the Shahbazan and Asmari Formations form a prominent topographic unit. It is differentiated from the Asmari Formation by an intervening conglomeratic leached zone and a change from limestone of the Asmari to the dolomite of the Shahbazan Formation. This boundary is often difficult to place, thus making it necessary to map the two formations as one unit. In this case, the two names are by hyphenated [7]. The main objective of this research is microbiostratigraphy of the Shahbazan Formation based on the larger benthic foraminifera, at the Chenar anticline, which is located at the southeastern Lurestan Basin.

2. Material and Methods

The studied stratigraphic section is located at southeastern flank of Chenar anticline with geographic coordinates 48° 01' 45" E and 32° 45' 03" N (Fig. 3).

For this research, 100 samples from the Shahbazan Formation in the selected stratigraphic section were studied. The Shahbazan Formation is 294 m thick in this area and overlies the Pabdeh Formation and underlies the Asmari Formation (Fig. 4). The first micropalaeontological and biostratigraphical studies of the Shahbazan Formation were carried out by Wynd (1965) [13], Adams & Bourgeois (1967) and Jalali (1987) [1] & [6].

All rock samples and thin sections are housed in the Department of Geology, Lorestan University. The taxonomic determination of the foraminifera is based on the foraminiferal classifications: Loeblich & Tappan (1988), Rahaghi (1983) and Hohenegger (2000) [8], [14] & [5]. The determined taxa are represented by *Assilina* sp., *Discocyclina* sp., *Gypsina* sp., *Halkyardia* sp., *Orbitolites complanatus*, *Somalina stefanii*, *Somalina* sp., *Robulus* sp., *Alveolina rutimeyeri*, *Alveolina* sp., *Amphistegina* sp., *Nummulites ataticus*, *Nummulites globulus*, *Nummulites* sp., *Praerhapidionina* sp., *Nepherolepidina* sp., *Globigerinatatheca barri*.

3. Systematic palaeontology

Alveolina D'Orbigny, 1826

Alveolina rutimeyeri Hottinger, 1962

Fig. 1

Description: Test ellipsoidal to fusiform or cylindrical, rarely spherical, coiling irregular in early stage of

microspheric generation but regular through-out megalospheric generation, chambers rapidly increasing in width in successive whorls to result in progressive elongation of the test, numerous septula perpendicular to the septum and outer wall form many small chamberlets that alternate in position in successive chambers, several inner whorls may have extreme basal thickening of the wall that fills most of the chamber lumen.

Total range: Early- Middle Eocene

Range in the studied section: Middle Eocene.

Occurrence: Middle Fars (Jahrum Formation), Alborz (Karaj Formation). Sample No. 14CH.

Amphistegina D'Orbigny, 1826

Amphistegina sp.

Fig. 2

Description: Test low trochospiral, lenticular and inequally biconvex, may be bi-involute or parually evolute on the spiral side, chambers numerous, broad, and low, strongly curved back at the periphery to form chamber prolongations, interior of all chambers with primarily formed tooth plate that extends from the aperture face to about the middle of the previous septum and almost completely divides the chamber lumen.

Total range: Eocene-Holocene.

Range in the studied section: Late middle Eocene.

Occurrence: Middle East, Western Tethys. Sample No. 47CH.

Assilina D'Orbigny, 1826

Assilina sp.

Description: Test large, flattened, maybe involute but more commonly evolute, with rapidly enlarging whorls and numerous chambers per whorl. Sutures radial, slightly curved back at the periphery. Imperforate and may be elevated, septa simple. Septal flap unfolded, no trabeculae. Marginal cord thick. Canal system with elongate meshes in the marginal canal. Intra-septal canals join the lateral canals of the lateral walls that in turn connect the spiral canal at the base of the whorl to the bundle of marginal canals at the periphery, simple, narrow and short sutural canals along the lateral canals may be forked or ramified and form rows of alternating openings along the imperforate septal suture.

Total range: Middle Paleocene-Holocene

Range in the studied section: Middle Eocene.

Occurrence: Eastern Asia, Middle East, Western Tethys. Sample No. 93CH.

Discocyclina Gumbel, 1870

Discocyclina sp.

Fig. 3

Description: Test is large, microspheric test up to 23 mm in diameter, discoidal to lenticular, thin or centrally inflated, megalospheric embryo with small sublobular protoconch embraced by larger reniform

deuteroconch, radial partitions in equatorial chambers form concentric annuli of rectangular chamberlets, those of successive cycles alternating in position, adjacent chamberlets of an annulus connected by annular stolons at the proximal end of the radial walls, those of successive annuli connected by two or three radial stolons at different levels, about fifteen tiers of prominent lateral chambers comprise most of the test thickness, vertical stolons connect chamberlets of the equatorial layer with the lateral chambers. Well-developed pillars end in surface papillae; wall calcareous, with dark median lines representing interseptal spaces or fissures but not true canals, surface granulate.

Total range: Middle Paleocene-Upper Eocene.

Range in the studied section: Early middle Eocene.

Occurrence: Eastern Asia, Middle East, Western Tethys. Sample No. 46CH.

Globigerinatatheca Brönnimann, 1952

Globigerinatatheca barri Brönnimann, 1952

Fig. 10

Description: Test small, globular and delicate wall, deeply incised sutures. Small sutural apertures with distinct rims, it has smaller tightly coiled initial spire.

Total range: Middle Eocene.

Range in the studied section: Early middle Eocene.

Occurrence: Tropical and temperate regions of Tethys. Sample No.4CH.

Gypsina Carter, 1877

Gypsina sp.

Fig. 4

Description: Test is large, attached, formed by a few encrusting layers of chambers that are closely appressed, polygonal in outline, and somewhat inflated, with convex upper surface, chambers of successive layers alternating in position. Groups or clusters of chambers may form knobs that are slightly elevated above the general surface: wall calcareous of fibrous calcite, without perforations other than the large apertural pores: aperture consists of large pores on the upper surface of the chambers.

Total range: Early Oligocene-Holocene.

Range in the studied section: Early middle Eocene.

Occurrence: Jahrum Formation, Karaj Formation, Southern Tethys. Sample No.17CH.

Halkyardia Heron-Allen and Earland, 1918

Halkyardia sp.

Fig. 8

Description: Test commonly small, up to about 1.3 mm in diameter, biconvex. Spiral side more convex. Megalospheric test with large hemispherical protoconch, large deuteroconch, and two primary auxiliary chambers, later chambers in numerous cycles. Small as seen from the spiral side arched toward the periphery and alternating in position with those of the

pre-ceeding cycle, only those of the final whorl visible on the opposite side where the chambers appear elongate, inflated and tubular umbilical region beneath the embryonic chambers filled with a wide perforate plug formed by horizontal lamellae and connecting pillars, periphery subangular, peripheral outline lobulate: wall calcareous, optically radial. Thickened by addition of lamellae on the distinctly perforate spiral side: no aperture other than the surface pores.

Total range: Middle Eocene (Lutetian)-Middle Oligocene (Rupelian).

Range in the studied section: Early middle Eocene.

Occurrence: Tethys, Eastern Asia. Sample No.19CH.

Nephrolepidina Douville, 1911

Nephrolepidina sp.

Fig. 12

Description: Megalospheric early stage with small proloculus about half surrounded by the reniform deuteroconch, the two chambers slightly compressed, separated by a thin imperforate wall with a central foramen and surrounded by a common thick tabulated wall, later chambers variously arranged, resembling *Helicolepidina* but without the thick spiral wall. Equatorial layer of chambers arcuate in older species, in younger species these are pointed at the top, spatulate, and tend to become hexagonal: basal stolon present.

Total range: Middle Eocene-Early Miocene (Burdigalian).

Range in the studied section: Chattian.

Occurrence: Tethys, Eastern Asia, Central America, North Africa. Sample No. 55CH.

Nummulites Lamarck, 1801

Nummulites atacicus Leymeri, 1846

Fig. 5

Description: Test globular, lenticular or discoidal, commonly large, up to about 12 cm in diameter, dimorphism pronounced in larger species, planispirally enrolled, commonly involute but may be evolute in the later stage, proloculus and deuteroconch separated by an imperforate common wall with a single central round pore and with a row of pores at the base of the septum, outer wall of the embryonal chambers perforate, later chambers simple and undivided, many per whorl, septa curved back at the periphery and may be sigmoidal, supplementary stolons in the unfolded septa, distinct marginal cord on the periphery. Marginal canal with a network of elongate meshes, sutural canals ramified.

Total range: Early-Middle Eocene.

Range in the studied section: Middle Eocene.

Occurrence: Tethys, Eastern Asia. Sample No.15CH.

Nummulites globulus Lymerie, 1846

Fig. 11

Description: Test small, about 3 mm and thickness 1mm, lenticular, Biconvex with a sharp periphery. The septa are radiate, thin and numerous, about 18, there are 5 whorls with a radius of 1 mm. The proloculus small has an internal diameter of about 90×75 microns.

Total range: Late Paleocene- Middle Eocene.

Range in the studied section: Late Middle Eocene.

Occurrence: Tethys, Eastern Asia. Sample No. 73CH.

Orbitolites Lmark, 1801

Orbitolites complanatus Lmark, 1801

Fig. 7

Description: Test large, discoidal, very slightly biconcave, large proloculus and second chamber forming an inflated nucleoconch, later cyclic chambers subdivided into many chamberlets, those of successive cycles alternating in position, chamberlets of a single cycle not inter connected but those of successive cycles connected by a crosswise oblique stolon system, annular chambers less defined in the later stage and chamberlets separated by thickened oblique walls; aperture of numerous rounded openings in transverse rows crossing the peripheral margin.

Total range: Early-Middle Eocene.

Range in the studied section: Early middle Eocene.

Occurrence: Cental America, Tethys, Eastern Asia. Sample No.14CH.

Praerhapidionina Vav Vessem, 1943

Praerhapidionina sp.

Description: Test is elongate, subconical, up to about 1 mm in length, circular in section, early stage planispirally enrolled, later uncoiled and rectilinear, chambers low and arched centrally, interior subdivided by a few inward projecting radial septula; wall calcareous, porcelaneous; aperture terminal, central.

Total range: Eocene (Lutetian)-Oligocene.

Range in the studied section: Middle Eocene.

Occurrence: Tethys, Eastern Asia. Sample No.77CH.

Robulus Reuss, 1860

Robulus sp.

Fig. 6

Description: Test large, biconvex, involute, planispirally enrolled, outer wall perforate, aperture star like.

Total range: Cretaceous - Early Oligocene

Range in the studied section: Early middle Eocene.

Occurrence: Jahrum Formation, Tethys, Eastern Asia. Sample No. 15CH.

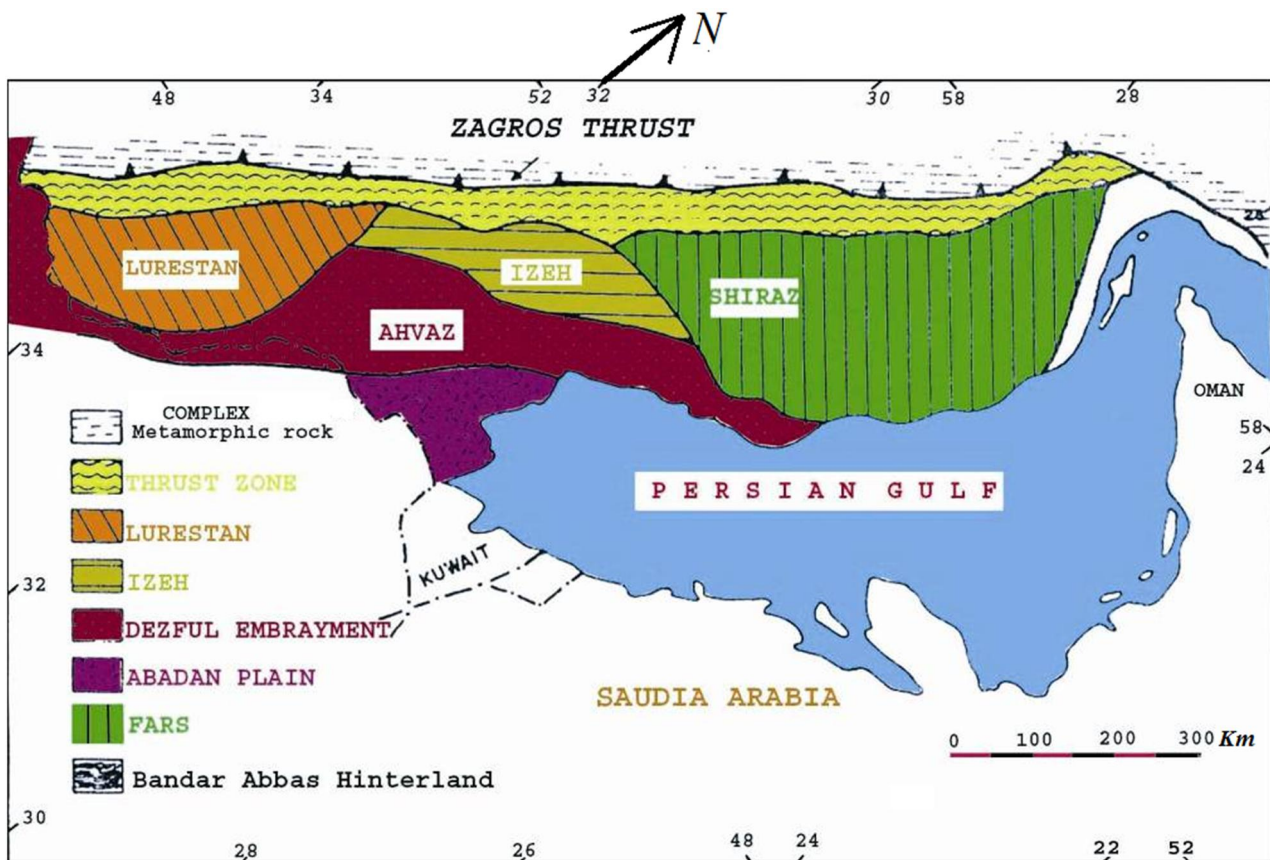


Fig. 1. Structural-sedimentary zones of Zagros Mountain (After Sherkaty & Letouzey, 2004).

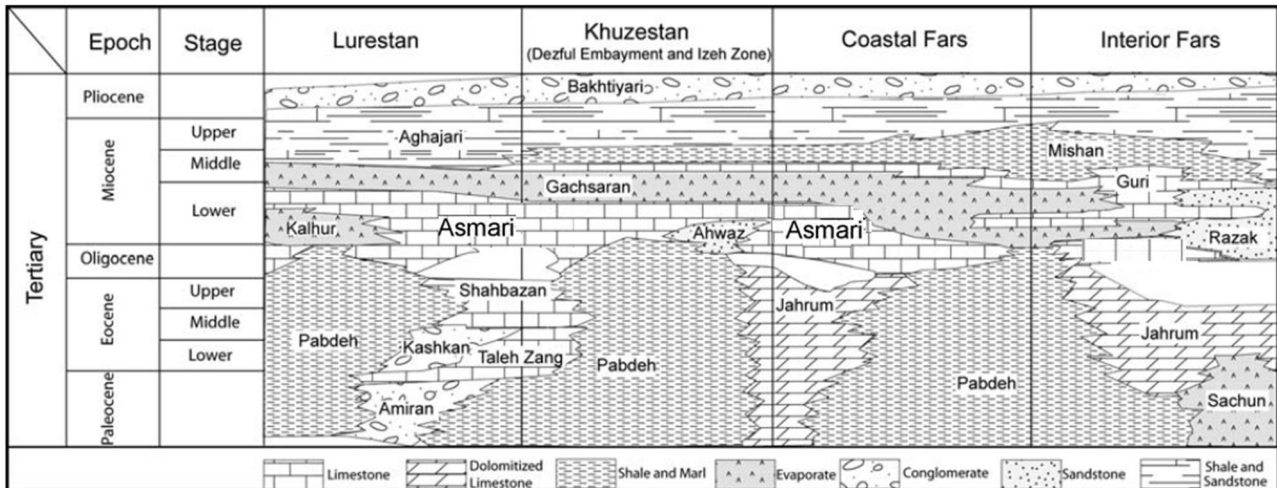


Fig. 2. A schematic stratigraphic section of the Cenozoic deposits of south west Iran, adapted from James and Wynd (1965).

Somalina Silvestri, 1938

Somalina stefanii Silvestri, 1938

Fig. 9

Description: Test large, up to 30 mm in diameter, discoidal to lenticular, cyclic chambers subdivided into chamberlets as in Orbitolites, with cross-wise oblique stolon system and possibly lateral stolons also, prominent lateral laminae as in Opertorbitolites enclose numerous chamberlets cavities, stolons connect the cavities to the main equatorial chamber layer; wall calcareous, imperforate, porcelaneous; aperture not described as all known specimens are embedded in limestone.

Total range: Middle Eocene (Lutetian).

Range in the studied section: Early middle Eocene.

Occurrence: Tethys, Eastern Asia, Pacific. Sample No.17CH.

4. Identified biozones

In this paper, two biozones have been recognized by distribution of the larger benthic foraminifera in the Chenar section of the Shahbazan Formation (Fig. 4). These two biozones are as follow:

1) *Somalina* sp. zone

This biozone is determined by the presence of *Assilina* sp., *Discocyclina* sp., *Gypsina* sp., *Halkyardia* sp., *Orbitolites complanatus*, *Somalina stefanii*, *Somalina* sp., *Robulus* sp. The faunal assemblage of this biozone corresponds to biozone no. 48 introduced by Wynd (1965), dated as Middle Eocene. The mentioned biozone forms the lower part of the Shahbazan Formation.

2) *Nummulites- Alveolina* Assemblage Zone

This biozone is defined by the presence of *Alveolina rutimeyeri*, *Alveolina* sp. *Amphistegina* sp., *Nummulites atacicus*, *Nummulites globulus*,

Nummulites sp., *Praerhapidionina* sp. The faunal assemblage of this biozone is exactly the same as the biozone no. 53 introduced by Wynd (1965) [13], dated as Middle Eocene. The mentioned biozone is located in the lower part of the Shahbazan Formation. Lower part of the Asmari Formation in this section is defined by the occurrence of *Nepherolepidina* sp. which suggested a Chattian age (?). In this case a para-conformity is identified between the upper part of the Shahbazan Formation (Middle Eocene) and the lower part of the Asmari Formation (Chattian).

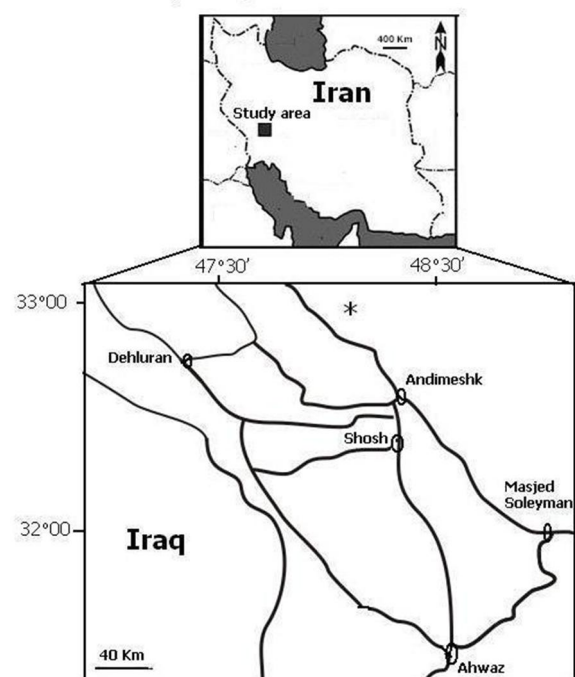


Fig.3. Location of studied area in northeastern of Andimeshk, SW of Iran (*).

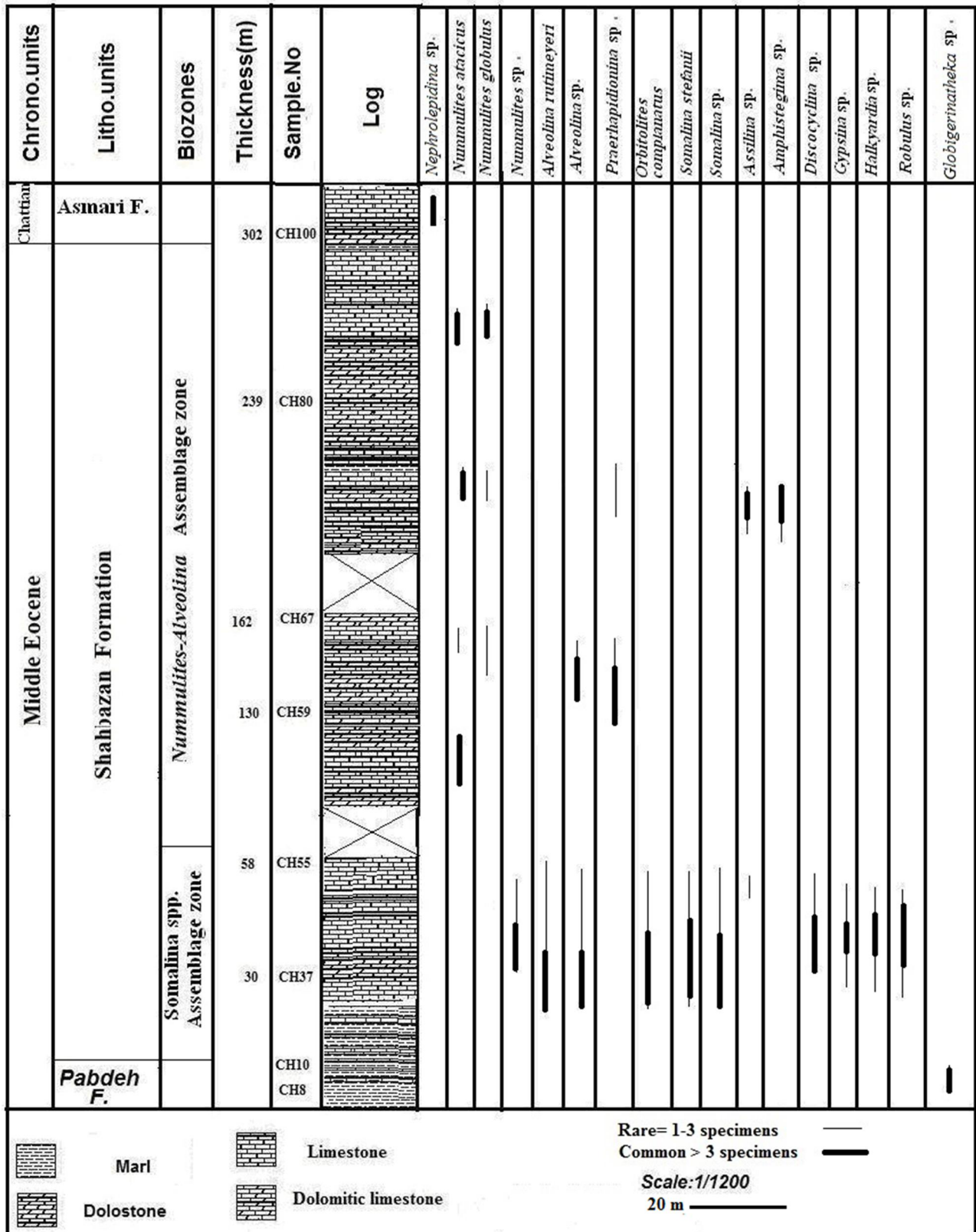
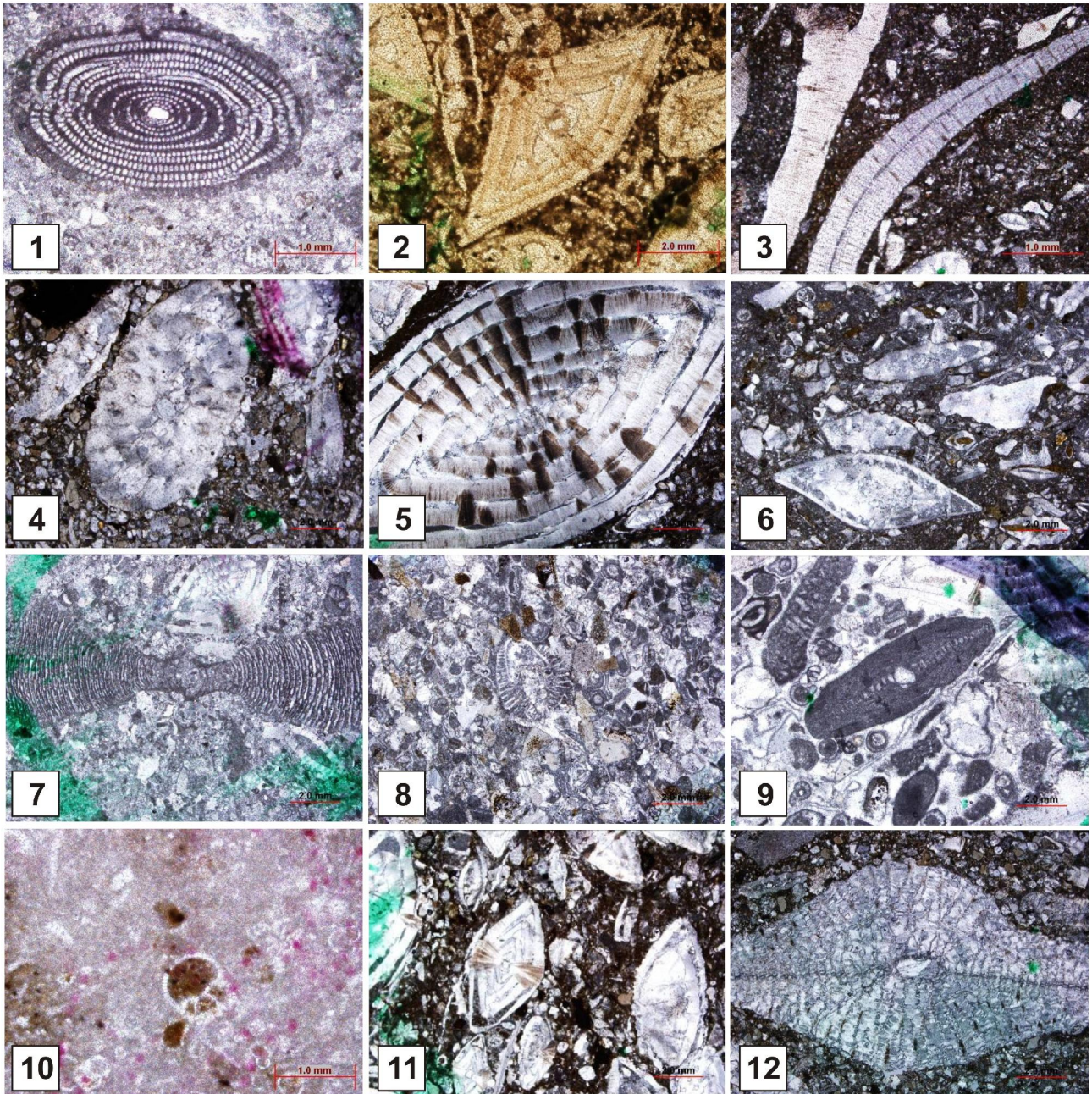


Fig. 4. Biostratigraphic column of the Shahbazan Formation in Chenar anticline.

Plate 1



1: *Alveolina rutmeyeri* (Sample No. 14CH), 2: *Amphistegina* sp. (Sample No. 47CH), 3: *Discocyclina* sp. (Sample No. 46CH), 4: *Gypsina* sp. (Sample No. 17CH), 5: *Nummulites atacicus* (Sample No. 48CH), 6: *Robulus* sp. (Sample No. 15CH), 7: *Orbitolites complanatus* (Sample No. 14CH), 8: *Halkyardia* sp. (Sample No. 19CH), 9: *Somalina stefanii* (Sample No. 17CH), 10: *Globigerinatastheca barri* (Sample No. 4CH), 11: *Nummulites globulus* (Sample No. 73CH), 12: *Nepherolepidina* sp. (Sample No. 55CH)

5. Conclusions

According to distribution of the benthic foraminiferal assemblage, the age of the Shahbazan Formation in the Chenar anticline is defined as Middle Eocene. The most important species are *Somalina* sp., *Orbitolites*

complanatus, *Somalina stefanii*, *Alveolina rutimeyeri*, *Alveolina* sp., *Amphistegina* sp., *Nummulites atacicus*, *Nummulites globules*. The occurrence of *Nepherolepidina* sp. in the lower part of the Asmari Formation reflects a para-conformity between the

Middle Eocene and Chattian (Late Oligocene). This gap is correlateable to Pyrenean Orogenic phase.

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