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LITHOSTRATIGRAPHY AND BIOSTRATIGRAPHY OF OLIGOCENE MIOCENE DEPOSITS (ASMARI FORMATION) IN SOUTH-WEST IRAN (ZAGROS BASIN, NORTHERN KHORRAMABAD)

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With 1 Figure, 2 Tables and 2 Plates

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ABSTRACT

For the lithostratigraphic and biostratigraphic analysis of the Asmari Formation in south-west of Iran (northern Khorramabad), two geological sections, one in the Kakareza region and the other one in the eastern Makhkalkuh, were selected and sampled. ≠It consists mainly of limestones, clayey limestones and sandy limestones. The Asmari Formation overlies the Shahbazan Formation with a paraconformity and underlies conformably the Gachsaran Formation. Based on micropalaeontologic research 40 genera and 19 species of benthic foraminifera, 3 genera and 2 species of pelagic foraminifera and 4 genera of calcareous algae (accompanied by a number of non-foraminifera) have been identified indicating a Burdigalian age for the sections under study. Based on the associated index foraminifera the *Borelis melo curdica - Meandropsina iranica - Schlumbergerina* assemblage zone has been selected. This biozone is comparable with the biozone NO. 1 of Adams & Bourgeois (1967) and biozone NO.61 of Wynd (1965). The *Borelis melo curdica - Meandropsina iranica - Schlumbergerina* assemblage zone is also considered to be equivalent to the biozone which was reported from the Upper Asmari Formation by Thomas (1948,1949).

Key words: Lithostratigraphy, biostratigraphy, foraminifera, Asmari Formation, Oligocene-Miocene, Iran

Introduction

The Asmari Formation is the youngest and most important reservoir rock of the Zagros Basin in the south-west of Iran which has been the focus of attention of a large number of geologists. There are, however still problems with respect to the exact litho- and chronostratigraphic position of this unit: with regards to the lithostratigraphy in the complete sections, the Asmari Formation has been divided into two members: one is the Sandstone Member of Ahwaz in the south-west of the Khuzestan area and the other one is the Evaporite Member of Kalhur in the Lorestan Province. With respect to the chronostratigraphy, according to Thomas (1948, 1949), this formation is divided into three units: the Lower Asmari with an Oligocene age, the Middle Asmari with an Aquitanian age, and the Upper Asmari with a Burdigalian age. However, these divisions do not exist everywhere, whether with regards to lithostratigraphy nor chronostratigraphy which is in itself extremely significant. Also, in some parts of Iran, the lower boundary of the Asmari Formation is in contact with the Pabdeh Shale Formation which is of Paleocene-Oligocene age, but in central Lorestan this formation is overlying the Late Eocene Shahbazan Formati-

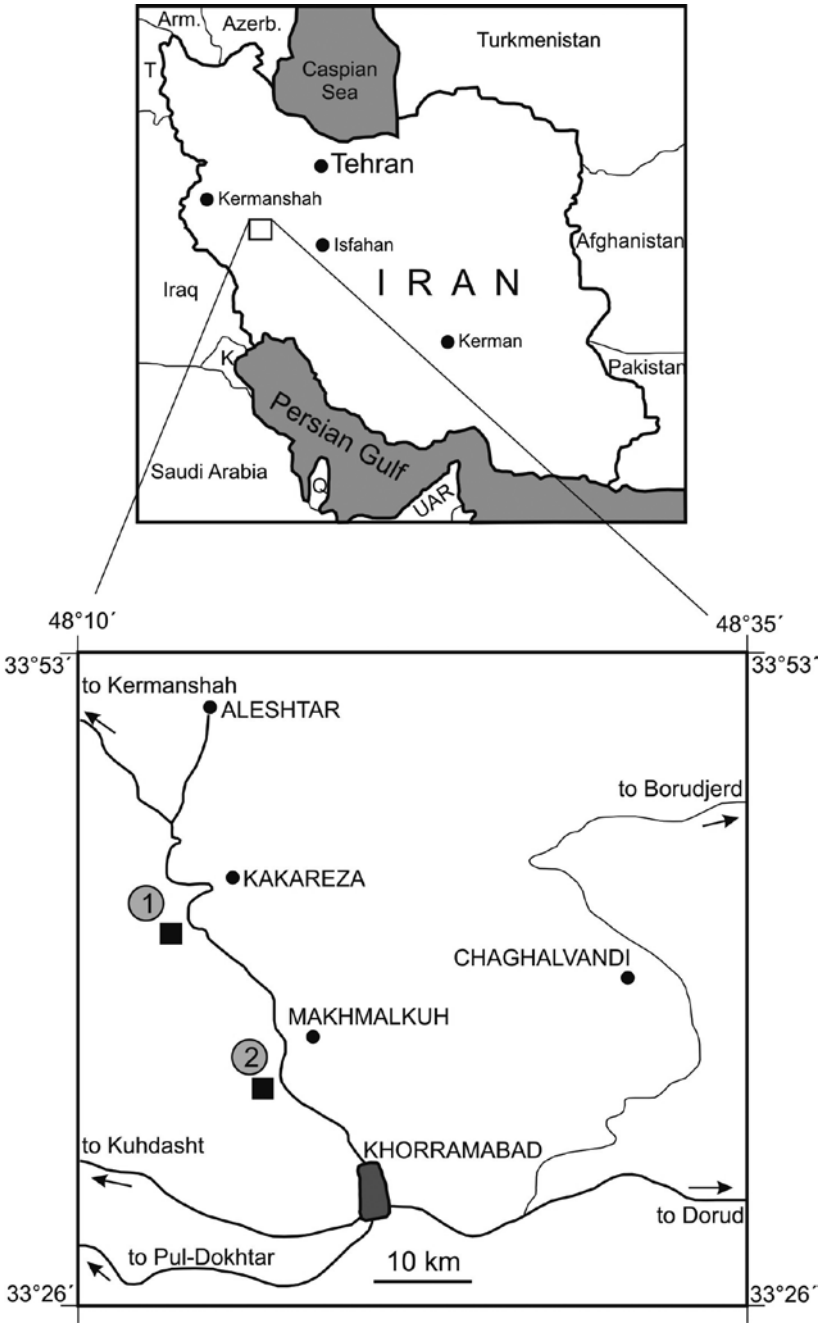

Fig.1: Locality map of the studied sections.

on and in internal Fars it shows a paraconformable contact with the Jahrum Formation (Eocene).

Considering the upper boundary, in certain areas the Asmari Formation is covered by anhydrites of the Gachsaran Formation which is of Early Miocene age, and in internal Fars the upper boundary of Asmari Formation is in contact with the Early Miocene Razak Formation. Therefore, the type of contact of the Asmari Formation with the underlying and overlying formations varies considerably. As a result, although many years have passed since the stratigraphy in the south-west of Iran was defined by James & Wynd (1965) and much information has been collected about the Asmari Formation more studies need to be done in order for a better bio- and chronostratigraphic correlation of the ambiguous parts of this formation.

Methods

The methodology in this research includes library, field and laboratory studies.

A) Library studies include all materials and scientific achievements related to the subject under study such as books, articles, magazines, unpublished reports, theses and the internet as well. Important information was also derived from personal communications with specialists.

B) In the field studies, various visits have been done for the overall geologic analysis of the area under study for a better understanding of the geological formations and the relationships between various structures and the identification of the faults in the region. Following this procedure the sampled locations were selected by means of air photographs, topographical maps 1:50.000, (Rahman Shahi (II)) and Sarab Doreh (III), geological map of 1:250000 Khorramabad and the field visits made.

The sampling of the geological sections under study has been done in variable distances (30 cm to up to one meter) with respect to the facies differences of the strata, and all sampling locations have been spray-marked.

Generally five main factors were considered in measuring the sections: 1- strike, 2- dip, 3- azimuth, 4- inclination, 5- length. The real thickness of the layers were then determined through the triangular method. The total number of samples taken from the sections under study is 211.

C) Laboratory studies include the preparation of thin sections from all collected rock samples. The microfossils were studied and determined using a binocular microscope OLYMPUS-BH-2.

Geographic Location and Stratigraphy of Sections

The sections under study in this text are located in Zagros folded zone and their geographical coordinates are as follows (Fig.1):

3.1 Kakareza section

This section is located 27.5 km north-west of Khorramabad (the road from Khorramabad to Aleshtar) in an area called Kakareza with the geographical coordinate of 48°14'10" eastern longitude and 33°44'26" northern latitude.

3.2 East Makhmalkuh section

This section is located 10 km north-west of Khorramabad (the road from Khorramabad to Aleshtar) in an area called East Makhmalkuh with the geographical coordinate of 48°17'33" eastern longitude and 33°36'22" northern latitude.

Lithostratigaphy of the sections

The sampling in both sections under study starts from the upper limit of red shale and sandstones belonging to the Kashkan Formation (Middle Eocene) and continues to marly and gypsum layers of the overlying Gachsaran Formation (Early Miocene). Due to lithological similarities in the field, the dolomitic limestone of the Shahbazan Formation (Late Eocene) is not separable macroscopically from the overlying Asmari Formation. The boundary between these two formations can only be determined by micropaleontological studies. All the samples collected from the upper boundary of the Kashkan Formation up to 36.70 meters thickness in the Kakareza section and to 45.20 meters thickness in the eastern Makhmalkuh section are belonging to the Shahbazan Formation and are devoid of any type of fossils. Above this stratigraphical niveau we are suddenly facing a high variety and abundance of fossil types which are representative for the upper Asmari Formation and indicative of Early Miocene (Burdigalian).

The lithostratigraphy of each section under study is presented separately:

4.1 Kakareza section

The thickness of this section is 82.60 m, the strike is 55-60° NE and dip is 30–40° NW. At this section, the Asmari Formation overlies the Shahbazan Formation (Late Eocene) with a paraconformity and underlies conformably the Gachsaran Formation (Early Miocene). In this section the Asmari Formation consists exclusively of carbonates comprising 5 rock units as follows:

Unit 1: dark gray, medium to thick-bedded limestone with frequent macrofossil fragments (28.10 m)

Unit 2: light gray, medium-bedded limestone with interbeds of clayey limestone (14.20 m)

Unit 3: dark gray, thick-bedded limestone with chert nodules (12.80 m)

Unit 4: dark gray, medium- to thick-bedded limestone with frequent macrofossil fragments (19.30 m)

Unit 5: light gray, medium-bedded clayey limestone (8.20 m)

4.2 Eastern Makhmalkuh section

The thickness of this section is 102.10 m, the strike is 30–40° NE and the dip is 45–50° NW.

In the eastern Makhmalkuh section, the Asmari Formation also overlies the Late Eocene Shahbazan Formation with a paraconformity and is conformably overlain by the Early Miocene Gachsaran Formation.

At this locality the Asmari Formation consists of carbonates which are divisible into 7 rock units as follows:

Unit 1: cream to light gray, medium-bedded limestone (7.60 m)

Unit 2: dark gray, medium to thick-bedded limestone with frequent macrofossil fragments (18.40 m)

Unit 3: dark gray, thick-bedded to massive limestone with chert and frequent macrofossil fragments (12.30 m)

Unit 4: light gray, medium-bedded limestone with sandy limestone interbeds (15.60 m)

Unit 5: gray, medium- to thick-bedded limestone with frequent macrofossil fragments (28.40 m)

Unit 6: gray, thick-bedded to massive limestone with chert & frequent macrofossil fragments (13.10 m)

Unit 7: light gray, medium-bedded clayey limestone (6.70 m)

Biostratigraphy of the sections

Various papers (Postuma 1971, Bolli & Saunders 1987, Sampo 1969, Mehrnoosh & Partoazar 1977, Loeblich & Tappan 1988, Kalantary 1992) were used to identify the microfossils. In total, based on the present micropaleontological study, 40 genera and 19 species of benthic foraminifera, 3 genera and 2 species of pelagic foraminifera, 4 genera of calcareous algae as well as a number of other micro- and macrofossils were identified from the sections which altogether indicate a Burdigalian age for the deposits under study.

The identified benthic foraminifera are as follows: *Meandropsina iranica*, *Borelis melo curdica*, *Miogypsina irregularis*, *Haplophragmium slingeri*, *Peneroplis evolutus*, *Austrotrillina howchini*, *Borelis* **cf.** *pygmaea*, *Miogypsinoides complanatus*, *Peneroplis thomasi*, *Cibicides* gr. *lobatus*, *Dendritina rangi*, *Triloculina trigonula*, *Austrotrillina asmariensis*, *Spiroclypeus* cf. *vermicularis*, *Operculina complanata*, *Nephrolepidina tournoueri*, *Spirolina cylindracea*, *Meandropsina anahensis*, *Miogypsina basraensis*, *Gypsina* sp., *Schlumbergerina* sp., *Elphidium* sp., *Nummulites* sp., *Heterostegina* sp., *Archaias* sp., *Assilina* sp., *Eouvigerina* sp., *Pseudochrysalidina* sp., *Bolivina* sp., *Planorbulina* sp., *Asterigerina* sp., *Nezzazata* sp., *Victoriella* sp., *Miniacina* sp., *Amphistegina* sp., *Anomalina* sp., *Gyroidina* sp., *Eponides* sp, *Discorbis* sp., *Pyrgo* sp., *Rotalia* sp., *Valvulina* sp., *Bigenerina* sp., *Quiqueloculina* sp., *Textularia* sp., miliolids, valvulinid.

The identified pelagic foraminifera are as follows: *Globigerinoides trilobus*, *Globigerina* sp., *Globorotalia* sp., *Globigerina* sp.

The identified non-foraminifera include the following ones:
Calcareous algae: *Lithothamnium* sp., *Archaeolithothamnium* sp., *Lithophyllum* sp., *Solenomeris* sp.

Kuphus arenarius, Tubucellaria sp., *Ostrea* sp., *Ditrupa* sp., corals, gastropods, ostracods, echinoderms, bryozoans, worm tubes, lamellibranchia.

Following these studies, based on the first and last occurrences and the proposed stratigraphic range of the identified microfossils, one assemblage zone was considered for both sections, namely:
Borelis melo curdica -Meandropsina iranica-Schlumbergerina Assemblage Zone

The thickness of this biozone is 82.60 m at Kakareza section and at Makhmalkuh section it has a thickness of 102.10 m. The base of this biozone which is located at the beginning of the section under study, is marked by the first appearance of Early Miocene index microfossils (*Meandropsina iranica, Dendritina rangi, Elphidium* sp.) associated with *Borelis melo curdica* and its top corresponds to the last appearance of *Schlumbergerina* sp. and *Elphidium* sp.

The most characteristic microfossils associated with this biozone are as follows:
Peneroplis evolutus, Borelis melo curdica, Borelis cf. *pygmaea, Meandropsina iranica, Miogypsinoides complanatus, Dendritina rangi, Miogypsina irregularis, Operculina complanata, Spirolina cylindracea, Meandropsina anahensis, Austrotrillina asmariensis, Miogypsina* cf. *basraensis, Schlumbergerina* sp., *Elphidium* sp., *Archaias* sp.

Considering the identified microfossil associations, particularly the presence of *Meandropsina iranica*, the age of this biozone is suggested to be Burdigalian. With regard to the age, this biozone is comparable with the *Meandropsina iranica - Borelis melo* group Assemblage Zone presented by Adams & Bourgeois 1967 and biozone No. 61 of Wynd (1965) from Iran's south-western regions (Zagros). This biozone may also be equivalent to the Upper Asmari Formation defined by Thomas (1948, 1949).

Conclusion

In contrast to stratigraphic data of the geological map 1:250000 Khorramabad, the Asmari Formation in each section under study is proved to be of Burdigalian age.

The lithology of Asmari Formation consists of limestone, clayey limestone and sandy limestone. The lower boundary of this formation has a paraconformity with the Shahbazan Formation, and its upper boundary is conformable with the Gachsaran Formation. The paraconformity at the base of the Asmari Formation can be attributed to the Pyrenean Tectonic Event in addition to abiotic and chemical changes within the Zagros Basin. The deposits of the Asmari Formation reflect a progression of the Early Miocene Sea as a result of Savin's stretched phase which is often accompanied by subsidence.

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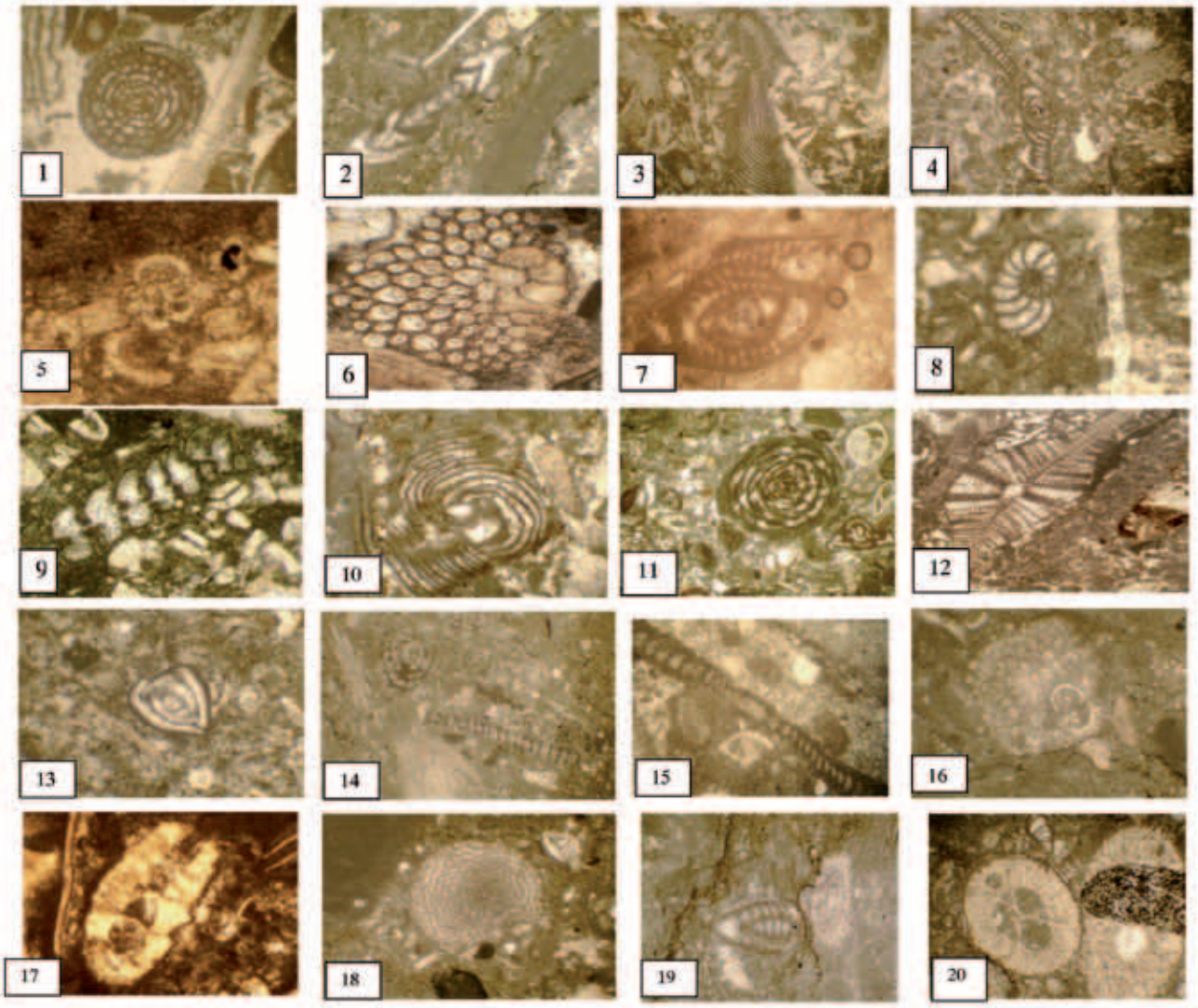
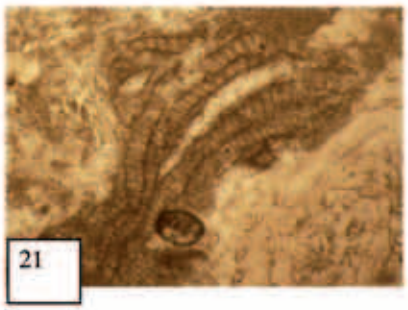
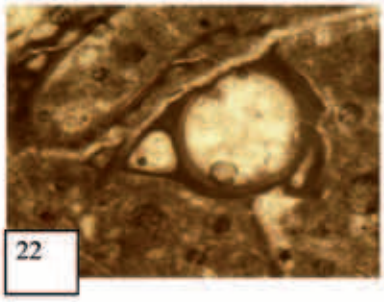
Plate 1 (all samples: x40, age: Burdigalian)

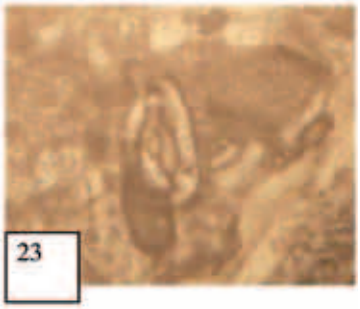


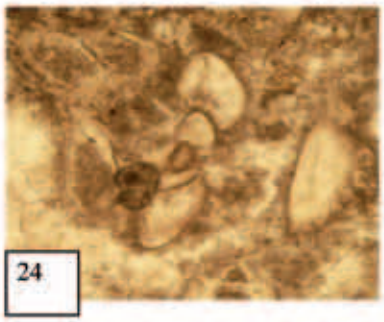
1 *Borelis melo curdica* (Reichel), Kakareza section
2 *Dendritina rangi* d'Orbigny, Makhmalkuh section
3 *Meandropsina anahensis* Henson, Kakareza section
4 *Peneroplis thomasi* Henson, Kakareza section
5 *Globigerina* sp., Makhmalkuh section
6 *Miogypsina irregularis* (Micheloti), Kakareza section
7 *Austrotrillina asmariensis Adams* , Makhmalkuh section
8 *Spirolina cylindracea* (Lamarck), Kakareza section
9 *Haplophragmium slingeri* Thomas, Kakareza section
10 *Peneroplis evolutus* Henson, Makhmalkuh section
11 *Borelis* cf. *pygmaea* (Hanzawa), Makhmalkuh section
12 *Nephrolepidina tournoueri* Lemoine and Douville, Kakareza section
13 *Triloculina trigonula* (Lamarck), Kakareza section
14 *Meandropsina iranica* Henson, Makhmalkuh section
15 *Meandropsina iranica* Henson, Kakareza section
16 *Miogypsina basraensis* Bronnimann, Kakareza section
17 *Miogypsinoides complanatus* (Schlumberger), Kakareza section
18 *Gypsina* sp., Makhmalkuh section
19 *Elphidium* sp., Kakareza section
20 *Tubucellaria* sp., Makhmalkuh section

Plate 2 (all samples: x40, age: Burdigalian)

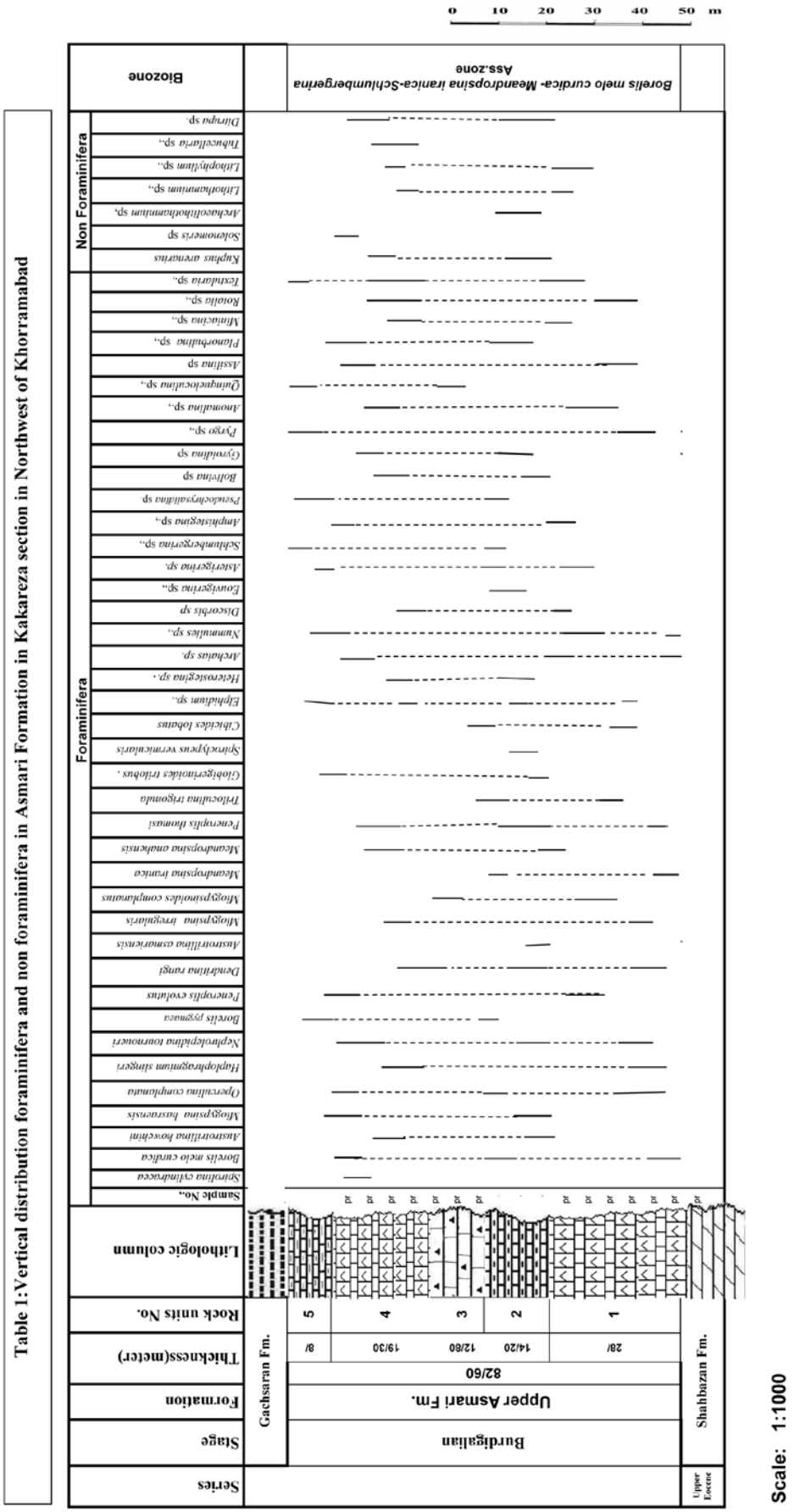








21 *Archaeolithothamnium* sp., Makhmalkuh section
22 *Kuphus arenarius* Lamarck, Kakareza section
23 *Schlumbergerina* sp. , Makhmalkuh section
24 *Anomalina* sp.., Kakareza section



Scale: 1:1000

Table 1: Stratigraphy and microfossils of the Asmari Formation at Kakareza section.

Table 2: Vertical distribution foraminifera and non foraminifera in Asmari Formation in Makhmalkuh section in north west of Khorramabad

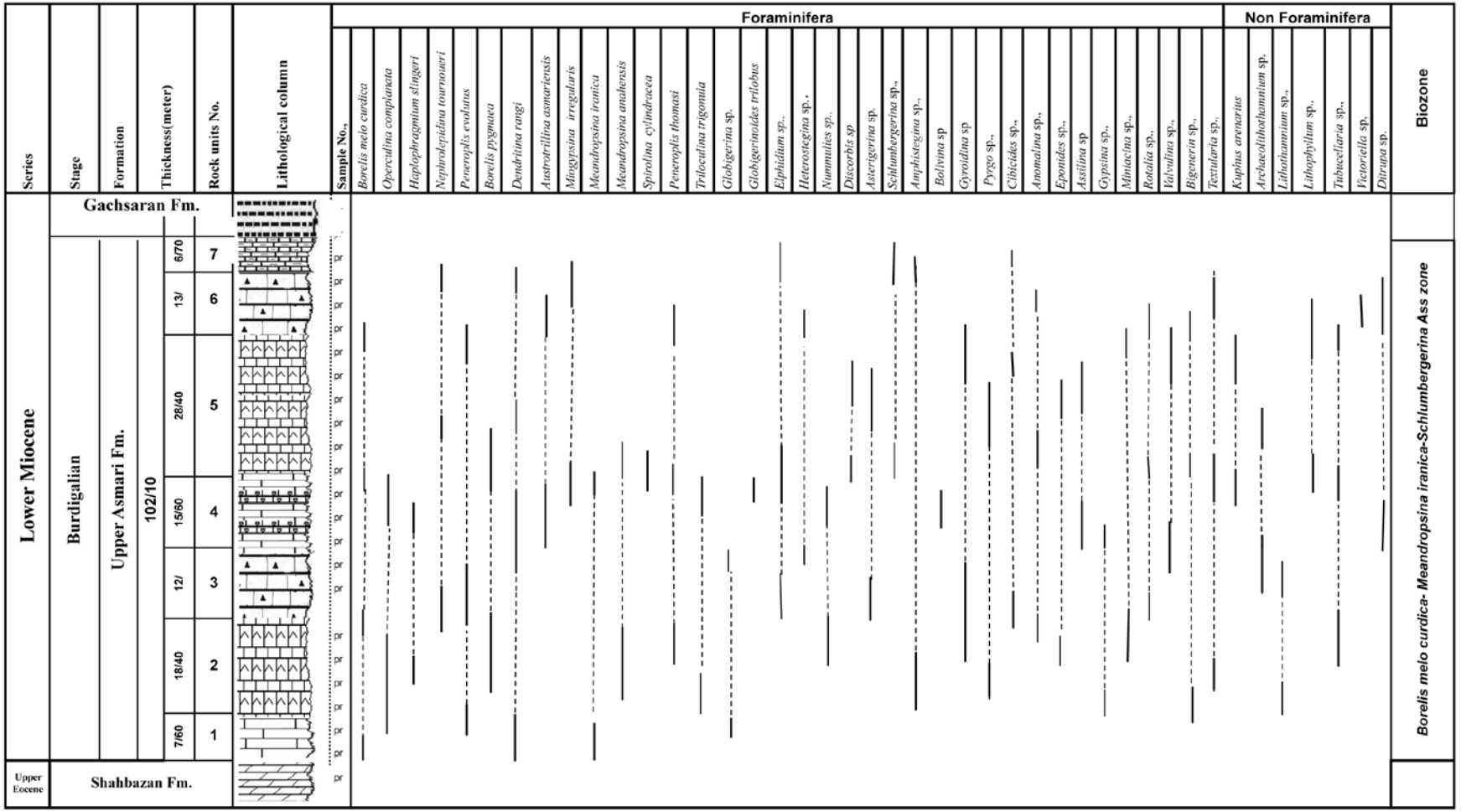


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Table 2: Stratigraphy and microfossils of the Asmari Formation at Makhmalkuh section.