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BIOSTRATIGRAPHY OF THE ASMARI FORMATION, BURUJEN AREA, IRAN

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Abstract

Lithological characteristics of the Asmari Formation in the Burujen area are: pelagic foraminifera wackestone-packstone; bentic foraminifera echinid packstone; bentic foraminifera corallinacea packstone; coral boundstone and echinid corallinacea packstone to grainstone; corallinacea boundstone; corallinacea bryozoa packstone; miliolid echinid wackestone; and bioclastic wackestone. The examined outcrops at the Buldaji, Chaghakhor, and Tang-e Kloreh locations are Upper Oligocene, Lower Miocene (Aquitanian) and Lower Miocene (Burdigalian) in age, respectively. Age was determined by the occurrence of *Lepidocyclina (Eulepidina)-Lepidocyclina (Nephrolepidina)-Nummulites, Miogypsina-Lepidocyclina* and *Neoalveolina melo* Group assemblage zones. Consequently, the outcrops at the Buldaji, Chaghakhor and Tang-e Kloreh locations are synonymous to lower, middle and upper Asmari Formation.

Introduction

The Asmari Formation was introduced by Buck and ıyo [5] as Asmari limestone, Oligocene in age. These :ks were referred to be Miocene in age [4].

Biostratigraphic criteria of the Asmari Formation were died by Wynd [27], and Adams and Bourgeois [1], and : facies by Wells [25].

The Asmari Formation at the type section consists of 4 meters resistant cream to brown fractured limestone 1]. The maximum thickness of the Asmari Formation ıges to 500 meters [21].

Lithologically, the Asmari Formation is characterized massive fractured limestone. Some shale and sandstone ers also occur within the limestone [23, 8].

Numerous marine water bentonic microfauna are sent in the Asmari Formation [16, 14]. The Asmari rmation is divided into lower, middle and upper units. This division is based on the presence of rich foraminiferal fauna. The Asmari units are coincident with the *Lepidocyclina (Eulepidina-Nephrolepidina)-Nummulites, Miogypsinoides-Archaias-Valvulinid, and Borelis melo-Meandropsina iranica* assemblage zones [1] (Fig. 1).

Most studies of the Asmari in the Zagros basin focus on the subsurface, and are mainly associated with oil field areas [22, 20]. In this study, however, the outcrops of the Asmari Formation far beyond the oil field areas are examined.

ywords: Asmari; Biostratigraphy; Burujen; Microfacies; go-Miocene

Regional Aspects

The Asmari Formation is present through most of the Zagros basin in southwest Iran (Fig. 2). Its outcrops consist of feature-forming limestone conformably overlain by evaporites of the Gachsaran Formation [15, 13] and underlain by rich foraminiferal gray marls of the Pabdeh Formation [17].

In the northwest of the Zagros basin, the middle portion of the Asmari Formation is replaced by evaporites of the Kalhur Member. Toward the southwest of the Zagros

AGE	ROCK UNITS	BIOZONES
Burdigalian	upper Asmari	Borelis melo-Meandropsina iranica
upper Aquitanian	upper-middle Asmari	Elphidium sp. 14-Miogypsina
lower Aquitanian	lower-middle Asmari	Archaias asmaricus-Archaias hensoni
Oligocene	lower Asmari	Eluepidina Nephrolepidina Nummulites

Figure 1. Biozonation of the Asmari Formation, modified from Adams and Bourgeois, [1].

basin, the limestones of the lower portion of the Asmari Formation are replaced mainly by sandstones of the Ahwas Member (Fig. 3). In the interior part of the Zagros basin, the Gachsaran Formation progressively replaces the upper portion of the Asmari Formation. In the far southwest of the Zagros basin, the Asmari Formation is replaced by the marls and shales of the Pabdeh Formation [15].

Study Area and Methodology

The study area is located to the west and southwest of Burujen, in the far southwest of central Iran. It is located at the southern margin of the crushed zone of high Zagros mountains (Fig. 4), and lies within the imbricated belt [19, 11], near the thrust border. Despite the poorly exposed Asmari outcrops in the study area, three locations (Buldaji, Chaghakhor and Tang-e Kloreh) were examined. Samples were taken almost every two meters, and sampling was based on facies variation of the outcrops. Approximately 170 thin-sections were studied.

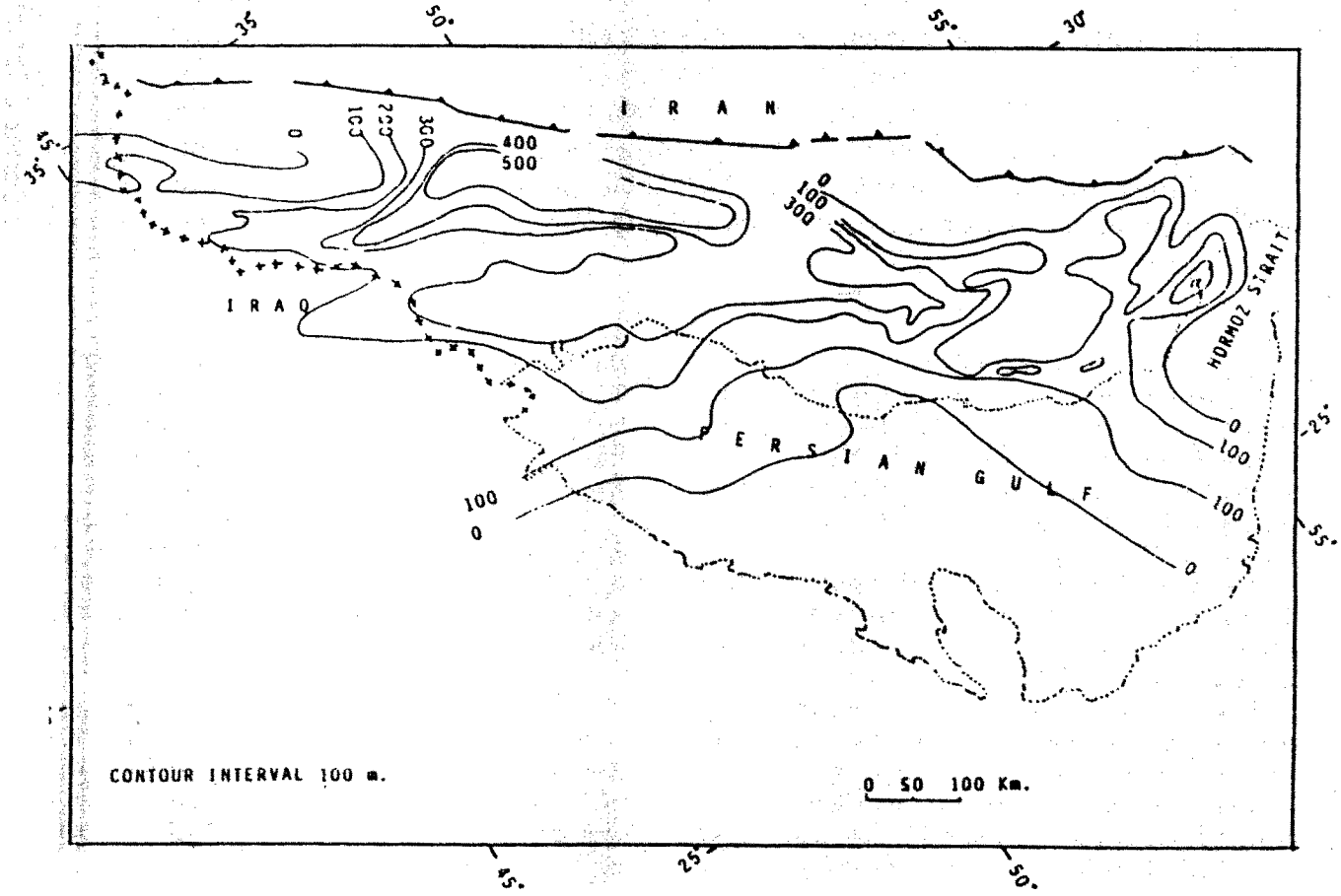

Figure 2. Isopack map of the Asmari Formation in the Zagros basin. Adopted from Motiei, [21]

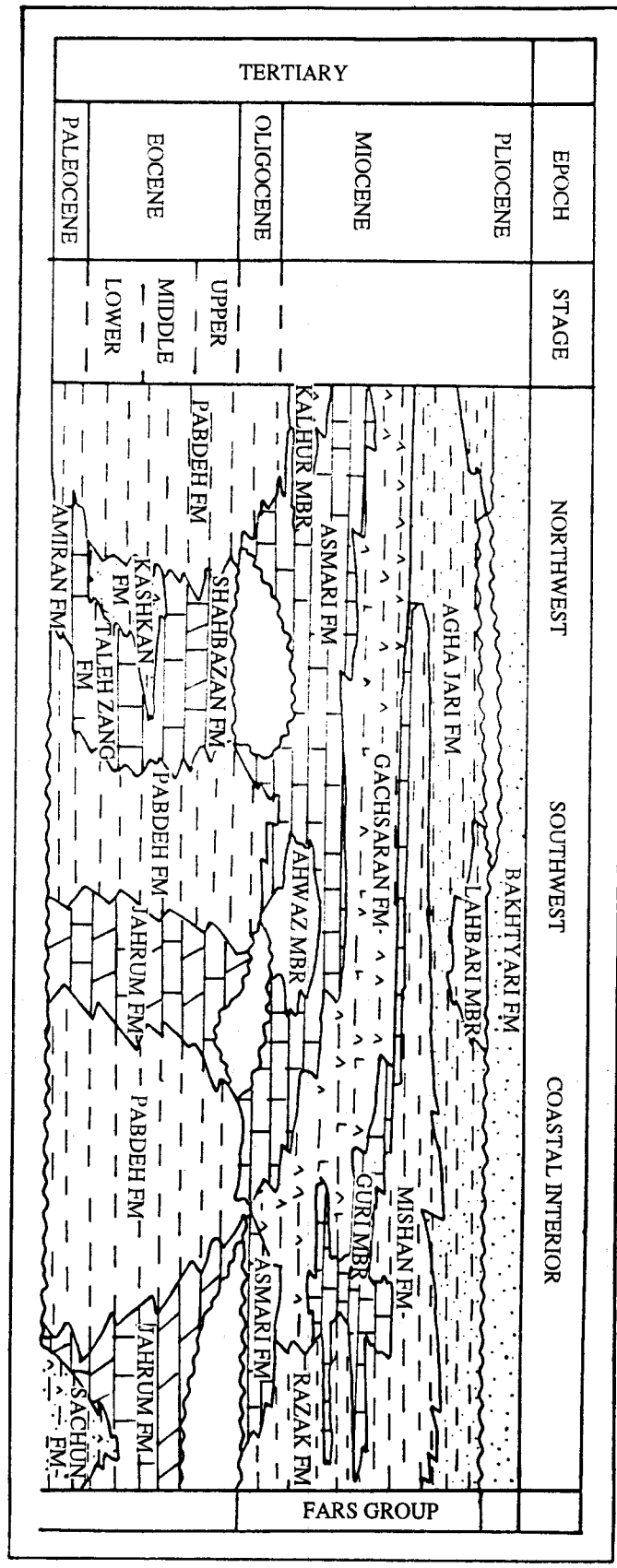

Figure 3. Tertiary lithostratigraphic correlation chart of southwest Iran (adopted from Ala [3]). Standard lithologic symbols used in lithology section (dots and circles for sandstones and conglomerate, dashes for siliciclastic mudrocks, rectangles for limestones, parallelograms for dolomite, dashes and inverse v for evaporites, and wavy lines for disconformities

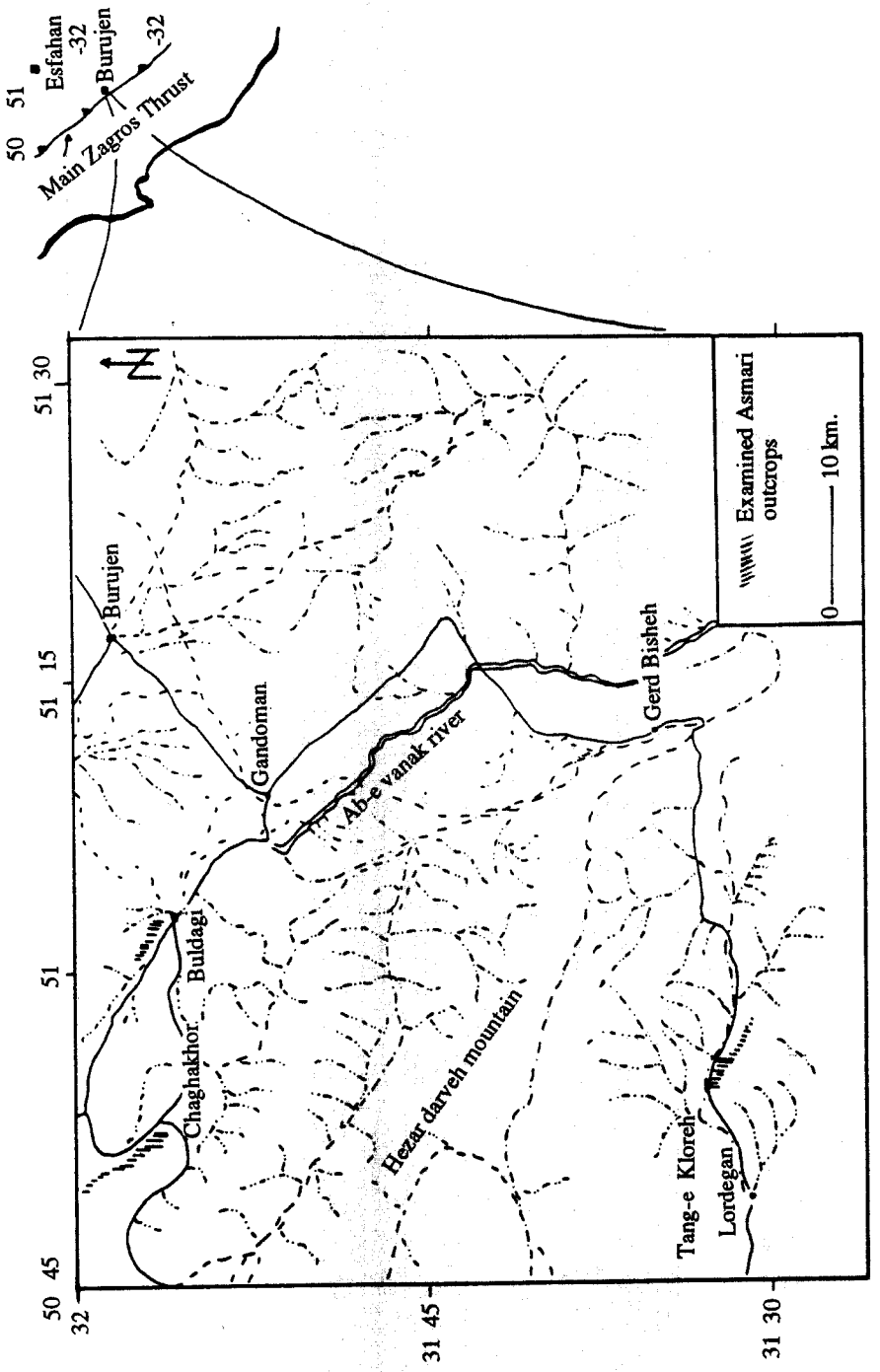

Figure 4. Location map for studied sections

A textural classification of porosity by Choquette and Pray [7], and rock classification according to the Dunham classification of carbonate rocks [9], and others [6, 12], and revised classification of limestones [26], and for paleontological description the foraminiferal genera and their classification [18] are also used.

Buldaji Location

The outcrops of the Asmari Formation at Buldaji are located two kilometers northwest of Buldaji City. The exposed Asmari carbonate rocks are predominantly fractured and show a north-northeast 80 degrees structural dip. The Asmari outcrops at this location are 100 meters in thickness, and light gray to light brown in color. Chert nodules are present at lower exposed layers of the Asmari Formation.

Lithology

Lithological characteristics of the Asmari Formation at the Buldaji mainly consist of pelagic foraminifera wackestone-packstone; bentic foraminifera echinid packstone; bentic foraminifera corallinacea packstone; coral boundstone; and echinid corallinacea packstone to grainstone.

Bentic forams are the predominant allochems, and are more common than pelagic forams. Fragments of corallinaceas, molluscs, echinids and bryozoans are present. These particles are mainly present in a micrite to microsparite matrix [12]. Coral fragments occur at the base of exposed rocks. Fractures are mostly replaced by secondary calcite. Stylolites are filled by iron oxide. No distinct porosity or dolomitization is observed in thin-sections.

Age and Assemblage Zone

The following microfauna are identified in limestones of the Asmari Formation at Buldaji: *Lepidocyclina (Eulepidina) dilatata; Lepidocyclina (Eulepidina) elephantina; Lepidocyclina (Nephrolepidina) tournoueri; Operculina complanata; Nummulites vascus; Rotalia viennoti; Spiroclypeus sp., Amphystegina sp., Heterostegina sp., Lepidocyclina (Eulepidina) sp., Lepidocyclina (Nephrolepidina) sp., Nummulites sp., Globigerina sp., Globorotalia sp., Lithophyllum sp., Lithothamnium sp., and Sphaerogypsina sp.* (Plates 1,2, 3A and 3B). Based on these microfauna, the outcrops of the Asmari Formation at Buldaji are Upper Oligocene in age.

The following biozones, with respect to their occurrences with specific microfauna, are also determined: *Globigerina sp.* assemblage zone, which is the same as biozone-55 of Wynd [27] occurs in the lower part of the Asmari Formation at Buldaji. *Lepidocyclina (Eulepidina)-Lepidocyclina (Nephrolepidina)-Nummulites* assemblage zone, synonymous with biozone-3 of Adams and Bourgeois [1], occurs in the middle and upper portion of the Asmari rocks at Buldaji. As a result, these rocks are correlatable to the lower Asmari Formation (Fig. 5).

Chaghakhor Location

The outcrops of the Asmari Formation are exposed at the north-northwest of the Chaghakhor swamp, 20 kilometers west of Buldaji City. These rocks are northwest-southeast trend with a northeast 60 to 70 degrees structural dip. The exposed Asmari Formation at this location is 60 meters in thickness and is light gray to light brown in color.

Lithology

Lithological characteristics of the Asmari Formation at the Chaghakhor mainly consist of bentic foraminifera corallinacea packstone; bentic foraminifera echinid packstone; corallinacea boundstone; and echinid corallinacea packstone to grainstone. Bentic forams, corallinaceas, and echinid fragments are the predominant allochems. Particles of bryozoans and molluscs are also associated.

These skeletal grains are present in a sparite to microsparite and micrite matrix. Rare intercrystalline and intergranular porosity is observed. Some boundstone layers are also present, and these are mainly characterized by corallinacean forams mats.

Age and Assemblage Zone

The following microfauna are identified in limestones of the Asmari Formation at Chaghakhor: *Miogypsinoides complanatus; Miogypsina sp.; Lepidocyclina (Nephrolepidina) tournoueri; Archaias sp.; Operculina complanata; Spiroclypeus sp.; Lepidocyclina sp.; Amphystegina sp., Nummulites sp.; Miliolids; Textularids; Rotalia sp.; Lithothamnium sp.; and Lithophyllum sp.* (Plates 3C, 3D, 4, 5A and 5B).

Based on these microfauna, the outcrops of the Asmari Formation at Chaghakhor are Oligo-Lower Miocene (Aquitanian) in age.

The following biozones, with respect to the occurrence of microfauna, are determined: *Miogypsina-Lepidocyclina* assemblage zone, which is the same as biozone-2 of Adams and Bourgeois [1], and assemblage zone [3] which is the same as *Nummulites sp.* of the above-mentioned author.

These facies are the same as biozones-2 and 3 of Adams and Bourgeois [1], reflecting that these rocks are correlatable to the lower and middle Asmari Formation (Fig. 6).

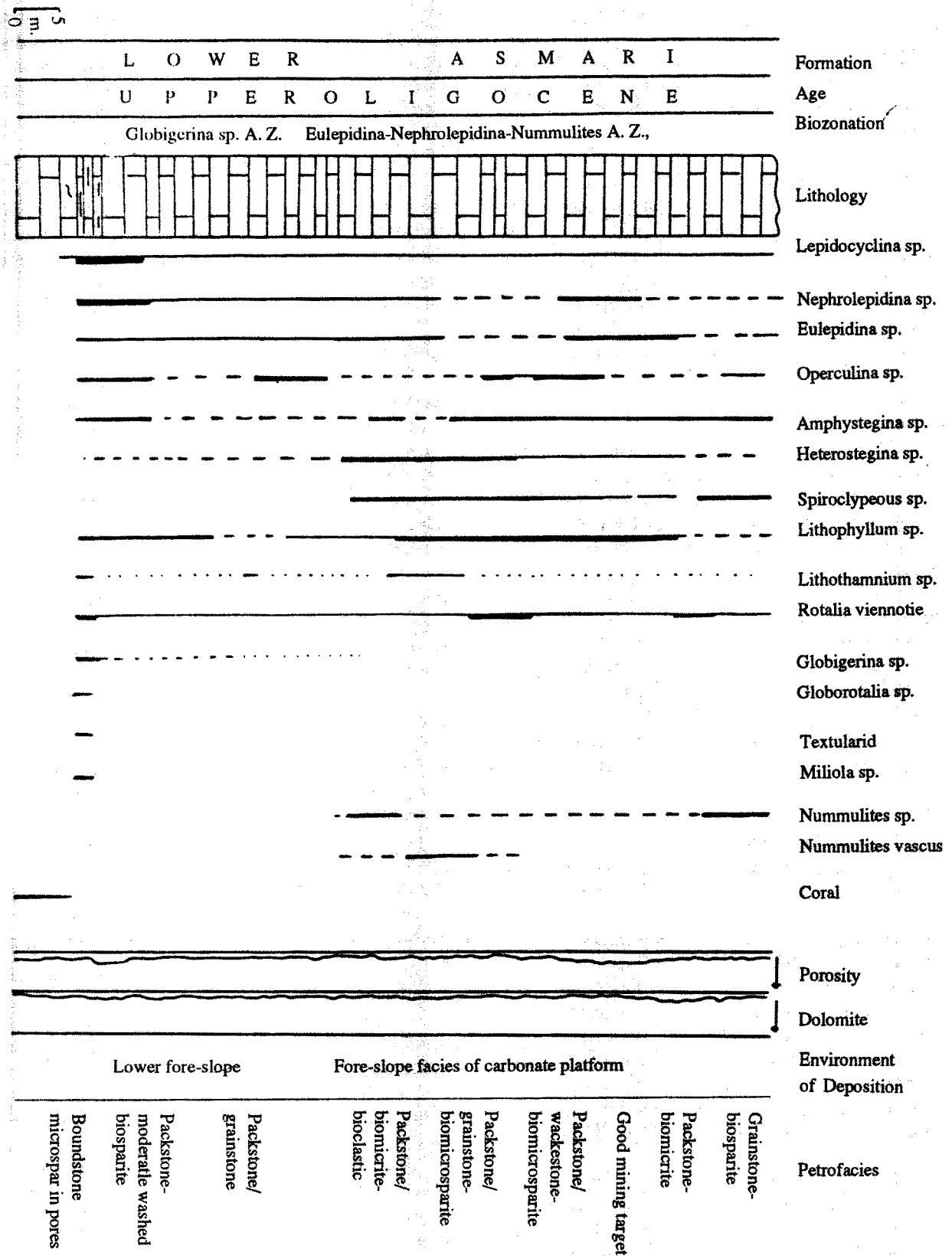

Figure 5. Faunal distribution, biozonation and lithological characteristics of the exposed Asmari Formation at Buldaji

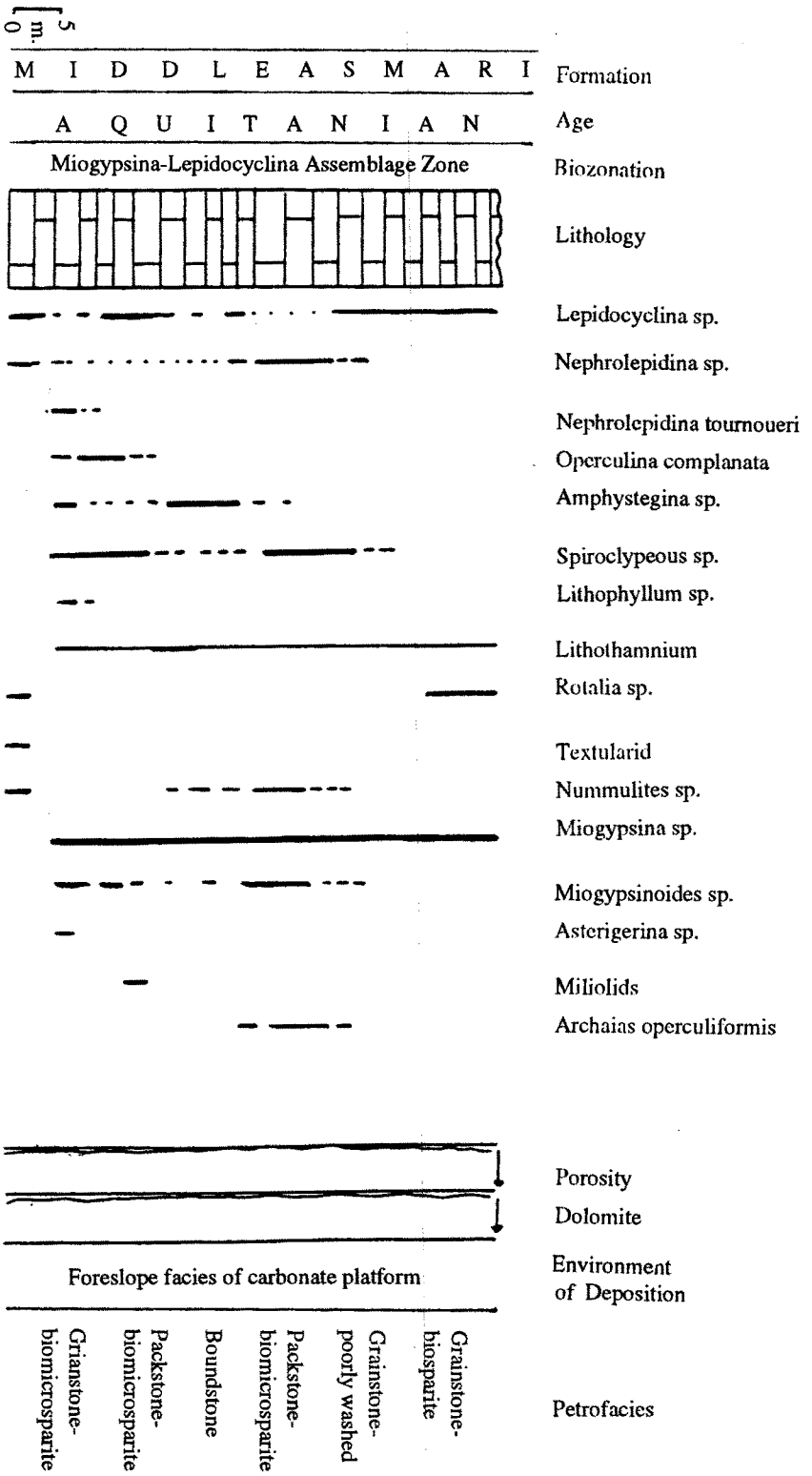

Figure 6. Faunal distribution, biozonation and lithological characteristics of the exposed Asmari Formation at Chaghakhor

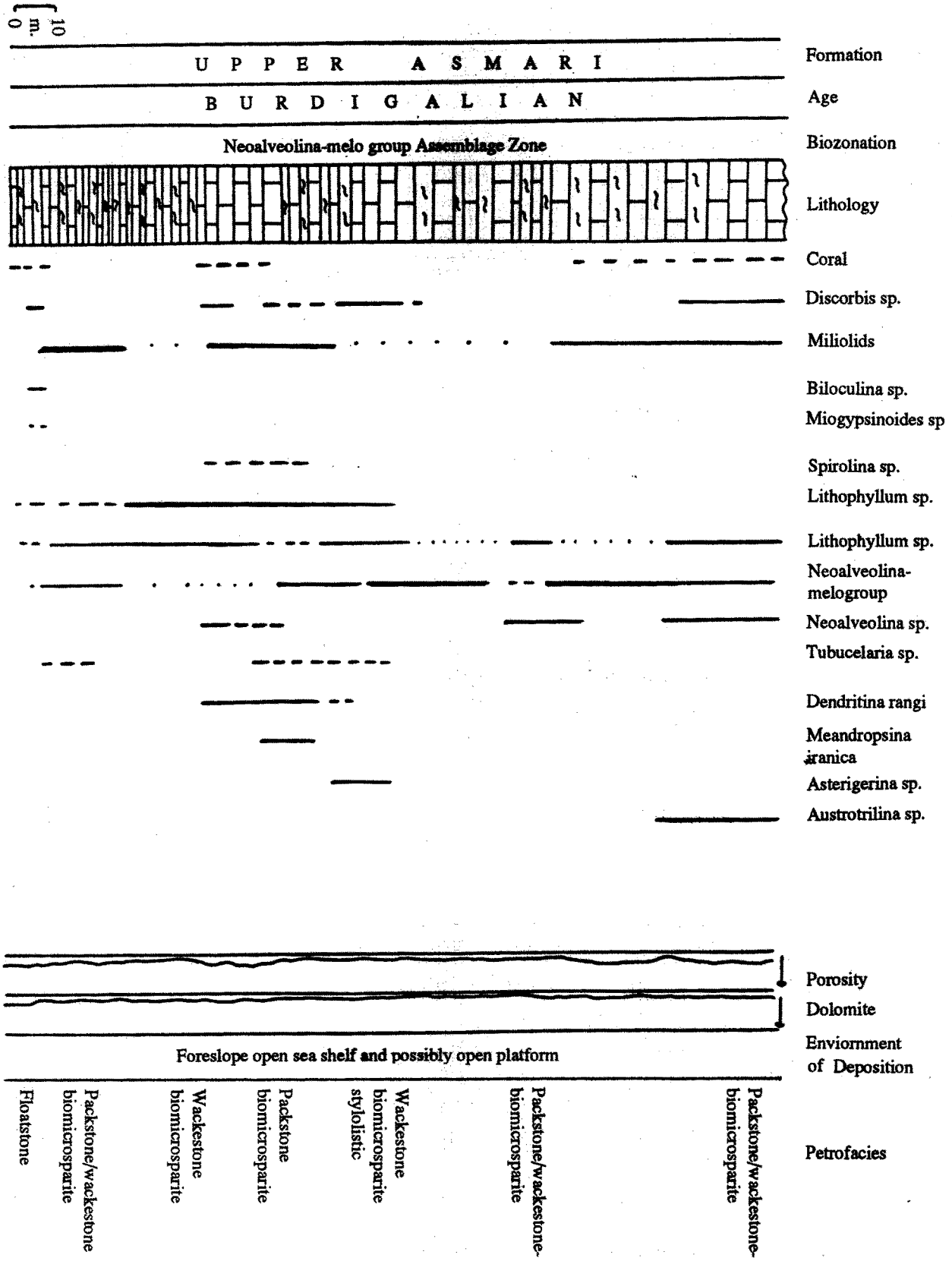

Figure 7. Faunal distribution, biozonation and lithological char acteristics of the exposed Asmari Formation at Tang-e Kloreh

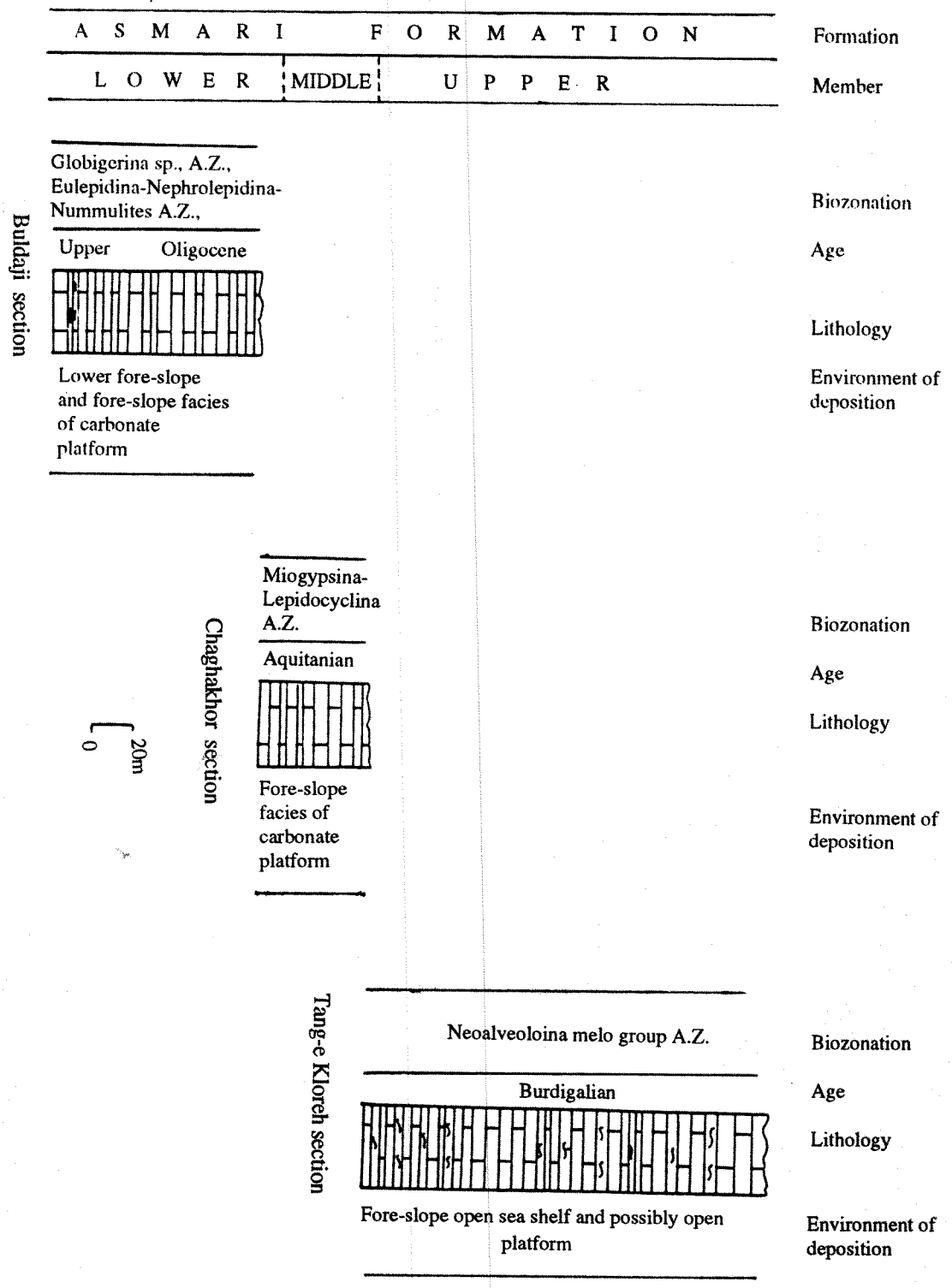

Figure 8. Correlation of the exposed Asmari Formation in the study area

Plate 1A. *Lepidocyclina (Nephrolepidina) tournoueri, Amphystegina, sp.* Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

Plate 1C. *Lepidocyclina sp., Rotalia viennoti*, Asmari Formation, Upper Oligocene, Buldaji, Scale 1 cm= 400 μ, LN

Plate 1B. *Lepidocyclina sp., Lepidocyclina (Eulepidina) sp.*, (equatorial), Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

Plate 1D. *Nummulites vascus, Rotalia viennoti, Operculina, complanata*, Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

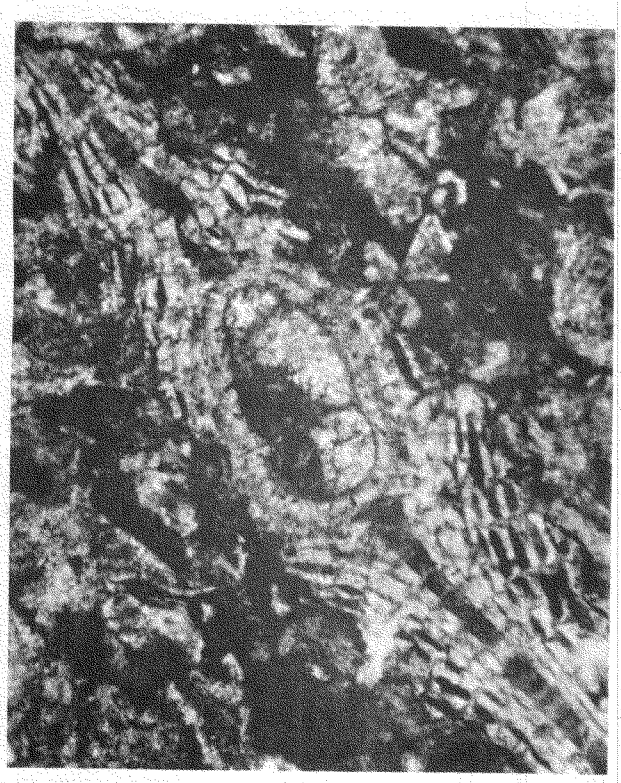

Plate 2A. *Lepidocyclina (Eulepidina) dilatata*, Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

Plate 2C. *Heterostegina sp.*, Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

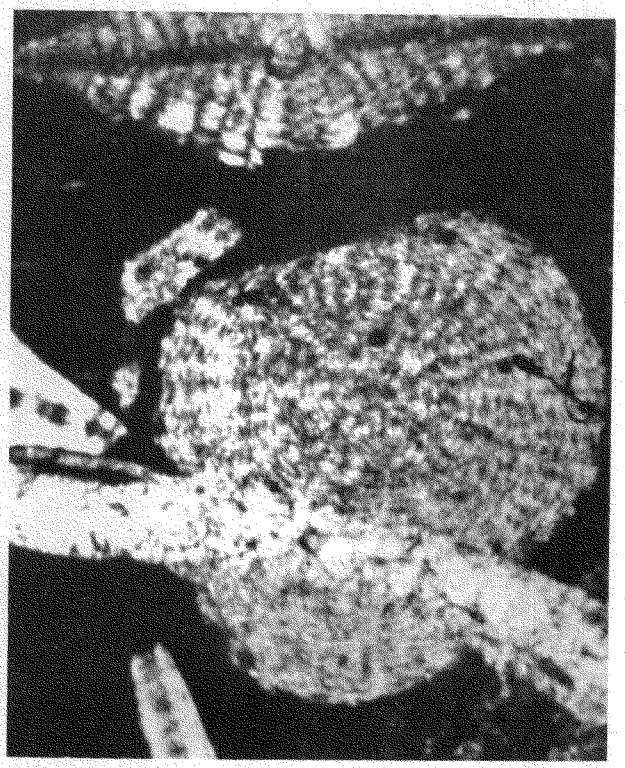

Plate 2B. *Sphaerogypsina sp.*, Asmari Formation, Upper Oligocene, Buldaji, Scale 1 cm= 400 μ, LN

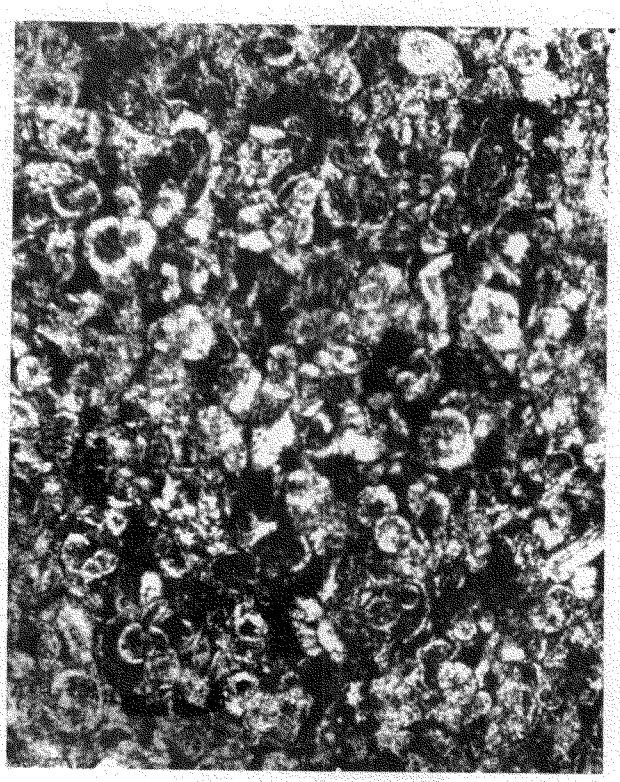

Plate 2D. Pelagic foraminifera packstone, Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

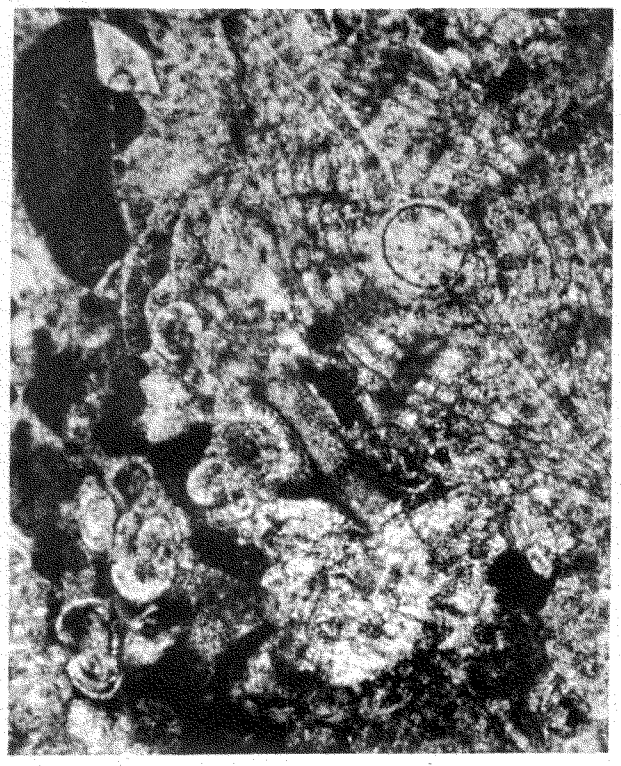

Plate 3A. Bentic foraminifera corallinacea packstone, Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

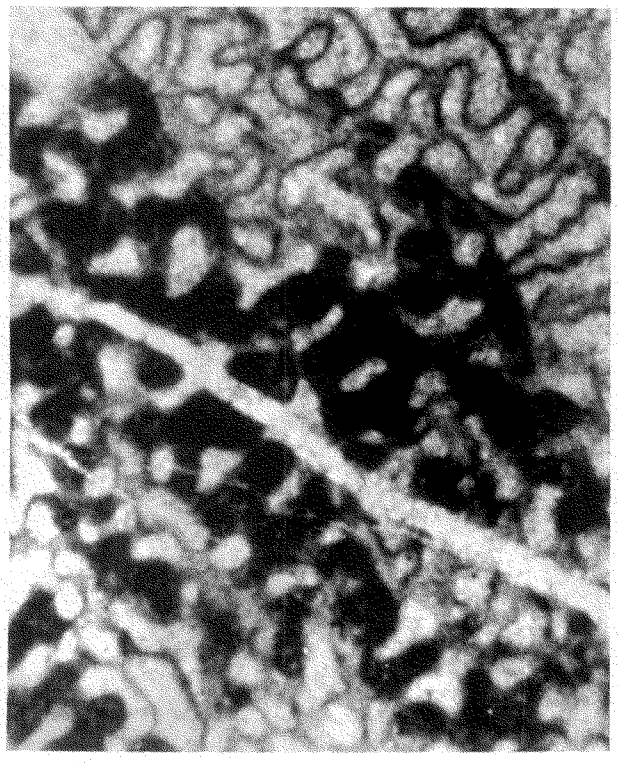

Plate 3B. Coral boundstone, Asmari Formation, Upper Oligocene, Buldaji. Scale 1 cm= 400 μ, LN

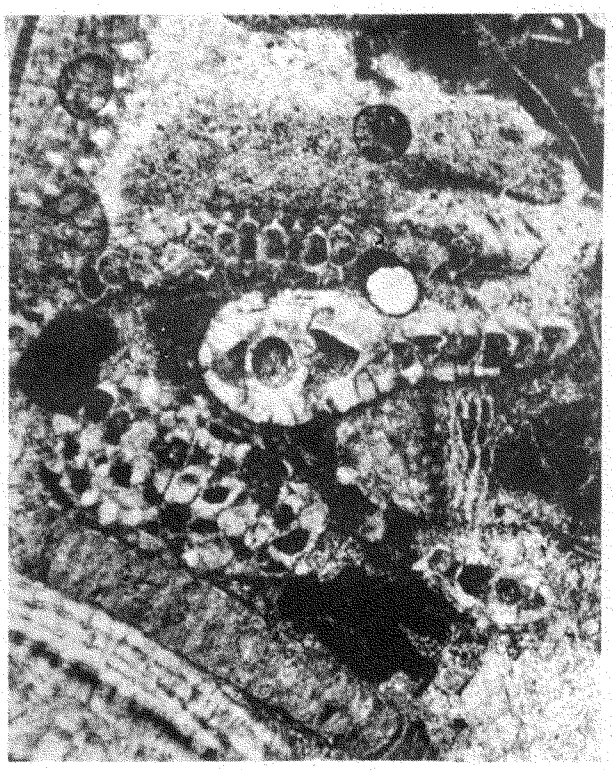

Plate 3C. *Miogypsinoides complanata, Lepidocyclina sp.*, Asmari Formation, Aquitanian, Chaghakhor, Scale 1 cm= 400 μ, LN

Plate 3D. *Nummulites sp., Miogypsina sp.*, Asmari Formation, Upper Oligocene-Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

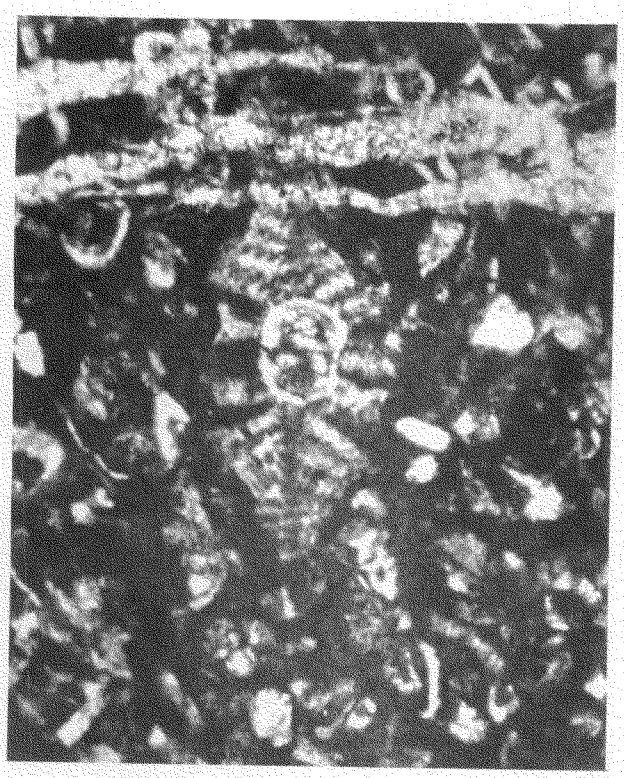

Plate 4A. *Lepidocyclina (Nephrolepidina) sp.*, Asmari Formation, Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

Plate 4B. *Spiroclypous sp.*, Red algae, Asmari Formation, Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

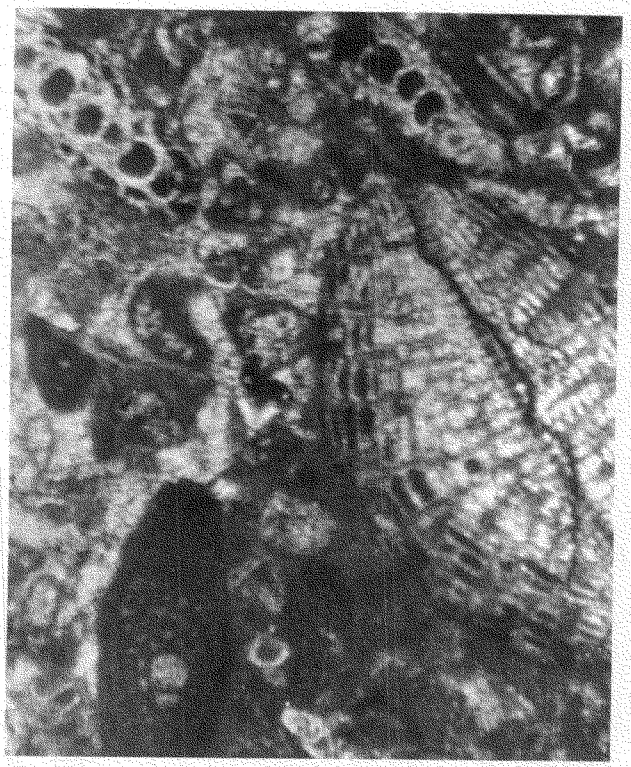

Plate 4C. *Archaias sp., Lepidocyclina sp., Miogypsina sp.*, Asmari Formation, Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

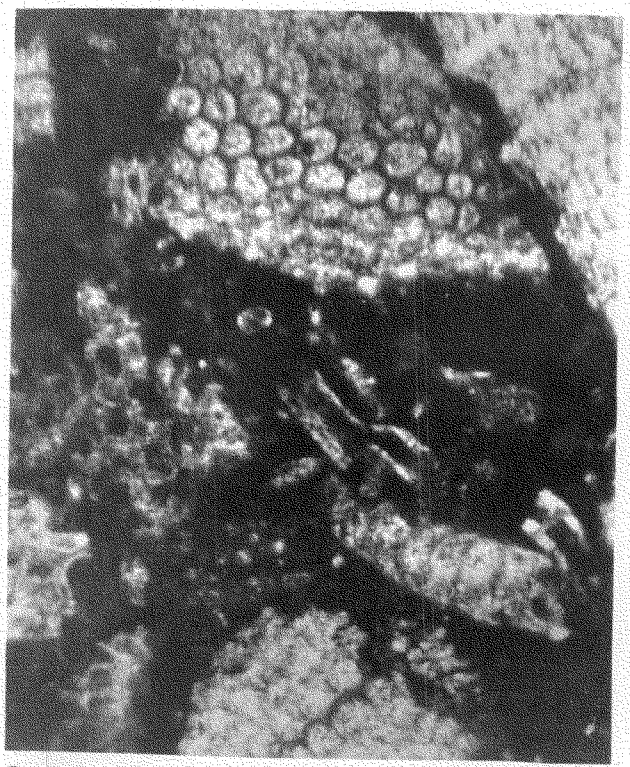

Plate 4D. *Lepidocyclina (Nephrolepidina) sp.*, (equatorial section), Asmari Formation, Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

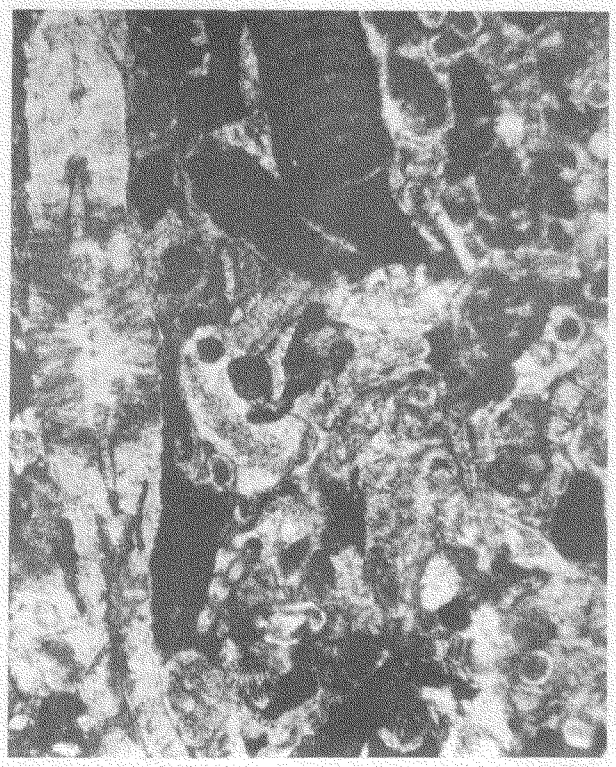

Plate 5A. Bentic foraminifera corallinacea packstone, Asmari Formation, Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

Plate 5C. *Meandropsina iranica*, Asmari Formation, Burdigalian, Tang-e Kloreh. Scale 1 cm= 250 μ, LN

Plate 5B. Corallinacea boundstone, Asmari Formation, Aquitanian, Chaghakhor. Scale 1 cm= 400 μ, LN

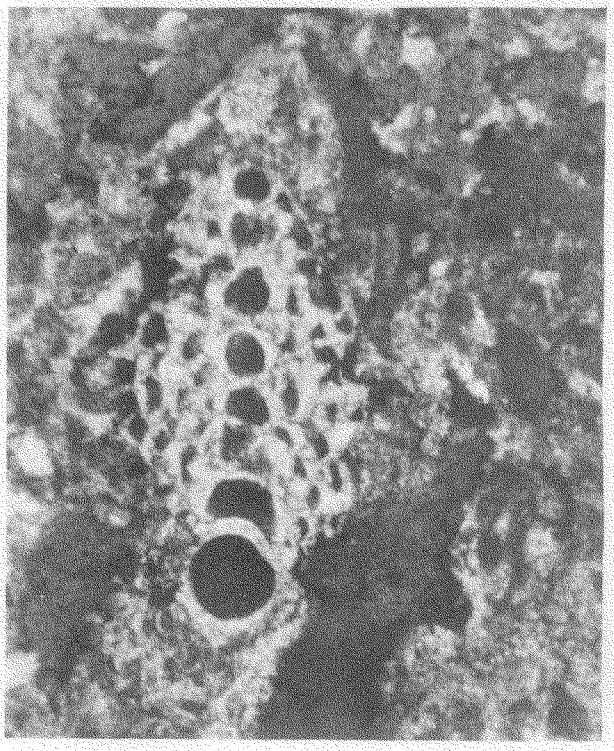

Plate 5D. *Miogypsina sp.*, Asmari Formation, Burdigalian, Tang-e Kloreh. Scale 1 cm= 250 μ, LN

Plate 6A. *Dendritina rangi*, Asmari Formation, Burdigalian, Tang-e Kloreh. Scale 1 cm= 250 μ, LN

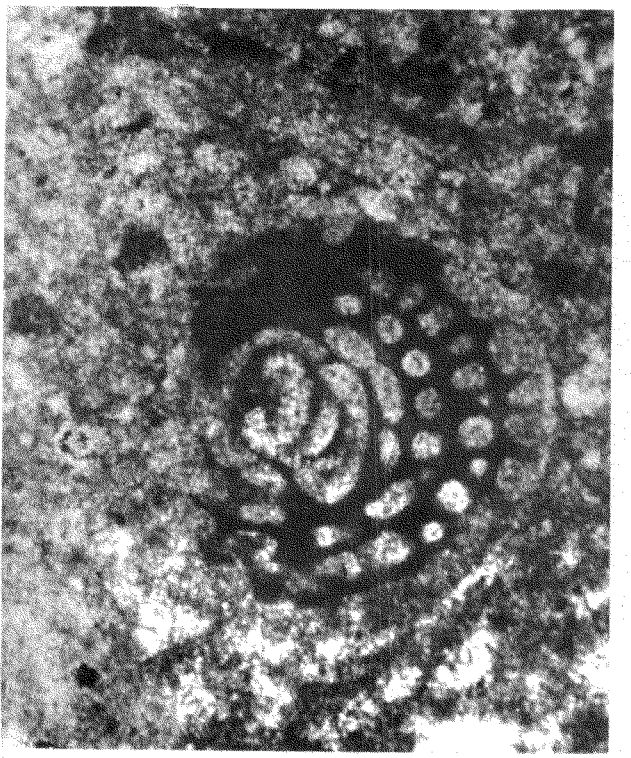

Plate 6C. *Neoalveolina melo Group*, Asmari Formation, Burdigalian, Tang-e Kloreh. Scale 1 cm= 250 μ, LN

Plate 6B. *Austrotrilina sp.*, Asmari Formation, Burdigalian, Tang-e Kloreh. Scale 1 cm= 400 μ, LN

Plate 6D. Miliolid echinid wackestone, Asmari Formation, Burdigalian, Tang-e Kloreh. Scale 1 cm= 400 μ, LN

Tang-e Kloreh Location

The outcrops of the Asmari Formation at Tang-e Kloreh are located 5 kilometers northwest of Lordegan City. The exposed Asmari Formation at this location is formed as a northwest-southeast elongated anticline. These rocks are 200 meters in thickness, light gray in color and are interbedded with marly limestone and marl layers. Some layers reveal a clastic appearance.

Lithology

Lithological characteristics of the Asmari Formation at the Tang-e Kloreh mainly consist of corallinacea bryozoa packstone; coral floatstone; miliolid echinid wackestone; and bioclastic wackestone. Bentic forams and fragments of echinid, red algae, bryozoa, mollusc and coral are present. These skeletal grains are associated with a micrite to microsparite and rarely sparite matrix. At the base, rock fabric tends to be floatstone [10].

Age and Assemblage Zone

The following microfauna are identified in limestones of the Asmari Formation at Tang-e Kloreh: *Neoalveolina melo Group; Meandropsina iranica; Dendritina rangi; Austrotrilina sp., Miogypsinoides sp., Discorbis sp., Asterigerina sp., Miliolia sp., Lithothamnium sp., and Lithophyllum sp.* (Plates 5C, 5D and 6).

Based on these microfauna, the exposed rocks of the Asmari Formation at Tang-e Kloreh are Lower Miocene (Burdigalian) in age.

The following biozone with respect to the occurrence of microfauna is determined as *Neoalveolina-melo Group* assemblage zone, which is the same as biozone-1 of Adams and Bourgeois [1]. As a result, these rocks are correlatable to the upper Asmari Formation (Fig. 7).

Conclusions

This study reveals that the Asmari Formation at the southern margin of the Zagros crushed zone (Burujen area) consists of pelagic foraminifera wackestone-packstone; bentic foraminifera echinid packstone; bentic foraminifera corallinacea packstone; coral boundstone; echinid corallinacea packstone to grainstone; and miliolid-echinid wackestone.

The outcrops of the Asmari Formation at the Buldaji are the same as those of the lower Asmari Formation. Recognition of the lower Asmari Formation at the Buldaji area is based on the occurrence of *Lepidocyclina (Eulepidina-Nephrolepidina)-Nummulites* assemblage zone, reflecting Upper Oligocene in age. The outcrops of the Asmari Formation at the Chaghakhor are the same as those of the lower-middle Asmari Formation. Recognition of the lower-middle Asmari Formation is based on the occurrence of *Nummulites* and *Miogypsina-Lepidocyclina* assemblage zones, reflecting Oligo-Lower Miocene (Aquitanian) in age. The outcrops of the Asmari Formation at the Tang-e Kloreh are the same as those of the upper Asmari Formation. Recognition of the upper Asmari Formation at Tang-e Kloreh is based on the occurrence of *Neoalveolina-melo Group* assemblage zone, reflecting Lower Miocene (Burdigalian) in age (Fig. 8).

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