



A Sedimentological and Paleontological review on Al Faidiyah Formation at Daryanah, in Al Jabal al Akhdar, Libya

Ali K. Khalifa¹, Mohammed F. El Hassi¹, Mostafa F. Mostafa¹ &
Ahmed R. El Menefy² (*)

1-Dept. of Geological Engineering, Bright Star University, City Road 11, P.O.B.
21864, Al Brega, Libya

2- Dept. of Earth Sciences, University of Benghazi, University Road 13, P.O.B.
9480 Benghazi, Libya

Abstract

The studied Al Faidiyah Formation at Daryanah-Al Abyar road-cut sequence is bounded by two erosional surfaces with the overlying Benghazi Formation and the underlain Al Abra q Formation. The formation is comprised of three units started with glauconitic clay at the base, followed by Operculinid-Lepidocyclinid marly limestone

(*) Email: Ali.k.khalifa92@gmail.com , Elhassi1990@gmail.com

intercalated by clay unit. The overall Al Faidiyah sequence is represented by four shallowing upward cycles.

*Micropaleontologically, four benthic foraminiferal species have been recognized (large benthic foraminifera, *Operculina complanata*, *Lepibocyclina dilatata*, *Heterostegina* sp. and *Nummulites fichteli*), together with planktonic foraminiferal representative (*Globigerina ciperoensis* and *Cassigerinella chipolensis*). Other macrofuna include bryozoans, pelecypods (*Chlamys* sp., *Spondylus* sp. *Oysters* sp. and *Pecten* sp.) and fragments of echinoids (plates and spines).*

*The depositional environment of Al Faydiah Formation accordingly, has been interpreted as open to confined platform, which corresponding to facies SMF-7 and SMF-8. The problem of the reworking was discussed herein from Al Faidiyah as the retrieved *Nummulites* from Al Faidiyah Formation is confirmed as reworked elements, due to: i) the existence of only A-Form, ii) discolored, corroded tests, iii) abraded test peripheral margin and iv) tests filled partially by glauconites.*

Keywords. *Foraminifer. Biostratigraphy. Daryanah-Al Abyar road-cut. Al Faidiyah. Libya.*

1. Introduction

The Al Faydiah Formation was introduced by [1] as nearly 50 m of a clay-carbonate sequence, exposed below the ruins of an old fortress near the AL Faydiah village entrance which is about 16 km south of Shahhat (Cyrene) city. Which is the type locality. [2-5] subsequently described the Al Faydiah Formation as consisting mainly of limestone. It also consists of greenish clay to marl at the lower portion of the formation grading upward to yellowish marly limestone. The basal clay unit, is glauconite-rich and common fossiliferous including abundant Bryozoans [6]. The Late Oligocene and Early Miocene Al Faidiyah Formation [3],

as well Al Faydiah Formation exposed at the Daryanah-Al Abyar road-cut section is located at Daryanah area at the lower escarpment, 50 km far from Benghazi city, at the coordinates (Long. 20° 25' 00" E and Lat. 32° 17' 24") (Fig. 1).

Both contacts of the Al Faidiyah Formation with the underlying Al Abraq Formation and the overlying Benghazi Formation are disconformable in nature and can be easily recognized in the study area by a glauconitic rich bed reflecting a transgressive event (Fig. 2). The studied sequence of the Al Faidiyah Formation is about 17 m thick and is consisting of three main units. The lower unit is represented by a glauconitic bed of about 0.5 m thick and is made of soft, thin, and dark green argillaceous limestone, However the upper part is largely an alternation of clay and marly limestone, about 16 m thick which is characterized by a diverse assemblage of Mollusca and large foraminifera. The main objectives of this study is to i)-Describe the microfacies of the samples based on depositional texture and fossils content of exposed Al Faidiyah Formation at Deryanah-Al Abyar road-cut; ii)- Highlight the paleontological content of the measured outcrop and iii)-Determine the depositional environment.

Ten rock samples were collected from the exposed Al Faydiah Formation at the Daryanah-Al Abyar road-cut section which attain a thickness of 16 m (Fig. 2). The studied samples have been subjected to Standard Paleontological Techniques for the separation of and microfossils tests from the contained sediments. However, selected macrofossils also been illustrated and identified. The recovered specimens then were cleaned, described, photographed, and stored.

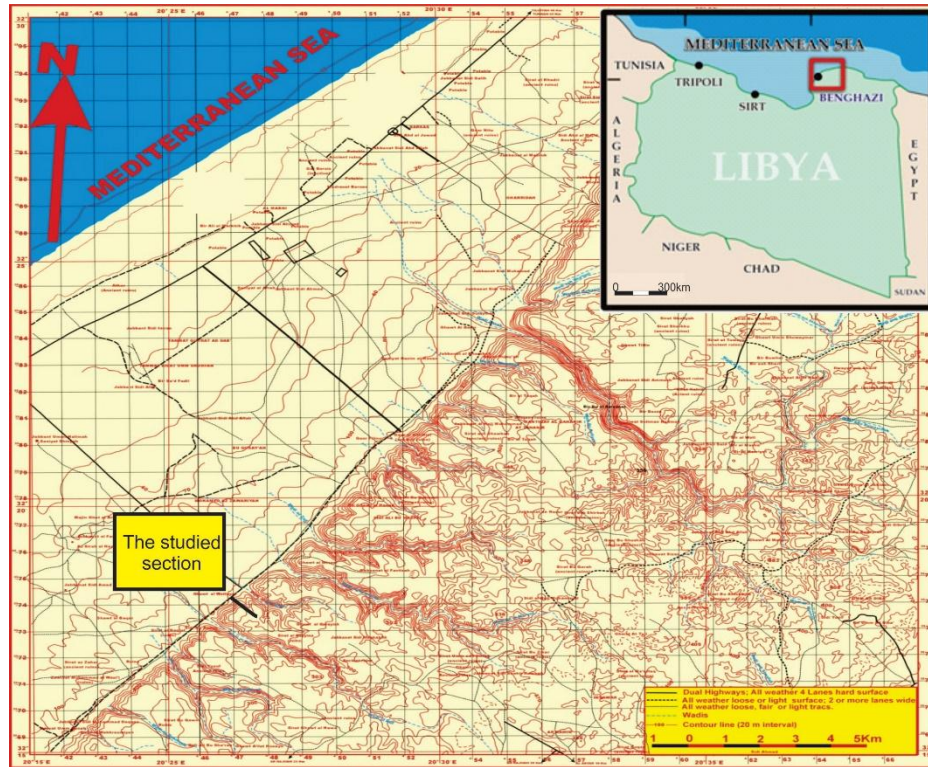


Figure 1. Map of Daryanah-Al Abyar area shows the location of Daryanah-Al Abyar road-cut studied section.

2 Sedimentology

The Al Faidiyah Formation at the studied section consists mostly of soft dark-grey, argillaceous limestone intercalated with quite hard and thickly-bedded limestone. The high concentration of glauconite grains at the base of this section marks the unconformable surface of the Al Faidiyah Formation with the underlying Al Abraç Formation. However, the upper unconformable surface with the overlying Middle Miocene Benghazi Formation is marked by extremely burrowed fauna (Fig. 2). Clay intercalated with marly limestone in a rhythmic pattern reflecting four shallowing cycles including the most of the basal glauconitic-rich bed (Fig. 3). The main established microfacies are:

1-Glaucanitic packstone microfacies: It composes of common glauconite, (packstone-texture), dark green in color, soft, with high concentrations of light green glauconite pellets.

The bioclastics are dominated by larger foraminifera (*Nummulites fichtelli*). The documented *Nummulites fichtelli* is treated herein, as a reworked staffs from the adjacent and eroded Al Abraaq Formation exposure. The reworking conclusion was suggested by [7]. *bryozoan* spp., echinoderm fragments (plates and spines), other pelecypods (*Oysters* sp. and *Pecten* sp.) (Plate1).

2-Operculinid-Lepidocyclinied marly grainstone microfacies: It consists of marly limestone, grainstone texture, yellow-cream color, soft to medium-hard.

The bioclastics are dominated by common fossils including larger Foraminifera (*Operculina complanata*, *Lepidocyclina dilatata*) and pelecypods (*Chlamys* sp., *Spondylus* sp. *Oysters* sp. and *Pecten* sp.) (Plate1). This unit is very rich in *bryozoan* assemblages which are very similar to that described by [5] from Al Faidiyah Formation at Cyrene-Apollonia road cut.

3-Operculinid-Lepidocyclinid clay wackestone microfacies: Sedimentologically each cycle of this unit consists of clay, wackestone in texture, greenish-brown, and soft.

Paleontologically these units yielded common fossils including *bryozoans* spp., and pelecypods (*Pecten* sp. and *Oysters* sp.) and Large foraminifera (*Operculina complanata*, *Lepidocyclina* sp.) with echinoid spines (Plate1).

3. Paleontology

The paleontologic assemblage recovered from the studied Al Faydiah formation at Daryanah- Abyar road is diverse and belong to five groups and includes planktonic foraminifera, large foraminifera (*Operculina complanata*, *Lepidocyclina dilatata* and *Nummulites fishtail*), bryozoa spp., pelecypods (*Chlamys* sp., *Spondylus* sp. *Oysters* sp. and *Pecten* sp.) , in addition to fragments of echinoids (plates and spines). The following is a brief note about the identified species:

3.1- bivalves

Phylum Mollusca Cuvier, 1795

Class Bivalvia Linné, 1758

Order Pictinide Gray, 1854

Family Pictinidae Gray, 1824

Genus *Chlamys* Roding, 1798

***Chlamys* sp. (Plate 1, Fig. 1)**



Figure 2. Unconformity surfaces of Al Faidiyah Formation with Al Abraq and Benghazi Formations.

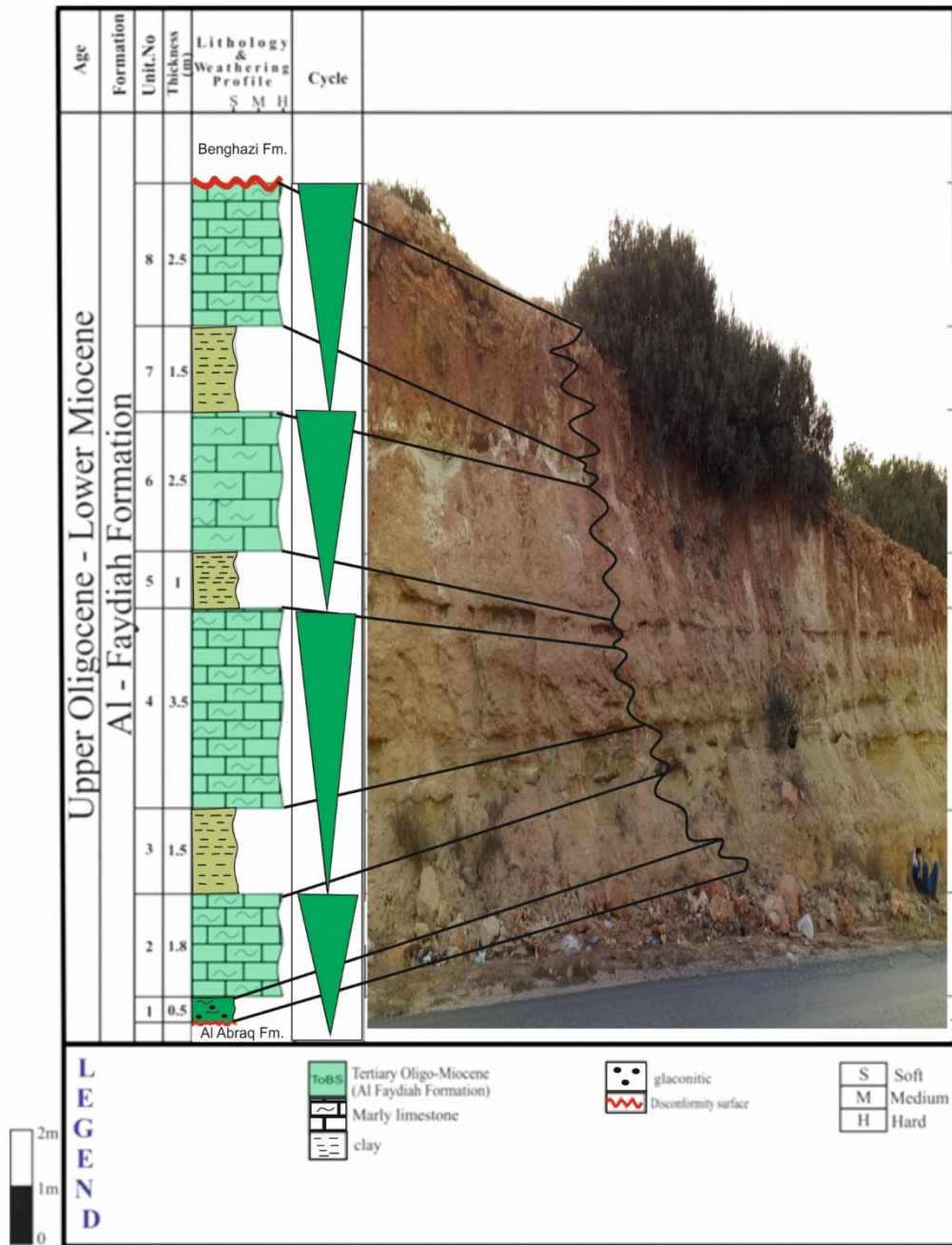


Figure 3. Stratigraphic columnar section of Al Faydiah Formation at Daryanah-Abyar road cut

Geologic range: Triassic- Recent.

Description: Equilateral shell, but inequivalve, right valve convex left valve flattened, and pronounced radiating ribs. Similar to pecten but the anterior auricles larger than the posterior ones with deep sinus for the byssus.

Genus *Pecten* Muller, 1776

***Pecten* sp. (Plate 1, Fig. 3)**

Description: very diverse genus characterized by Equilateral shell, right valve convex left valve flattened, with equal auricles and pronounced radiating ribs.

Geologic range: Cretaceous- Recent.

Order Ostride Gray, 1854

Family Ostridae Rafinsque, 1815

Genus *Ostrea* Linnaeus, 1758

***Chlamys* sp. (Plate 1, Fig. 2)**

Description: Right valve flattened and left valve convex, with lamellar structure and one adductor muscle scar placed centrally.

Geologic range: Cretaceous- Recent.

3.2- Large foraminifera

Order: Foraminiferida Eichwald, 1830

Suborder: Rotaliina Delage and Herouard 1896

Superfamily: Nummulitacea de Blainville 1827

Family: Nummulitidae de Blainville 1827

Genus: *Nummulites* Lamarck (1801)

***Nummulites fichteli* Mechelotti, 1841 (Plate 1, Fig. 7)**

Description: test medium size, lenticular with sharp periphery with reticulate septal filaments. Granulation reduced and pillars less developed in axial section. Spire almost regular with septa initially straight becoming more inclined and curved in outer whorls.

Geologic range: Early- Late Oligocene.

Operculina complanata Defrance, 1824 (Plate 1, Fig. 6)

Description: Test planispiral and flattened of medium to large size, numerous narrow chambers in many rapidly expanding whorls. Sutures strongly curved. Wall calcareous and lamellar and Surface may smooth or postulate.

Geologic range: Oligocene- Holocene.

Suborder: Orbitodacea

Family: Lepidocyclinidae, Scheffer 1932 (Plate 1, Fig. 5)

Lepidocyclina Gumbel, 1870

Description: Test discoidal to inflated, lenticular with distinct equatorial layer of chambers and zones of lateral chambers at each side. No canal system.

Geologic range: Neogene.

3.3. Evidences for reworking *Nummulites* in Al Faidiyah Formation:

- 1- Corroded peripheral outline of the test from rounded periphery to irregular "corroded" periphery
- 2- Glauconite grains partially filled some *Nummulites* chambers, (Fig. 4)
- 3- Some of the retrieved *Nummulites* show a degree of discoloration.
- 4- The rarity of the *Nummulites fichteli*



Figure 4. Reworked *Nummulites fichtelli* (A- Form) shows corroded perphral and glauconite-filling (Bar scale = 1mm)

4. Depositional environment:

The total recovered assemblages generally refer to a shallowing upward trend. They include reworked *Nummulites fichteli* and planktonic forams at the base of the formation followed by common operculinid and lepidocyclinid assemblages, which are assumed to thrive in open shelf settings. The depositional environment of Al Faydiah Formation has been interpreted on the bases recovered fauna and the depositional texture to be range from (open to restricted platform) This corresponds to facies SMF 7 and SMF 8 of [8], (Fig. 5).

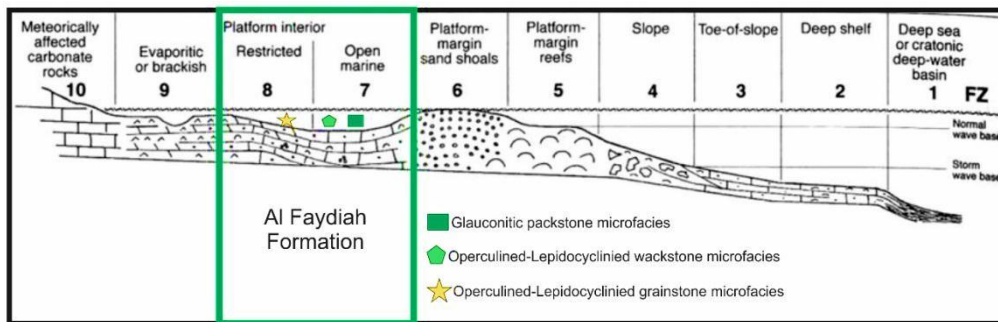


Figure 5. The depositional environment model of Al Faidiyah Formation at Daryanah-Abyar road cut modified after [8]

Conclusion

- 1- Al Faydiah formation at Daryanah-Al Abyar road cut is subdivided into three microfacies: i) glauconitic clay packstone ii) Operculinid-Lepidocyclinid marly grainstone iii) Operculinid-Lepidocyclinid clay wackestone.
- 2- The identified microfossils are represented by five groups and include planktonic foraminifera, and large foraminifera (*Operculina complanata*, *Lepidocyclina dilatata*, and *Nummulites fichteli*). The nature of the test of the latter larger foraminifera was examined under the microscope in this study and shows i) Corroded peripheral outline of the test from the rounded periphery to irregular "corroded" periphery ii) Glauconite grains are partially filled some *Nummulites* chambers, iii) Some of the retrieved *Nummulites* show a degree of discoloration and iv) *Nummulites fichteli* is relatively rare. The reporting of bryozoa spp., pelecypods (*Chlamys* sp., *Spondylus* sp. *Oysters* sp. and *Pecten* sp.), in addition to fragments of echinoids (plates and spines), is also characteristic. Accordingly, Al Faydiah Formation is dated as Early Miocene.
- 3- The depositional environment of Al Faydiah Formation has been interpreted based on the recovered fauna and the depositional texture to be range from (open to restricted platform) which corresponds to facies SMF 7 and SMF 8 of [8].

Explanation of plate 1

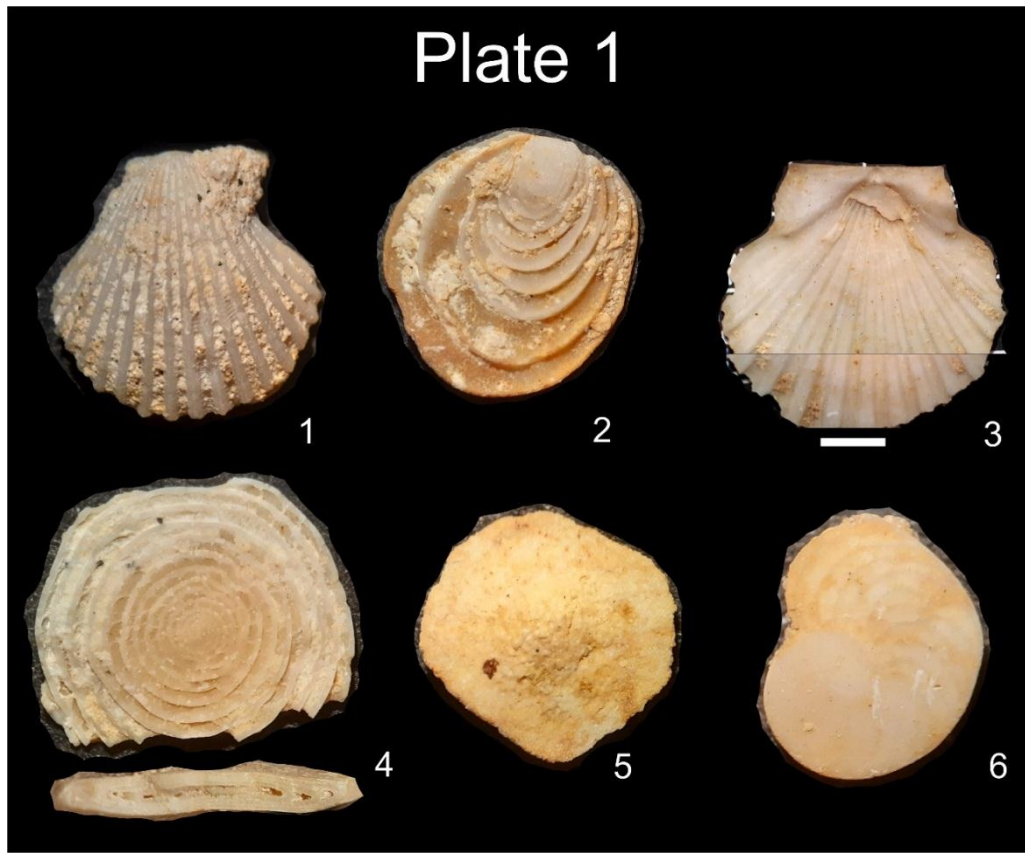
- 1- *Chlamys* sp. from Operculinid- lepidocyclinid marly Limestone unit; of Al Faydiah Formation At Daryanah –Abyar road-cut section.
- 2- *Oyster* sp. from clay unit; of Al Faydiah Formation At Daryanah – Abyar road-cut section.

3-*Pecten* sp. from Glauconitic marly unit; of Al Faidiyah Formation At Darynah –Abyar roadcut section.

4-*Nummulites fichteli* (equatorial and axial sections) from the glauconitic unit of Al Faidiyah Formation At Darynah –Abyar road cut.

5-*Lepidocyclina* sp., from the Operculinid- lepidocyclinied marly Limestone unit of Al Faidiyah Formation At Darynah –Abyar road cut section.

6-*Operculinacomplanata*, from the Operculinid- lepidocyclinied marly Limestone unit of Al Faidiyah Formation At Darynah –Abyar road cut section.



References

- [1] PIETERSZ, C. R., (1968) Proposed nomenclature for rock units in Northern Cyrenaica. In: Geology and Archaeology of Northern Cyrenaica, Libya (ed. F.T. Barr). Petrol. Explore. Soc. Libya, 10th Annu. Field Conf., 125-130.
- [2] KLEN, I., (1974) Geological map of Libya 1:250 000. Sheet. NI 34-14, Benghazi Explanatory Booklet. Indust. Resear. Cent. Tripoli. 49 pp.
- [3] ROHLICH, P., (1974) Geological map of Libya, 1:250 000: sheet Al Bayda NI 34-15. Explanatory booklet. Ind. Res. Cent., Tripoli.70p.
- [4] ZERT, B., (1974) Geologic map of Libya, 1:250,000 Darnah Sheet (NI 34-16), Explanatory booklet. Industrial Research Centre, Tripoli,49 PP.
- [5] ABDULSAMAD, E. O., EL-EKHFIFI, S. S., AND MUFTAH, A. M. (2018). Stratigraphy and larger benthic foraminifera of Middle Eocene to Middle Miocene rocks along the Tobruk-Al Bardia scarps, Northeastern Cyrenaica, Libya. Stratigraphy, 15(3), 123-141.
- [6] EL SAFORI, Y. A. AND MUFTAH, A.M (2007) Oligocene bryozoans from Al Jabal Al AlAkhdar, Libya. Egypt. Jour. Paleontol., 7 Cairo, 315-334.
- [7] EL HAWAT, A. S. AND SHELMANI, M. A. (1993) Short Notes and Guide book on the Geology of Al Jabal al Akhdar Cyrenaica, NE Libya, Earth Sciences Society of Libya (ESSL), special publication, Tripoli, 70 pp.
- [8] Wilson, J.L., (1975) Carbonate Facies in Geologic History. Springer-Verlag, Berlin, 395 pp.