

***Nummulites alsharhani* n.sp. (Late Lutetian) from Jabal Hafit and Al Faiyah: Western side of the Northern Oman Mountains, United Arab Emirates**

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Abstract

Nummulites alsharhani n.sp. (Group: *Nummulites distans*) is taxonomically analysed and described from fossiliferous limestones on the western limb (Tle4) of Jabal Hafit anticline, Al-Ain area, and from Al-Faiyah Range Mountains (northeast of Jabal Al Aqabah, U.A.E.). This species evolved in parallel lineage with the phyletic line of *Nummulites maximus* d'ARCHIAC, 1850. The phylogeny of the lineage of *Nummulites alsharhani* is from tight to lax while the opposite trend is found in the lineage of *Nummulites maximus*. This species conforms well with that described from Turkey by DECROUEZ & SELCUK (1981) as *Nummulites* aff. *maximus*.

Key Words

United Arab Emirates, Arabian Gulf, Eocene, Late Lutetian, *Nummulites*.

Résumé

Nummulites alsharhani n.sp. (Lutétien supérieur) de Jabal Hafit et Al Faiyah: flanc occidental du nord des montagnes d'Oman, Emirats Arabes Unis.- *Nummulites alsharhani* n.sp. (groupe de *Nummulites distans*) est analysée taxonomiquement et décrite des calcaires fossilifères du flanc occidental (Tle4) de l'anticlinal de Jabal Hafit, région de Al-Ain, et de la chaîne montagneuse de Al-Faiyah (nord-est de Jabal At Aqabah, U.A.E.). Cette espèce représente une lignée ayant évolué parallèlement à la lignée phylétique de *Nummulites maximus* d'ARCHIAC, 1850. La spire de *Nummulites alsharhani* est serrée au centre et lâche vers l'extérieur tandis que le contraire se remarque chez *Nummulites maximus*. Cette espèce est conforme à celle qui a été décrite de Turquie par DECROUEZ & SELCUK (1981) sous le nom de *Nummulites* aff. *maximus*.

Mots-clés

Emirats Arabes Unis, Golfe arabe, Eocène, Lutétien Supérieur, *Nummulites*.

I. INTRODUCTION

This work describes *Nummulites alsharhani* n.sp. which are collected from two different localities in the U.A.E., namely: Jabal Hafit and Al-Faiyah Range Mountains. The first locality (Jabal Hafit) lies southeast of Al-Ain city which is situated in the eastern part of Abu Dhabi Emirate, U.A.E. The second locality is in the Al-Faiyah Range Mountains about 100 km north of the first locality (Fig. 1).

A. Jabal Hafit locality

Jabal Hafit, has the most complete sequence for studying Eocene and Oligocene rocks in the U.A.E. The litho- and biostratigraphy and structural setting of the Palaeogene succession of the Jabal Hafit

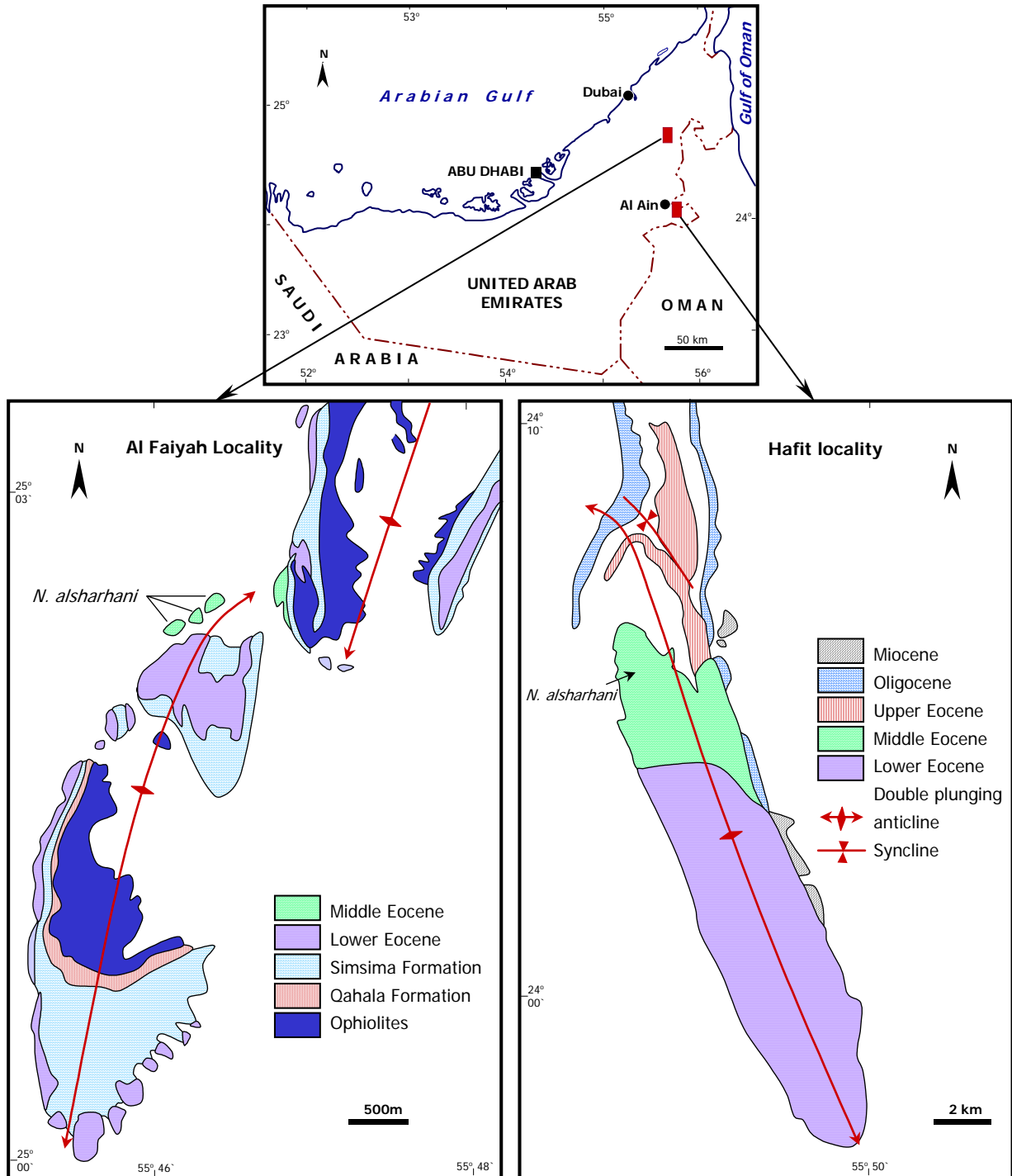
anticline has been investigated by HUNTING (1979), CHERIF & EL-DEEB (1984), WARRAK (1986), ANAN *et al.* (1992), HAMDAN & BAHR (1992), and NOWEIR (2000).

HUNTING (1979) established a geologic map of Jabal Hafit, and devised the first lithostratigraphic and chronostratigraphic subdivision of the Paleogene strata of the area. The ages of lithostratigraphic units were mainly based on the micropaleontologic data of TERRATEST (1973). Eleven mappable and coded rock units were recognized; Tle1 to Tle7, Tlo1, Tlo2, Tm2 (T=Tertiary, l=Lower, e=Eocene, o=Oligocene, and m=Miocene).

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Fig. 1: Simplified geologic map showing the location of the study area.



CHERIF & EL DEEB (1984) studied the Paleogene sequence of Jabal Hafit. They formally introduced Hafit, Senaiya and Al Jaww formations and subdivided them into members in partial agreement with the lithostratigraphic units established by HUNTING (1979). They redefined some of the Hunting's units to fit their proposed lithostratigraphy and assigned revised ages to some of the units based on new micropaleontologic data. WARRAK (1986) applied HUNTING's (1979) stratigraphic subdivisions of the Tertiary rocks in Jabal Hafit.

HAMDAN & BAHR (1992) recognized and formally redefined three formations and eight members. The gross lithologic characteristics, thicknesses, nature of the stratigraphic contacts and unit ages were based in index planktonic foraminifera and *Nummulites* for each rock unit. These formal rock units arranged from base to top as follows:

1. Rus Formation (late Early Eocene)

This is divisible into two members, arranged in descending order as follows:

- Hilli Member
- Wadi Tarabat Member

2. Dammam Formation (Middle to Late Eocene)

This is divisible into three members, arranged in descending order as follows:

- Mazyad Member
- Ain Al Faydah Member (Eastern limb).
- Wadi Al Nahyan Member

3. Asmari Formation (Early to Middle Oligocene)

This is divisible into three members, arranged in descending order as follows:

- Muwaiji Member
- Mutaredh Member
- Zakher Member

B. Al Faiyah locality

The second locality lies in the Al Faiyah Range Mountains (Fig. 1), belonging to a group of regional ridges that formed by folding of the Upper Cretaceous to Lower Tertiary sedimentary rocks exposed along the western margin of the Northern Oman Mountains. The anticlines of the Al-Faiyah Mountains (Jabal Buhays, Jabal Aqabah, Jabal Rumaylah, Jabal Al-Faiyah and Jabal Mulayhah), generally trend NNE-SSW and are flanked by thrust faults striking parallel to the hinges. These folds resulted from northeast-southwest tectonic shortening during the Tertiary.

In both the Jabal Hafit and Al-Faiyah localities, the studied stratigraphic sections examine strata

belonging to the Middle Eocene Ain Al Faydah Member of the Dammam Formation (Tle4 of HUNTING, 1979 = middle Middle Eocene; though CHERIF & EL DEEB, 1984 assigned a late Middle Eocene age for it). The present study confirms the age of this unit, reported by ANAN *et al.* (1992), HAMDAN & BAHR (1992) and WHITTLE *et al.* (1996) to be middle Middle Eocene to late Middle Eocene (late Lutetian) age. This conclusion is based on fauna collected at the two stratigraphic sections. The aim of this work is to describe *Nummulites alsharhani* which is believed to be new.

II. LITHOSTRATIGRAPHY

The Dammam Formation was introduced by BRAMKAMP (1941) in an unpublished ARAMCO report. The type section is located along the Dhahran Al'Alah road from where this road first intersects margin of the Dammam Dome in eastern Saudi Arabia (at lat. 26°19'26"N, long. 50°04'5"E) (see POWERS *et al.*, 1966; POWERS, 1968). In the type locality the Dammam Formation attains a thickness of about 28m and consists of tan to light-colored limestones with interbeds of shale in lower part and marl in upper part.

The Dammam Formation is widely exposed around the western periphery of the northern Oman Mountains.

The thickness of the Ain Al-Faydah Member is 337m at its type section. It consists of a buff, grey-weathered medium-grained fossiliferous, nummulite-rich limestone interbedded with yellow marl (Fig. 2a).

It shows lateral and vertical facies changes from north to south characterized by changes in color and proportion of marl. The base of the Ain Al-Faydah Member is conformable and gradational with the underlying Wadi Al-Nahyan Member. The top of the Ain Al-Faydah Member is also conformable with the overlying Mazyad Member. *Nummulites alsharhani* n.sp. occurs in a monospecific bank near from the top of the Ain Al-Faydah Member.

In the Al-Faiyah Range Mountains, the Dammam Formation was first recognized by NOWEIR *et al.* (1998) at one locality along the western flank of the Buhays-Aqabah anticline, (Table 1), at that locality, the formation consists of 10 m of shallow marine shelf nummulitic limestone with thin-bedded marl, dated as latest Middle Eocene (Bartonian) on the basis of *Nummulites ptukhiani* and *Nummulites cf. lyelli*, according to SCHAUB'S nummulitic scale (1981). In the present work, we have discovered another locality along the northeastern side of the

Fig. 2a: Lithostratigraphic section of the Middle Eocene rocks at the western limb of Jabal Hafit anticline.

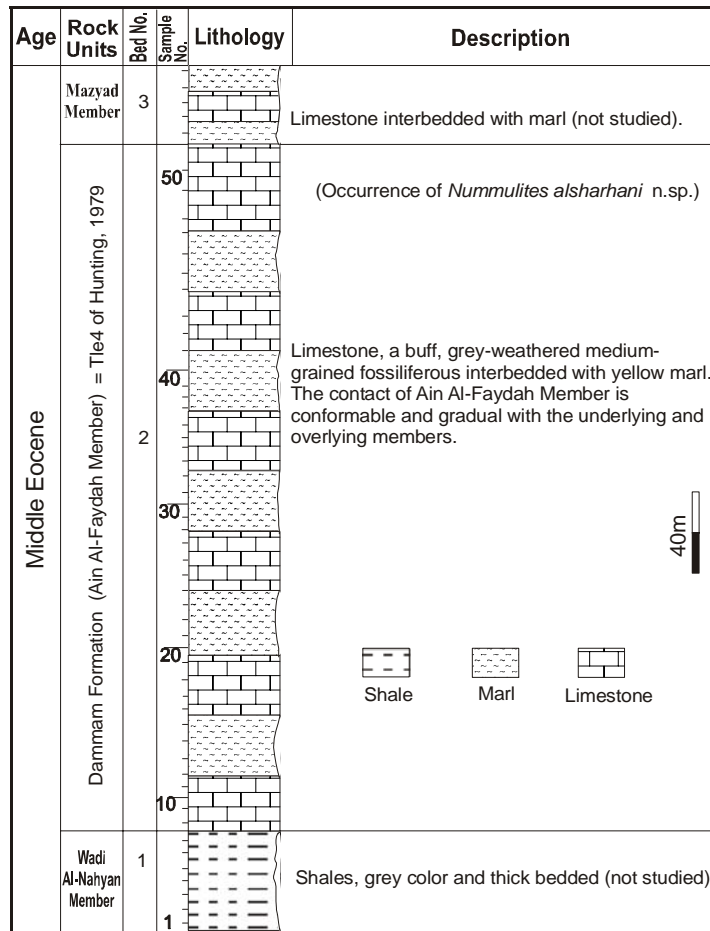
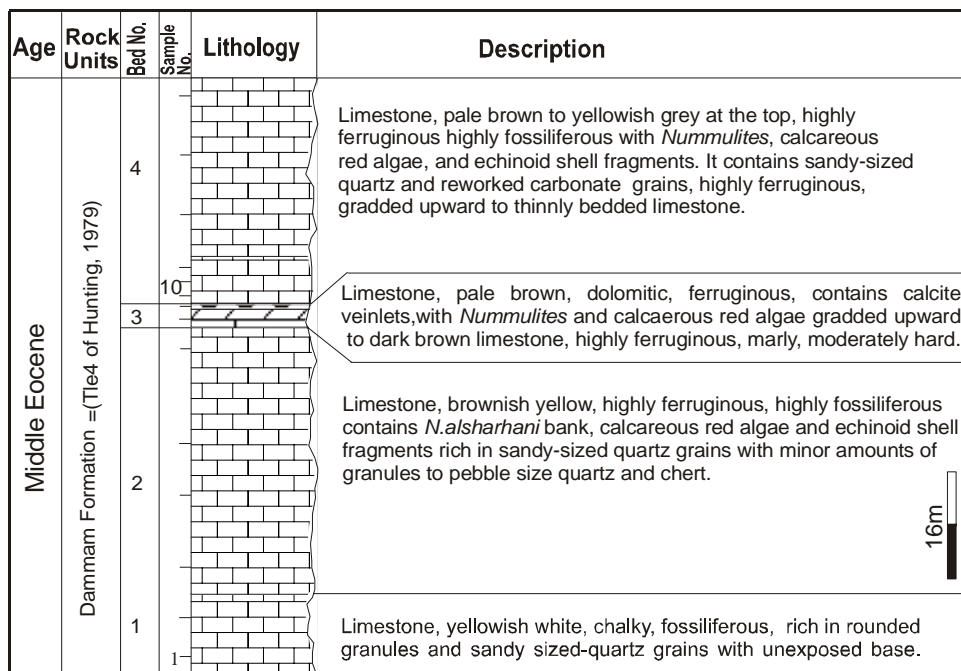


Fig. 2b: Lithostratigraphic section of the Middle Eocene rocks, northeast of Jabal Aqabah, Al Faiyah Range Mountains.



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Table 1: Distribution of the surface outcrops of the Dammam Formation in the study area according to different authors.

Author Stage	Jabal Hafit (Hunting, 1979)	Jabal Hafit (Cherif & El Deeb, 1984)	Jabal Hafit (Hamdan & Bahr, 1992)	Jabal Hafit (Whittle et al., 1996)	Jabal Al Faiyah (Noweir et al., 1998)	Present study		
Upper Eocene	Tle6	Semaya Formation	Member (A)	Mazyad Member	Unit 3 (Argillaceous Shaley Limesone)	Dammam Formation	Mazyad Member	
	Tle5							
	Middle Eocene	Lutetian	Hafit Formation	Upper Limestone Member	Ain Al-Faydah Member	Unit 2 (Nummulitic Limestone)	Dammam Formation	Ain Al-Faydah Member
Tle4								
Tle3		Middle Marl Member	Wadi Al Nahyan Member	Unit 1 (Marly Limestone)	Wadi Al Nahyan Member			
		Lower Limestone Member						

Jabal Aqabah anticline, (Table 1) where a 90 m thick sequence of inner neritic highly nummulitic (*Nummulites alsharhani* n.sp.) limestone forms a bank of about 30 m. thickness. Above this is a massive limestone layer becoming thinly bedded towards the top, (Fig. 2b). We suggest a latest Lutetian (Middle Eocene) age based on the presence of *Nummulites maximus* group (*N. alsharhani* n.sp.). These *Nummulites* were also dated following SCHAUB'S nummulitic scale (1981).

III. LOCATION FOR THE STRATIGRAPHIC SECTIONS

The first stratigraphic section was examined from a site on the western limb of Jabal Hafit. The base of the section is located at latitude 24° 07' 7" N, and longitude 55° 45' 7" E, while its top is located along the same latitude at longitude 55° 44' 35" E, (Fig. 1). The second stratigraphic section was measured Northern on the northeastern side of Jabal Al Aqabah, at latitude 25° 04' 15" N and longitude 55°

46° E, at Al-Faiyah Range Mountains, Western side of the Oman Mountains, near Al Dhayd city, U.A.E. (Fig. 1).

IV. DEPOSITORY

The Holotype and the Paratypes for the new *Nummulites* species are deposited at Ain Shams University, Faculty of Science, Geology Department, Cairo, Egypt, in the collection of Mohamed BOUKHARY.

V. SYSTEMATIC CLASSIFICATION

Order: Foraminiferida EICHWALD, 1830
Suborder: Rotaliina DELAGE & HEROUARD, 1896
Superfamily: Rotaliacea EHRENBERG, 1839
Family: Nummulitidae DE BLANVILLE, 1827
Subfamily: Nummulitinae DE BLANVILLE, 1827
Nummulites distans Group
Nummulites alsharhani n.sp.
Pl. I, figs.1-14; Pl. II, figs.1-9

Etymology: In honour of Abdul Rahman Sultan ALSHARHAN, Professor of Sedimentary rocks and Petroleum Geology of the Middle East, Geology Department, Faculty of Science, United Arab Emirates University.

Holotype: Pl. I, fig. 9.

Paratypes: 10 microspheric specimen and 20 megalospheric specimen.

Locus Typicus: Jabal Hafit anticline, western limb, United Arab Emirates.

Stratum typicum: Sample 50 Bed no.2 (uppermost part), Ain Al Faydah Member, Dammam Formation.

Microspheric generation (B-form): Form is flat, undulate, thick in center and with rather thin margin. The diameter reaches to 113mm, and maximum thickness 5mm, while that of SCHAUB, 1981, the diameter ranges from 40-110 mm and thickness from 4-6.5mm for *N. maximus* (Table 2 and Fig. 3).

Equatorial Section: Spire is narrow (tight) rather irregular, particularly at the first half of radius; septa are inclined and curved in the inner third, irregular, undulate and at the same time long in the second third of the radius, short in the external third of the radius. The number of whorls per radius as follows: 51 whorls in a radius of 21.4mm, 54 in 22.5mm, 56 in 23 and rarely 67 whorls in 33mm; while in SCHAUB, 1981 has *N. maximus* SCHAUB, 1981, 48 whorls in radius of 28.5mm, 56 in 34-38mm, 66 in 40-41.4mm, and 68 in 43mm (Table 2, and Fig. 3).

Megalospheric generation (A-form): Form is lenticular, septal filaments are sigmoidal to meandriform. The average diameter 7.6mm, and average thickness 3.5mm; while that of SCHAUB, 1981, the diameter from 5 to 13 mm and thickness from 2.5mm to 4mm for *N. maximus* (Table 2, and Fig. 3).

Table 2: Measurements of *N. alsharhani* n.sp. in comparison with *N. maximus*, *N. aff. maximus*, *N. distans*, *N. polygyratus* and *N. millecaput*.

Microspheric (B- form) generation

Species name	<i>N. maximus</i> D'Archiac, 1850 after Schaub, 1981	<i>N. distans</i> Deshayes, 1838, after Schaub, 1981	<i>N. polygyratus</i> Deshayes, 1838, after Schaub, 1981	<i>N. millecaput</i> Boubée, 1832, after Schaub, 1981	<i>N. alsharhani</i> n.sp. Present study
Diameter & Thickness in mm	D = 40-110 mm T = 4-6.5 mm				D = 110 mm T = 5 mm
Form of the test	Flat form and thin margins				Flat, undulate and thick in center
Septa	Inclined, curved and irregular				Curved, inclined & thin with keeled
Number of Whorls/radius	48 whorls in a radius of 28. 5- 31.8 mm 56 whorls in a radius of 34- 38 mm 66 whorls in a radius of 40- 41.4 mm 68 whorls in a radius of 43 mm	15 whorls in a radius of 10.4- 13.8 mm 17.5 whorls in a radius of 12.2- 16.8 mm 20 whorls in a radius of 17.5- 19.5 mm	24 whorls in a radius of 12.5- 20.5 mm 30 whorls in a radius of 20.8- 25 mm 35 whorls in a radius of 25.4 mm	38 whorls in a radius of 21- 23.5 mm 44 whorls in a radius of 22- 25.5 mm 45 whorls in a radius of 22.5- 26 mm	51 whorls in a radius of 21.4 mm 54 whorls in a radius of 22.5 mm 56 whorls in a radius of 23 mm 67 whorls in a radius of 43 mm

Plate I

Figs. 1-14: *Nummulites alsharhani* n.sp.

Sample 50, Ain Al Faydah section, Jabal Hafit:

Figs. 1-4: Microspheric form, equatorial section, and figs. 5-14: Megalospheric form, figs. 5-13: equatorial section, and fig. 14: Axial section.

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Plate I



Table 2: Megalospheric (A- form) generation.

Species name	<i>N. maximus</i> D'Archiac, 1850 after Schaub, 1981	<i>N. aff.</i> <i>Maximus</i> Decrouez & Selcuk, 1981	<i>N. distans</i> Deshayes, 1838, after Schaub, 1981	<i>N.</i> <i>polygyratus</i> Deshayes, 1838, after Schaub, 1981	<i>N. millecaput</i> Boubée, 1832, after Schaub, 1981	<i>N. alsharhani</i> n.sp. Present study
Diameter & Thickness in mm	D = 5-13 mm T = 2.5-4 mm	D = 4-6 mm T = 2-3 mm	D = 3-5 mm T = 2-3.6 mm	D = 4-8 mm T = 1.5-2.5 mm	D = 4-8 mm T = 2-4 mm	D = 7.6 mm T = 3.5 mm
Form of the test	Lenticular	-	Lenticular	Lenticular & Plate form	Lenticular	Lenticular
Septal filaments	S- shaped	-	Radial	Radial to sinuous	S-shaped, flexuous	Sigmoidal to meandriiform
Septa	Irregular, inclined and wrinkled thin	-	Irregular	Irregular	Regular, inclined & wrinkled	Irregular and very inclined
Number of Whorls/radius	-	3 whorls in a radius of 3.15 mm 4 whorls in a radius of 3.3 mm	3 whorls in a radius of 1.8- 2.8 mm	3 whorls in a radius of 2.2- 3 mm 4 whorls in a radius of 2.7- 3.3 mm	4 whorls in a radius of 2.7 mm 6 whorls in a radius of 3.2- 3.8 mm	2 whorls in a radius of 1.65- 2.2 mm 3 whorls in a radius of 2.2- 2.6 mm 4 whorls in a radius of 2.45- 2.5 mm
Size of protoconch Age	1-1.7 mm Late Lutetian	1.0 mm Late Lutetian	0.6-0.7 mm Middle Cuisien	0.6-1.1 mm Late Cuisien	0.8-1.2 mm Middle Lutetian	1.3-1.8 mm Late Lutetian

Fig.3: Spiral diagram of *Nummulites alsharhani* n.sp.

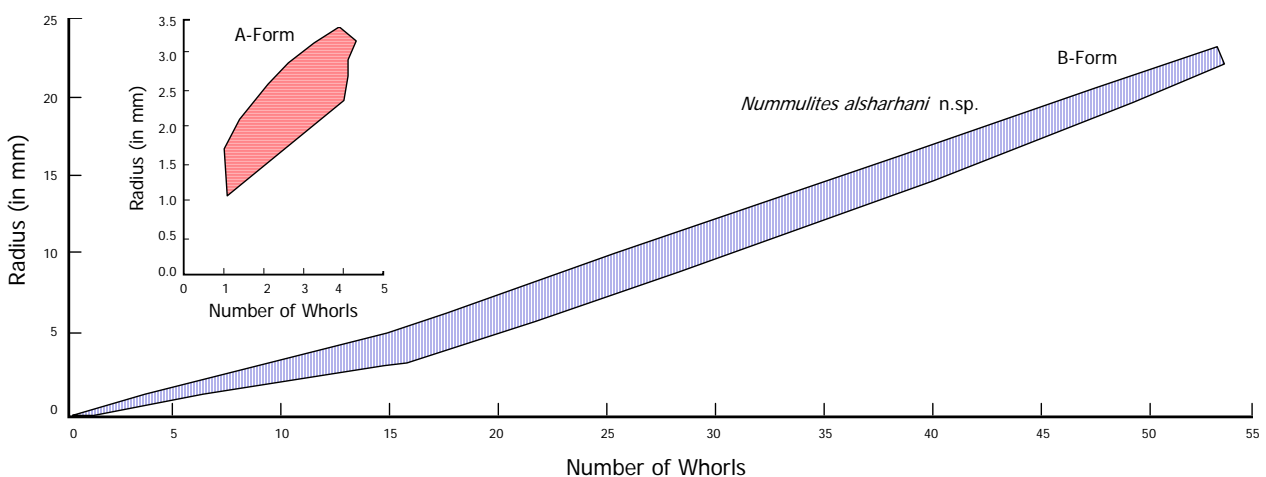


Plate II

Figs. 1-9: *Nummulites alsharhani* n.sp.

Figs. 1-3 & 6 sample 50 Ain Al Faydah Member, Dammam Formation, Jabal Hafit and figs. 4-5, figs. 7-9, sample AT7, Dammam Formation, Al-Faiyah: Figs. 1-7: Microspheric form: figs. 1-4: equatorial section, figs. 5 & 6: Axial section and fig. 7: External, figs. 8 & 9 Megalospheric form: fig. 8: equatorial section, and fig. 6: Axial section. Depository member: Figs. 1-3 & 6: H5001-5004 and figs. 4, 5, 6, 7, 8 & 9: AT71-AT75.

Nummulites alsharhani n.sp. (Late Lutetian) from Jabal Hafit and Al Faiyah

Plate II



Equatorial section: Septa are rather irregular, very inclined and undulated. Deuteroconch and the early chambers are very low. The spire remains regular from the second whorl till the periphery. The number of whorls per radius as follows: 2 whorls in radius of 1.65-2.37mm, 3 in 2.2-2.6mm, and 4 in 2.45-4.2mm, the protoconch is large, and is 1.628mm, while in *N. maximus* SCHAUB, 1981, it ranges from 1.3 to 1.8mm (Table 2, and Fig. 3).

Remarks: *Nummulites alsharhani* n.sp. compare well with *N. aff. maximus* in DECROUEZ & SELCUK, 1981 from South Turkey. It has few whorls in the megalospheric generation as compared with *N. maximus*, in addition to the relaxation of the early whorls in the megalospheric form of *N. maximus* as it is evolved from very lax stock as early as *Nummulites luterbacheri* BOUKHARY, BASSIOUNI & HUSSEIN-KAMEL.

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