

Miocene benthonic foraminiferal biostratigraphy of Wadi El Deir, Southern Galala Plateau, Egypt

Magdy S. Nassif¹, Nagwa Ibrahim², Mahmoud A. Omran³ and Sarah S. El.Wakeel⁴

^{1 4} Department of Geology, Faculty of Science, Suez Canal University, Ismailia, Egypt

² Department of Geology, Faculty of Science, Zagazig University, Zagazig, Egypt

Abstract: The Miocene rocks are carefully studied and sampled from Wadi El Deir section (Lat. 28° 51' 16" N and Long. 32° 35' 20" E) which exposed of the Southern Galala Plateau in the Eastern Desert. Lithostratigraphically, the Miocene sequence could be differentiated into two main rock units arranged from the oldest to youngest; Hommath, and Sarbut El Gamal formations. In terms of benthonic foraminifera zonation, the study area is yielded I benthonic foraminiferal zone; *Amphistegina vulgaris* – *Textularia gramen* – *Amphimorphina haueriana* Assemblage zone (Lower Miocene), *Stilostomella* spp. – *Bulimina* spp. – *Mesolenticulina* spp. Assemblage Zone and *Textularia nussdorfensis* – *Textularia mariae* Assemblage Zone (Middle Miocene).

Keywords: Miocene, benthonic foraminifera, biostratigraphy, Eastern Desert-Egypt

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I. Introduction

Since the early Nineteenth Century, the Miocene sediments in the Gulf of Suez region and their relations to the evolution of the Gulf of Suez basin have been intensively studied by many authors, such as; Issel (1899); (Barthoux & Douvillé 1914); (NSSGSE) (1964 & 1974); Ghorab & Marzouk (1967); Garfunkel & Bartov (1977); El-Heiny (1981 & 1982); Abd El- Razek (1991); Nassif *et al.* (1992); Issawi *et al.* (1999); Sadek (2001); Abd El-Naby *et al.* (2010); Mandur & Baioumi (2011); and Hewaidy *et al.* (2012 & 2013). The present study is concerned with establishment of the possible biostratigraphic benthonic foraminiferal biozone across Miocene rocks from Wadi El Deir section (Lat.28° 51' 16" N and Long. 32° 35' 20" E) of the Southern Galala Plateau in the Eastern Desert, Egypt.

II. Study Area

The study area is about 80.5m. located of the Southern Galala Plateau in the Eastern Desert (Fig.1). The main target of the present work is to study in details the different lithostratigraphic units of the Miocene sequence and their different biostratigraphic zones. There is one main stratigraphic surface section, namely Wadi El Deir

(Lat. 28° 51' 16" N and Long. 32° 35' 20" E).

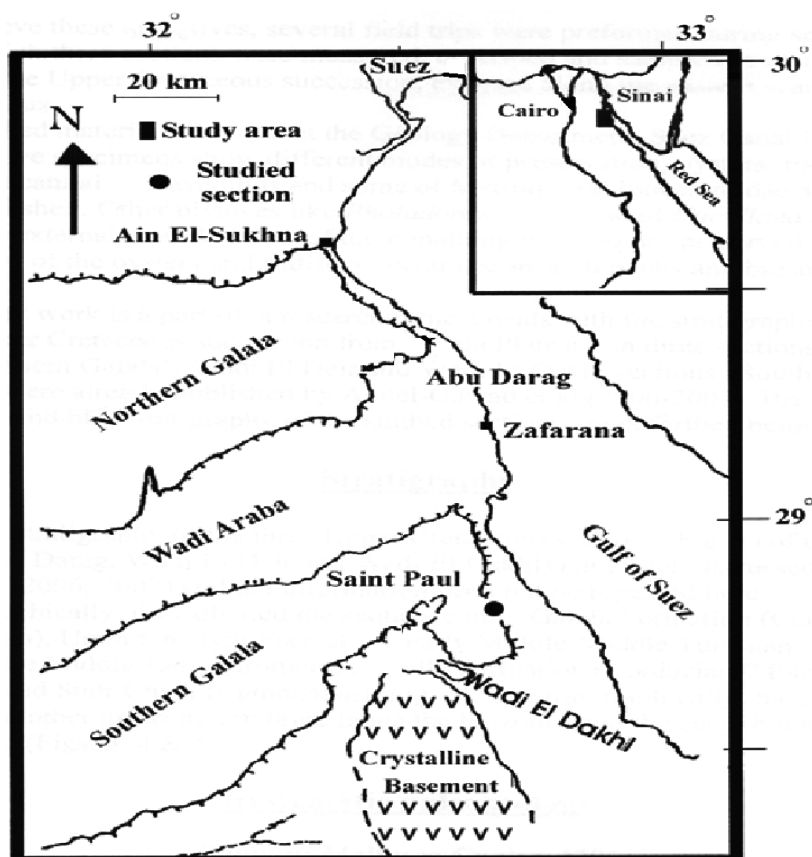


Fig.1: Location map of the studied area.

III. Methods

About 41 representative samples were measured and sampled. These samples were subjected to detailed biostratigraphic analysis based on the benthonic foraminiferal content to recognize the different Miocene biozones. For benthonic foraminifera examination, about 100-200 gm. Of dried rock samples were soaked overnight in a solution of hydrogen peroxide (H_2O_2) concentration 30% until full distintegration and washed over 63 mm. sieve.

The microfossil content were picked and separated into foraminifera then, identified by using stereo-microscope with magnification 10, 20 and 40X. All the identified benthonic foraminifera were photographed by the scanning electronic microscope (SEM).

IV. Lithostratigraphy

The field study has enabled to recognize four rock units representing the Miocene sedimentary rocks of the Southern Galala Plateau as following from the oldest to youngest:

IV-1 Hommath Formation

Author: Abdallah and Abd El-Hady (1966).

Type locality: at the hill of triangulation point (110) on the southern side of Wadi Hommath.

Thickness: 51.3m.

Lithology at the type section: It consists of interbedded yellow sandy limestone, yellow friable sandstone, and yellow brown sandy marls with yellowish brown calcareous grits at the bottom.

Boundaries: Overlies Eocene rocks and underlies Sarbut El Gamal Formation.

Age: Lower to Middle Miocene

Description in the present study: This Formation consists of yellow marl with yellowish gray conglomeritic bed separating it from the underlying Upper Eocene rocks at the bottom of this formation and composed of interbedded yellowish red slity shale and yellow marl with gypseous and limonitic (Fig.2-a), which attains 22m. thick in the Wadi El Deir section.

IV-2 Sarbut El Gamal Formation

Author: Ghorab and Marzouk (1967) Type locality: Gebel Sarbut El Gamal

Lat.: 2° 98' N - Long.: 33° 5' E

Thickness: 379

Lithology at type section: White, yellow, compact, non-bedded algal limestone at the top and bottom, with grey marl interbeds in between.

Boundaries: At the type section, this formation overlies Gharandal Formation and outcrops on the surface.

Age: Middle Miocene (Serravallian)

Description in the present study: the rocks of the Sarbut El Gamal Formation cover a large portion of the studied area. It is composed of dirty white Limestone, compact, massive, coralline with yellowish brown marl with fossiliferous limestones with gastropoda and pelecypoda. It attains approximately 56m in Wadi Deir (Fig.2-b).



Fig.2: (a) Field photograph shows the Hommath Formation. (b) Field photograph shows the Sarbut El Gamal Formation.

V. Biostratigraphy

Benthonic foraminifera are occurred continuously with common, abundant, rare and very rare which can be practically used to subdivide the successions into three benthonic foraminiferal zone as following:

V.1 *Amphistegina vulgaris* – *Textularia gramen* – *Amphimorphina haueriana* Zone

Type: Assemblage zone.

Age: Lower Miocene.

Origin of name: After the co-occurrence of *Amphistegina vulgaris* **d'Orbigny**, *Textularia gramen* **d'Orbigny** and *Amphimorphina haueriana* **Neugeboren**.

Locality: Wadi El Deir section.

Thickness: 1 m.

Boundaries: This zone is defined by the last occurrence of *Amphistegina vulgaris* **d'Orbigny** to the last occurrence of *Textularia gramen* **d'Orbigny** and *Amphimorphina haueriana* **Neugeboren**.

Biostratigraphic position: The base of this zone is unexposed while overlain by

Stilostomella spp. - *Bulimina* spp. - *Mesolenticulina* spp. zone.

Characteristic species: This zone is characterized by the occurrence of *Pseudotriplasia elongate* Malecki, *Guppyella pozonensis* (Cushman and Renz), *Matanzia* cf. *Bermudezi* Palmer, *Quinqueloculina* cf. *padana* Perconig, *Flosculinella* cf. *bontangensis* (L. Rutter), *Nodosaria?* *elegantissima* (d'Orbigny), *Bolivina molassica* Hofmann, *Valvulineria californica* Cushman, *Valvulineria complanata* (d'Orbigny), *Valvulineria miocenica* Cushman, *Cibicidoides* cf. *micrus* (Bermudez), *Cibicidoides* cf. *ungerianus ungerianus* (d'Orbigny), *Neoepionides schreibersi* (d'Orbigny), *Elphidium crispum* (Linnaeus), *Elphidium* sp., *Cibicides refulgens* de Montfort, *Amphistegina bohdanowiczii* Bieda, *Amphistegina mammilla* (Fichtel & Moll), *Hansenisca soldani* (d'Orbigny), *Elphidiella ? dollfusi* (Cushman), *Elphidiella minuta* (Reuss) and *Linaresia* sp2. **Correlation:** The present zone equivalent to the associations of benthic foraminifera which recorded in Central Paratethys (Cicha *et al.*, 1998) eg. *Haplophragmoides suborbicularis*; *Reticulophragmium amplexans*; *R. rotundidorsatum* and *Bolivina hebes* (Tab. 5-1).

V.2- *Stilostomella* spp. – *Bulimina* spp. – *Mesolenticulina* spp. Zone

Type: Assemblage zone.

Age: Middle Miocene.

Locality: Wedi El Deir section.

Origin of name: After the co-occurrence of *Stilostomella* spp., *Bulimina* spp. and

Mesolenticulina spp.

Thickness: 21 m.

Boundaries: This zone is defined by the last occurrence of *Stilostomella* spp. to the last occurrence of *Bulimina* spp. and *Mesolenticulina* spp.

Biostratigraphic position: This zone overlies *Amphistegina vulgaris* – *Textularia gramen* – *Amphimorphina haueriana* Zone and underlies *Textularia nussdorfensis* – *Textularia mariae* Zone.

Characteristic species: This zone is characterized by the occurrence of *Lenticulina smileyi* (Kleinpell), *Lenticulina inornata* (d'Orbigny), *Lenticulina formosa* (Cushman), *Lenticulina convergens* (Brönemann), *Lenticulina reniformis* (d'Orbigny), *Lenticulina* aff. *multinodosa* Schijfsma, *Flosculinella* cf. *bontangensis* (L. Rutter), *Brizalina beyrichi beyrichi* (Reuss), *Brizalina beyrichi carinata* (Hantken), *Brizalina alata* (Seguenza), *Brizalina catanensis* (Seguenza), *Bulimina semicostata* Nuttall, *Bulimina* cf. *sculptilis* Cushman, *Bulimina elegans* d'Orbigny, *Bulimina* cf. *jacksonensis* Cushman, *Bulimina alazanensis* Cushman, *Bulimina buchiana* d'Orbigny, *Bulimina striata Mexicana* Cushman, *Bulimina striata* d'Orbigny, *Cibicidoides ungerianus ungerianus* (d'Orbigny), *Cibicidoides cushmani* (Barbat and von Estorff), *Cibicidoides barnetti* (Bermúdez), *Cibicidoides guazumalensis* (Bermúdez), *Bolivina versatilis* Hofmann, *Bolivina jriensis* Tedeschi, *Baggina dentata* Hagn, *Baggina californica* L.Finger, *Cancris sagra* (d'Orbigny), *Cancris bavaricus* Knipscheer, *Uvigerina graciliformis* Papp and Turnovsky, *Uvigerina macrocarinata* Papp and Turnovsky, *Uvigerina basicordata* Cushman and Renz, *Uvigerina multistriata* Hantken, *Uvigerina acuminata* Hosius, *Uvigerina pigmaea* d'Orbigny, *Uvigerina pudica* Luczkowska, *Stilostomella* cf. *anomala* (Reuss), *Stilostomella soluta* (Stache), *Stilostomella anomala* (Reuss), *Stilostomella nuttalli* (Cushman and Jarvis), *Stilostomella adolphina* (d'Orbigny), *Stilostomella consobrina* (d'Orbigny), *Stilostomella ovicula* (d'Orbigny), *Stilostomella* sp1, *Stilostomella* sp2, *Mesolenticulina moravica* (Karrer), *Mesolenticulina partidiana* McCulloch, *Mesolenticulina* sp1, *Mesolenticulina* sp2, *Mesolenticulina helene* (Karrer), *Quinqueloculina* sp., *Quinqueloculina angulostriata* Cushman and Valentine, *Quinqueloculina cribrosa* (Egger), *Siphonina reticulata* (Czjzek), *Planulina ambigua* Franzenau, *Planulina ariminensis* d'Orbigny, *Planulina wullerstaii* (Schwager), *Planulina* cf. *austriaca* (d'Orbigny), *Planulina compressa* (Hantken), *Planulina costata* (Hantken),

Planulina renzi Cushman and Stainforth, *Cibicides lobatulus* (Walter and Jacob), *Cibicides boueanus* (d'Orbigny), *Cibicides* cf. *amphysiliosis* (Andreae), *Nonion commune* (d'Orbigny), *Bathysiphon filiformis* M. Sars, *Cibicidina* sp. L.Finger and *Ozawaia* sp. **Correlation:** The present zone is equivalent to the lowermost part of Lower *Lagenidea* Zone in Vienna Basin (Papp and Schmid, 1985); the lowermost part of *Reticulophragmium amplexens* - *Reticulophragmium berggreni* Zone in Greenland Sea (Kaminski et al., 2006); the lowermost part of Lower *Lagenidea* Zone in Eastern Slovenia (Brown, 2011) and the lowermost part of Lower *Lagenidea* Zone in Central Paratethys (Hohenegger et al., 2014) (Tab. V-1).
V.3- *Textularia nussdorfensis* – *Textularia mariae* Zone

Type: Assemblage zone. **Age:** Middle Miocene. **Locality:** Wadi El Deir section.

Origin of name: After the co-occurrence of *Textularia nussdorfensis* d'Orbigny and

Textularia mariae d'Orbigny.

Thickness: 2 m.

Boundaries: This zone is defined by the last occurrence of *Textularia nussdorfensis* d'Orbigny to the last occurrence of *Textularia mariae* d'Orbigny.

Biostratigraphic position: This zone overlies *Stilostomella* spp. – *Bulimina* spp. – *Mesolenticulina* spp. Zone.

Characteristic species: This zone is characterized by the occurrence of *Textularia bornniana* d'Orbigny, *Goesella* cf. *rotundata* (Cushman), *Cibicidoides robertsonianus* (Brady), *Asteroammonia* cf. *katangliensis* Voloshinova et al. and *Asteroammina* sp.

Correlation: The present zone equivalent to *Anomalinoidea dividens* Zone, *Varidentella reussi* Zone, *Elphidium reginum* Zone in Romania (Filipescu, 2004); *Anomalinoidea dividens* Zone, *Elphidium reginum* Zone in Paratethys (Piller et al., 2007), middle part of *Reticulophragmium amplexens* Zone in Greenland Sea (Kaminski et al. 2006) (Tab. V-1).

Plate 1

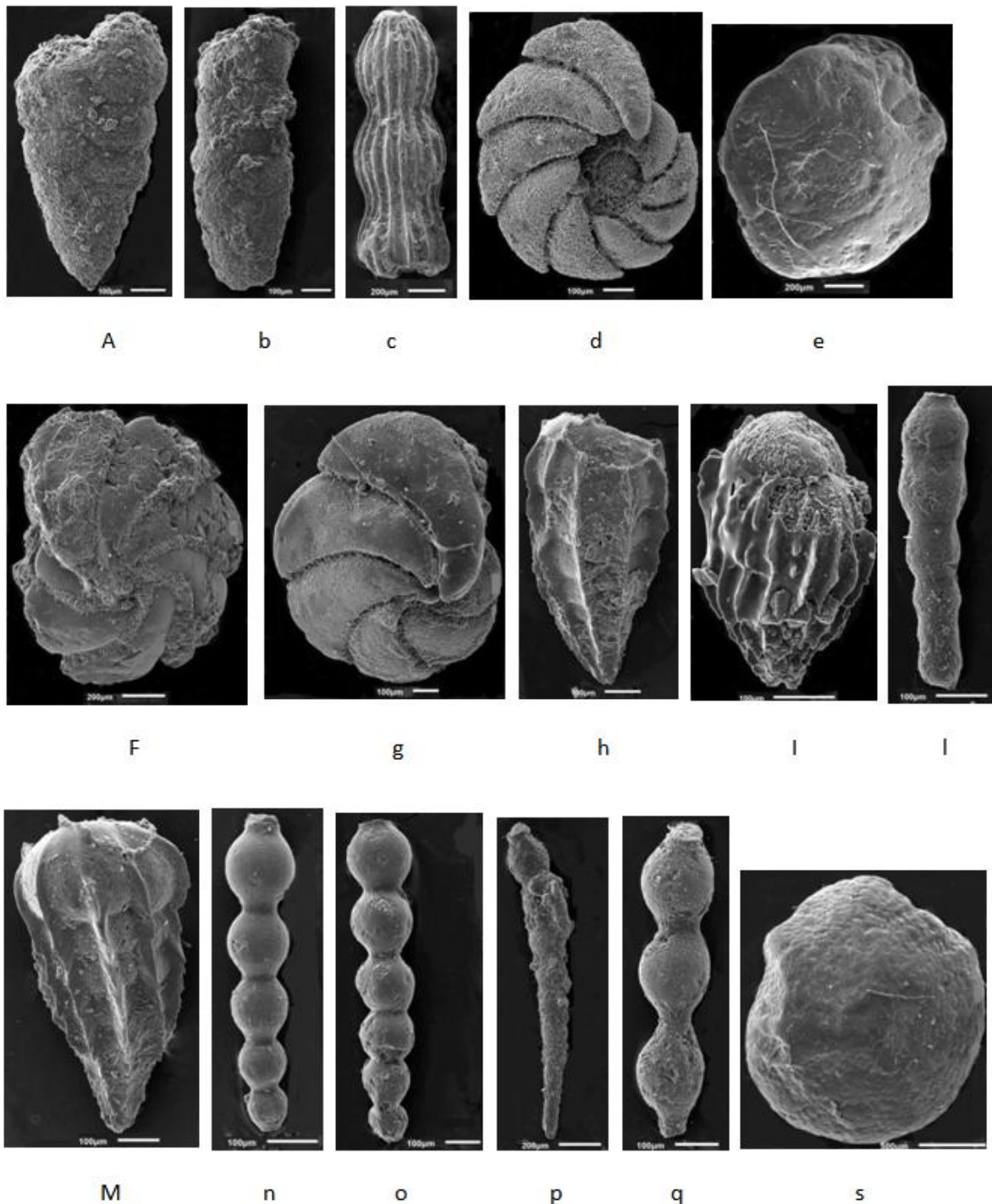
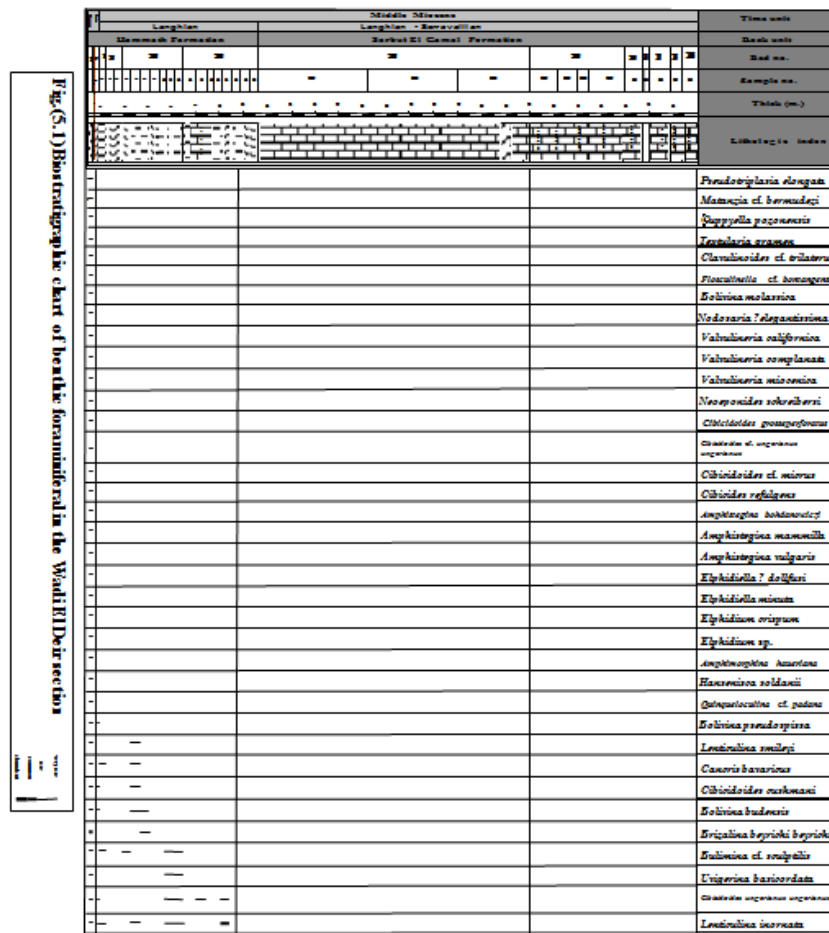


Plate1: a-*Textularia mariae* d'Orbigny, b- *Textularia nussdorfensis* d'Orbigny, c- *Amphimorphina haueriana* Neugeboren, d- *Mesolenticulina helene* (Karrer), e- *Amphistegina bohdanowicz* Bieda, f- *Mesolenticulina moravica* (Karrer), g- *Mesolenticulina partidiana* McCulloch, h- *Bulimina alazanensis* Cushman, i- *Bulimina buchiana* d'Orbigny, l- *Stilostomella ovicula* (d'Orbigny), m- *Bulimina elegans* d'Orbigny, n- *Stilostomella adolphina* (d'Orbigny), o- *Stilostomella anomala* (Reuss), p- *Stilostomella consobrina* (d'Orbigny), q- *Stilostomella nuttalli* (Cushman and Jarvis), s- *Amphistegina vulgaris* d'Orbigny

Present study	Hohenegger <i>et al.</i> (2014) Central Paratethys	Brown (2011) Eastern Slovenia	Kaminski <i>et al.</i> (2006) Greenland Sea	Filler <i>et al.</i> (2007) Paratethys	Filipescu (2004) Romania	Papp and Schmid (1985) Vienna Basin	Age
<i>Textularia nussdorensis</i> – <i>Textularia mariae</i> Z.			<i>Reticulophragmium amplectens</i> Assem. (<i>R. pusillum</i>)	<i>Porosonion granosum</i> Z.	<i>Porosonion aragviensis</i> Z.		Serravallian
				<i>Elphidium hauerinum</i> Z.	<i>Dogielina sarmatica</i> Z.		
				<i>Elphidium reginum</i> Z.	<i>Elphidium reginum</i> Z.		
				<i>Anomalinoidea dividens</i> Z.	<i>Varidentella reussi</i> Z. <i>Anomalinoidea dividens</i> Z.		
<i>Silostomella</i> spp. – <i>Bulimina</i> spp. – <i>Mesolenticulina</i> spp. Z.	<i>Bulimina - Bolivina</i> Z.	<i>Bolivina dilatata</i> Z.		<i>Bulimina - Bolivina</i> Z.	Valperina Zone	<i>Bulimina - Bolivina</i> Z.	Middle Miocene
	Agglut. F.Z.	<i>Uvigerina cf. pygmaea</i> Z.					
	Up. <i>Lagenidea</i> Z.	<i>Pappina robusta</i> Z. Up. <i>Lagenidea</i> Z.	<i>Reticulophragmium amplectens</i> – <i>Reticulophragmium berggreni</i> Assem. (<i>R. rotundioratum</i> , <i>R. pusillum</i>)			Up. <i>Lagenidea</i> Z.	Langkuan
	Low. <i>Lagenidea</i> Z.	Low. <i>Lagenidea</i> Z.				Low. <i>Lagenidea</i> Z.	
<i>Amphistegina vulgaris</i> – <i>Textularia gramen</i> – <i>Amphimorphina haueriana</i> Z.							Barligallian
							Early Miocene

Table (V.1): Tentative biostratigraphic correlation for the Miocene benthic foraminiferal biozones.



VI. Conclusion

An attempt to establish the biostratigraphic benthonic foraminiferal biozone across the Miocene of the Southern Galala Plateau in the Eastern Desert, Egypt has been carried out. One stratigraphic sections were recorded; Wadi El Deir section. Detailed studies of the foraminiferal distribution, occurrence and thickness of the selected section was performed as well as correlating the biozones with their equivalents in different localities.

The Miocene rocks in the area was subdivided into two main formations arranged from oldest to youngest; Hommath and Sarbut El Gamal formations. In terms of benthonic foraminifera zonation, the study are is yielded I benthonic foraminiferal zonation; *Amphistegina vulgaris* – *Textularia gramen* – *Amphimorphina haueriana* Assemblage zone (Lower Miocene), *Stilostomella* spp. – *Bulimina* spp. – *Mesolenticulina* spp. Assemblage Zone and *Textularia nussdorfensis* – *Textularia mariae* Assemblage Zone (Middle Miocene).

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