Paleocene benthic foraminiferal biostratigraphy and paleobathymetry in the sections between El Sheikh Fadl and Ras Gharib, Eastern Desert, Egypt

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ABSTRACT: Analysis of Paleocene benthic foraminifers of El Sheikh Fadl – Ras Gharib traverse, Egyptian Eastern Desert, reveals the presence of *Gavelinella danica* Total Range Zone, which is subdivided into four benthic foraminiferal assemblage subzones and correlated with the associated planktic foraminiferal zonations. However, the *eugubina* Zone is characterized by *Cibicidoides pseudoacutus – Spiroplectinella dentata* Subzone, in addition to *Cibicidoides alleni, C. susanaensis, Anomalinoides welleri*, and *Gaudryina pyramidata*, developed in a middle to upper bathyal environment with relatively well – oxygenated conditions. The *pseudobulloides - pseudomenardii* (base) Zones show mainly a Velasco - type faunas, with the *Angulogavelinella avnimelechi – Nuttallides truempyi* Subzone, together with *Gavelinella beccariiformis, Cibicidoides alleni, Anomalinoides welleri*, and *Coryphostoma midwayensis*. Microfauna indicates a gradual deepening to bathyal and deeper environments. The third assemblage follows the *pseudomenardii* (top) and *velascoensis* (base) Zones, and is typical of continental shelf (middle to outer neritic) conditions, i. e. Midway - type faunas, with the *Hoeglundina scalaris – Lenticulina midwayensis* Subzone. *Alabamina midwayensis, Anomalinoides midwayensis*, and *Cibicidodes succedens* are encountered in this assemblage subzone. The topmost part of the succession (*velascoensis* Zone), is equated with the *Loxostomoides applinae* Subzone, and displays an inner neritic to littoral assemblage, dominated by *Valvulineria aegyptiaca, V. scrobiculata, Osangularia plummerae, Bulimina gr. trigonalis*, and *Bathysiphon paleocenicus*. A shallowing environment prevailed during latest Paleocene times, accompanied by oxygen deficient conditions.

INTRODUCTION

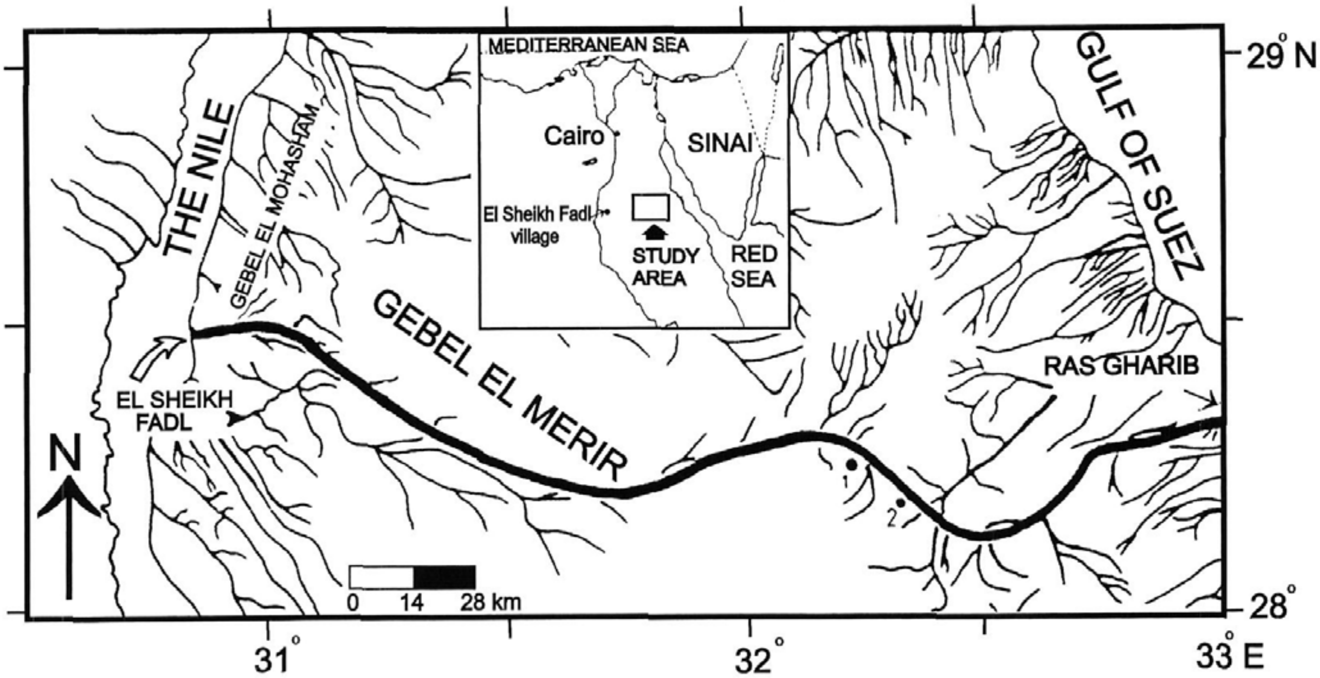
The El Sheikh Fadl – Ras Gharib traverse (about 245km) extends from El Sheikh Fadl village on the eastern bank of the River Nile to Ras Gharib City on the western Coast of the Gulf of Suez. It crosses the Egyptian Eastern Desert and lies approximately at latitudes 28°00' and 28°15'N and longitudes 32°00' and 32°15'E (text-fig. 1). Late Cretaceous rocks are widely exposed above the basement range in the eastern side close to the Gulf of Suez, while the Paleogene ones occupy the western side until reaching the River Nile. This study is concerned with the Paleocene sequence of the Dakhla, Tarawan, and Esna formations, respectively.

Previous studies of geology, micropaleontology, mainly planktic foraminifers, and stratigraphy on the Paleocene succession in the northern Eastern Desert include: Hume 1911; Ghorab 1961; Said 1962, 1990; Beckmann et al. 1969; Abdallah et al. 1970; Issaw 1971; Kerdany and Belety 1971; Abdel Kireem 1976; Abdel Kireem and Abdou 1979; Mazhar et al. 1979; Khalifa and El Sayed 1984; Soliman et al. 1986; Abu Khadra et al. 1987; Bandel et al. 1987; Aref et al. 1988; Kassab 1990; Haggag 1992; Strougo et al. 1992; Kassab and Keheila 1994; and Speijer 1994.

Despite all previous studies, nothing has been published on the Paleocene benthic foraminifers of the study area. Therefore, two stratigraphic sections were measured and sampled eastwards from El Sheikh Fadl village. One, at 140km, includes the Esna Formation (O) and the other, at 151km, contains the Dakhla, Tarawan, and Esna formations (S, text-fig. 2). The present aims to 1) re-examine and verify the Paleocene planktic foraminiferal biostratigraphy; 2) deduce the probable paleobathymetry and environmental conditions prevailed during the deposition of the Paleocene succession in the study area, and 3) evaluate the benthic foraminiferal biostratigrophy and create a list of identified species.

MATERIALS AND METHODS

This paper is based on samples collected from two field sections; one at 140km (7 shale samples, with 7m. thick.), and the other at 151km (29 marl, shale, and limestone samples, with 47.5m thick.) from El Sheikh Fadl village. Samples were soaked in a 10% solution of H_2O_2 and washed over 125 and 63μm sieves, then dried in a stove at 70°C for at least 24 hours. Quantitative benthic and planktic foraminiferal analyses were carried out on the 125μm fraction. The foraminifera showed good preservation in the Paleocene samples. For planktic foraminiferal biostratigraphy, marker species were given special conideration. In contrast, all benthic foraminiferal specimens (average about 200-700 individuals) were picked from a split of the sample and stored in a slide. From this split the proportions of planktic foraminifers (% P), and total foraminiferal numbers (TFN) were counted. Diversity of benthic foraminiferal assemblages expressed here as the number of benthic species (NBS) was also computed. The presence of mixed Midway and Velasco - type faunas (Berggren and Aubert 1975) in the Paleocene samples allowed calculation of the MF/VF ratio. An attempt to check the Paleocene environmental changes related to oxygenation conditions is made throughout the investigation of epifaunal and infaunal morphotype species (Corliss 1985) and inferring the E/I ratio using the 63μm mesh size frac-



TEXT-FIGURE 1
Location map. 1, section "O" at 140km; 2, section "S" at 151km east of El Sheikh Fadl.

tion. Study material is filed in the collection of Minia University, Geology Department (MUGD), Minia, Egypt.

LITHOSTRATIGRAPHY

The lithostratigraphic nomenclature and general lithologic characteristics of the Paleocene Series of El Sheikh Fadl – Ras Gharib sections are shown in text-figure 2. The Paleocene strata outcropping in this traverse can be divided lithologically into three rock stratigraphic units arranged from base to top as: the Dakhla Formation , Tarawan Formation, and Esna Formation.

1) Dakhla Formation: This term was introduced by Said (1961) for the Maastrichtian-Paleocene marine shale-marl succession, with siltstone, sandstone and limestone interbeds, exposed at the area north of Mut (Dakhla Oasis, Egyptian Western Desert). It lies upon the Phosphate Formation and underlies the Tarawan Formation at its type locality. Here, the Dakhla Formation overlies the Late Cretaceous Sudr Formation and underlies the calcareous late Middle Paleocene Tarawan Formation. It consists of light brownish marl at base and black, to dark gray, fissile shales totaling 23.5m. in thickness (at 151km. section, "S"). Sometimes, these shales are gypsiferous. The Dakhla Formation is devoid of megafossils, but rich and diversified in planktic and benthic foraminifera. It follows the Danian and most of the Middle Paleocene times (from P1a to the lower part of P3; Blow 1969; Berggren and Van Couvering 1974; and Toumarkine and Luterbacher 1985).

2) Tarawan Formation: This term was coined by Awad and Ghobrial (1965) for the Paleocene chalky limestone succession containing marly bands, exposed at Gabal Tarawan (Kharga Oasis, Western Desert).

In the present area, the Tarawan Formation lies between dfs the Dakhla and Esna formations. It consists of grayish brown, hard marl and limestone of 3m thick (at 151km section, "S"). Macrofossils are scarce in the formation, but foraminiferal assemblages are abundant and diverse. Tarawan Formation occupies the latest Middle Paleocene time (top of P3 Zone).

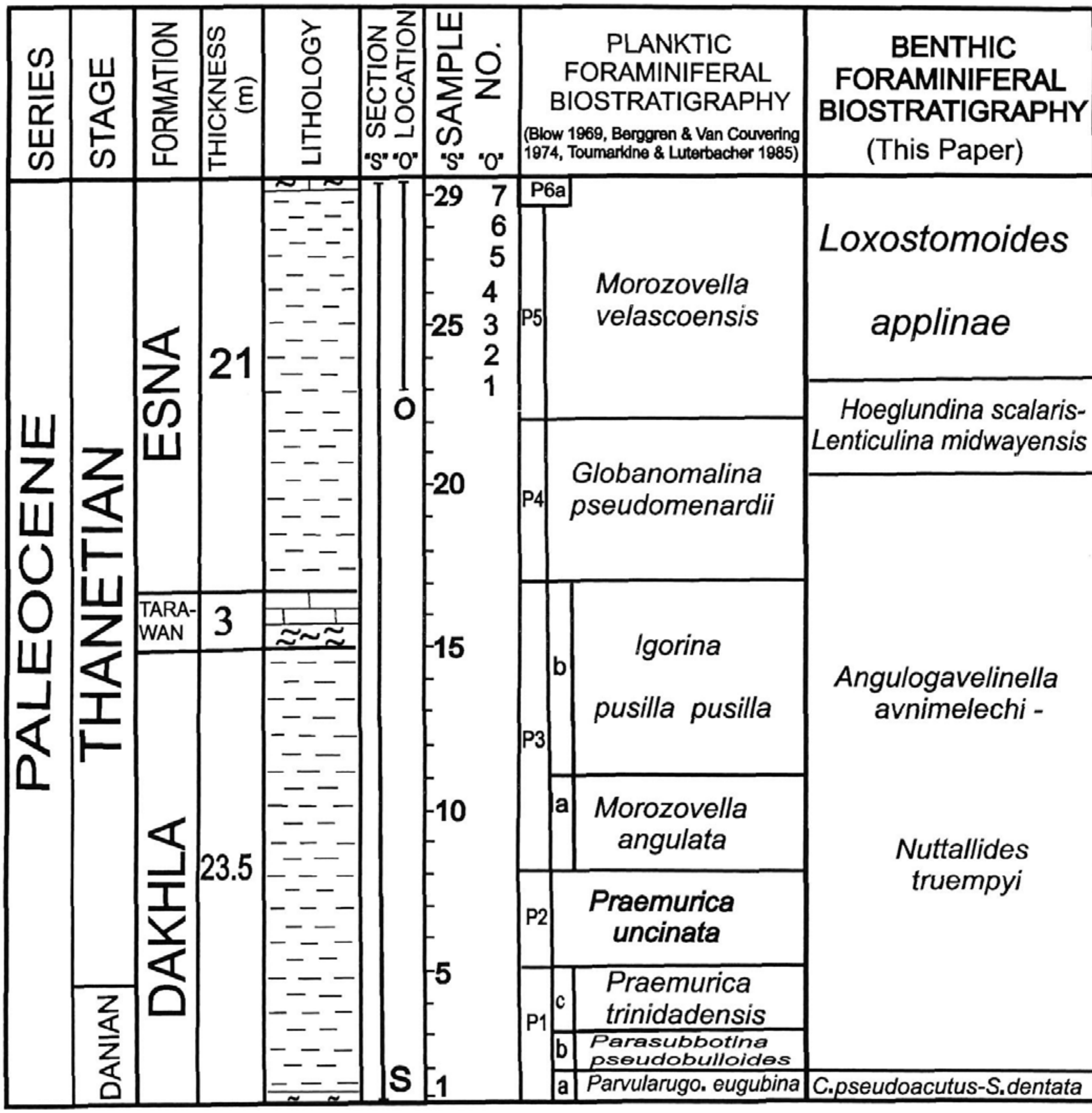
3) Esna Formation: Beadnell (1905) used "Esna Shale" as a descriptive term for the Eocene shales of the Esna – Aswan region. Said (1962) proposed the term "Esna Shale" as a formal rock unit to describe the open marine shale - marl succession of Late Paleocene – Early Eocene age exposed at Gabal Oweina (Esna area, Nile Valley). This formation underlies the Thebes Formation and overlies the Tarawan Formation.

In the area of study, the Paleocene section of the Esna Formation consists of greyish green, saliferous and ferruginous shales with thin marly limestone band at top (21m. and 7m. thick., at 151 and 140kms. sections, respectively). Esna Formation lies upon the Tarawan Formation and underlies the Thebes Formation. Its age is Late Paleocene. (P4 and P5 Zones, Blow 1969; Berggren and Van Couvering 1974; and Toumarkine and Luterbacher 1985).

BIOSTRATIGRAPHY

Planktic Foraminiferal Biostratigraphy

Planktic foraminifera are abundant in all of the studied samples and the occurrence of biostratigraphically important marker species has provided the biochronologic framework of this study (text-fig. 2). The biotratigraphy of both studied sections, particularly the second complete one (at km 151 from El Sheikh Fadl village,"S"), ranges from the *Abathomphalus mayaroensis* Zone (Late Maastrichtian) to the *Morozovella edgari* Zone (Early Eocene), without evidence of sedimentary gaps. The K/T



TEXT- FIGURE 2
Generalized lithostratigraphy and biochronology of the Paleocene Series in the study area. Bars refer to selected measured sections.

boundary is simple to determine in the field in spite of the lithologic contact of the marly bed between both the Sudr Formation (Maastrichtian) and the Dakhla Formation (Danian). All the planktic foraminiferal zones of the Paleocene beginning from the *Parvularugoglobigerina eugubina* Zone (P1a) to the *Morozovella velascoensis* Zone (P5), are recognized in the studied sections, following the Tethyan zonal concepts of Blow 1969; Berggren and Van Couvering 1974; and Toumarkine and Luterbacher 1985.

Benthic foraminiferal biostratigraphy

Generally, benthic foraminifera are less reliable biostratigraphic markers than planktic foraminifera, in spite of their great abundance and diversity in the Paleocene strata of study area. More than 120 benthic foraminiferal species and subspecies (text-fig. 3) were identified from the Paleocene deposits of both studied sections, allowing local benthic foraminiferal biostratigraphic zonation.

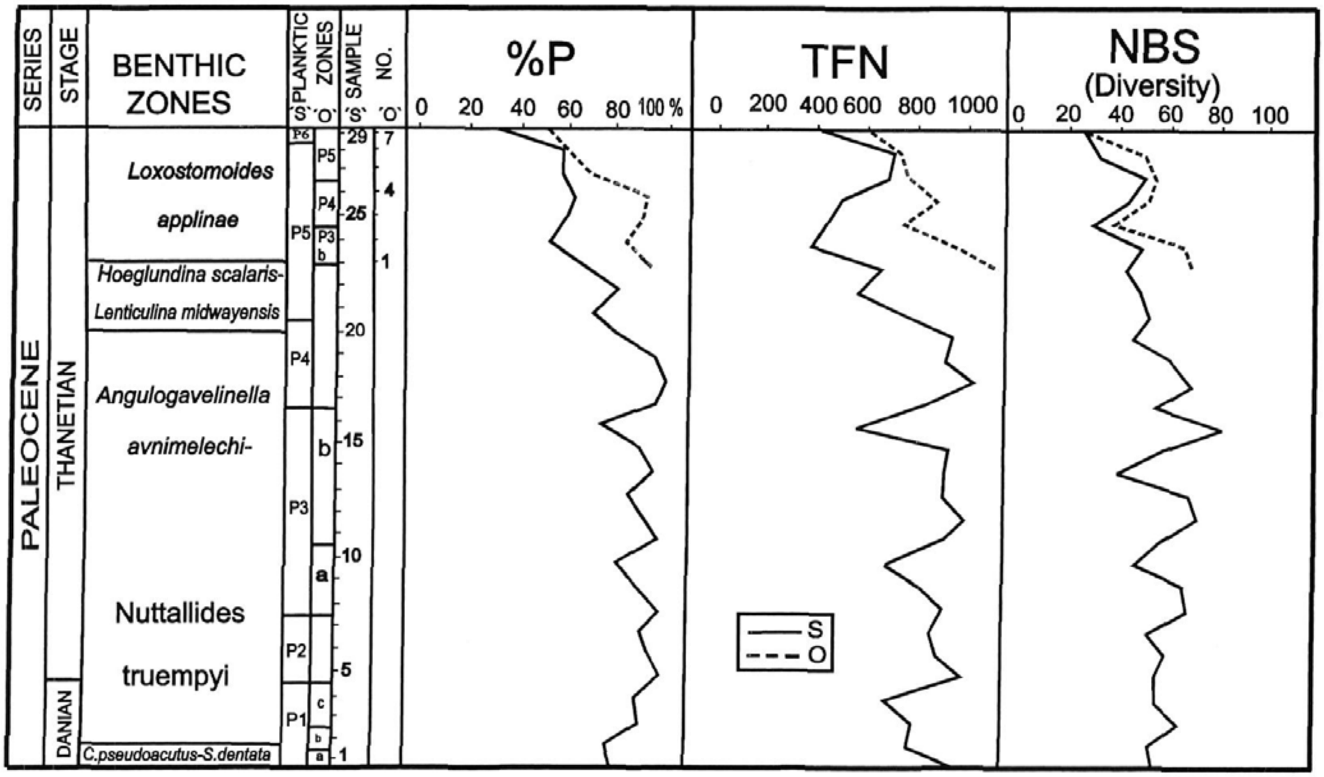
PALEOCENE																													AGE
DANIAN				THANETIAN																									
DAKHLA														TARAWAN		ESNA													FORMATION
*	**	P. trinidadensis		P. uncinata			M. angulata			Igorina pusilla pusilla						Globanomalina pseudomenardii					M. velascoensis								PLANKTIC FORAM ZONES
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	SAMPLE NO.
C	C		C	C	C	C	A		A	C	C	R	V	R	R	R	C	V	V		V	R	R	R	.	V	R	V	*Cibicidoides allenii*
V				V	V		V			V	V	V		V	V	V	V	V				V		V		R	V	V	*Dorothia bulletta*
.		V						V	R		R			V		C	R	R	V	V	V	R				V	V	V	*Eponides mariei*
C	R	R	R	C	C	R	V	R	R	R	R	V		R	R	C	C	C	R	C	R	C	R	R	V	V	V	R	*Gavelinella danica*
R	R	R	R	V	V				R	V	V	V				V	R	R	R	C	C	R	R	R	R	R	V	V	*Lenticulina midwayensis*
V	R	R	R	R	R	R	R	R	R	R	R	R	V	V	R	R	V	V	R	R	V		V		R	V		V	*Gyroidinoides depressa*
V	V	R	R	V	V	V	V		V	V	V	V		V	R	R	V	V	V	V	V		R		R	R	R	V	*Valvulineria scrobiculata*
V		V							V							C	R	V	V		R			V	R	R		V	*Siphogenerinoides eleganta*
C	C	C	R	R	R	R	R	R	R	R	R	V			V			V			V	V	V		R	R	V		*Spiroplectinella dentata*
R	R	V				V	V	V	V	V	V	V	V	R	R	R	V	R		V				V		V	.		*Eponides lunatus*
V	V			R	V						V	V			V	V	V	V	V	V	V	V					V		*Spiroplectinella knebelii*
C	R	R	R	C	R	C	R	R	R	R	C	R			R	R	C	R	R	V	V	V			V	V	.		*Gaudryina pyramidata*
R		V		V	V	V		V	R	V						V							V		V		V		*Pyramidulina paupercula*
C	C	R	R								V				V				R	V		V	R		V	V	V		*Lenticulina muensteri*
R		R	C	R	R	V	V		V	V	R	V	V	R	R	C	R	R	R	V	V		V		V	V			*Anomalinoides acuta*
V	V	R		R	V	V		R	V	V	V	R		R	R	C	R	R	V	R		V	R	V	V	R			*Eponides plummerae*
R			R	R		R				R	R	R	V	V	C	V	V	V	V		V		V			R			*Gaudryina aissana*
.	V		V			V	R	R			V	R		V	R	R	R	R	V	V			R		V	V			*Bulimina midwayensis*
V									R			R				V			R		V		R	V	R	V			*Bathysiphon arenaceous*
R		V	V	V	V	V											V			V			V			V			*Lenticulina pseudomamilligera*
R	V	V	V		V	V	R	V		V	V	V			V	V	V								V				*Pleurostomella paleocenicus*
V	V			V			R	V			V				V	V	V	V	V	V	V	V	V		.				*Laevidentalina gracilis*
V		V	V					V		V		V			R		V								V				*Ramulina navarroana*
V							V	V	R		V	V			V	R	R	R		V	R	V	V	V					*Nodosaria (?) longiscata*
R		V	R	R	R		V	V	V	R	V	R	V	R	R	R	R	R	R	R	V	V	V						*Anomalinoides praespissiformis*
R		R	V		V		V	V	V	V	V	V			V		V	V					V						*Stilostomella paleocenica*
R	V	R	V	V	R	V	R	V		V	R	V								V			V						*Reussoolina apiculata apiculata*
R		V	V	V		V			R											R	R	R	R						*Anomalinoides midwayensis*
C	C	C	R	R	V	R	C	C	R		R	R	V	V		R		V	V		V	R							*Anomalinoides welleri*
V	R	V	C	C	A	A	A	A	A	C	A	C	R	C	R	A	A	C	R	V	.	.							*Nuttallides truempyi*
V	V			V	V	V	V	V	V						V		V	V			V	V							*Lenticulina discrepans*
V	V	V			V			V			V		V			R				R	V								*Pseudonodosaria manifesta*
V	V	R	V				V	V		V		V			V		V	V			R								*Stilostomella midwayensis*
V		V	V	V	V		V								V					V	.								*Marginulina sp.*
R	R	R	R	C	R	R	R	R	V	V	R	R	V	R	C	R	V	V	V	.									*Gavelinella rubiginosa*
C	R				R	V					C	R		V	R				V										*Cibicidoides pseudoacutus*
R	V	V	V	V	V		R	V		V	V	R		V	R	V		V											*Oolina globosa*
C	C	R	R	V	V		V	V			V						R	V											*Cibicidoides susanaensis*
	V	V			V	V	R			V	V				R		R	V											*Dentalina colei*
V	V	V	V					V				V						.											*Chilostomella eocenicus*
V			R	C	R	R	V	R			V		V		V	V	V												*Marssonella oxycona trinitatensis*
C	V	R	V	R	V	R	R		R	R	R			V			V												*Gyroidinoides subangulata*
R	R	R	R	V	R		R	V	V	V					V	V	.												*Tritaxia midwayensis*
R	V	R	V	V	R	V	R	V					V		R	V	V												*Pullenia quinqueloba*
R	R	R	V	R	R	R	R	V	V	V	R	C	R	R	R	C													*Coryphostoma midwayensis*
V		V	V	V	V	V		V		V	V	V	V	V	R	V													*Dorothia pupa*
V	V	R	V	V			V	R			V	V		V	R														*Guttulina trigonula*
V	V	V	V		V	V	R			V	R	V			V														*Lagena hispida*
R	C	A	A	A	C	C	C	C	A	R	C	C	V	C	C														*Angulogavelinella avnimelechi*
V		V			R	V	V						R		V														*Marssonella oxycona oxycona*
R	R	R	V	R	V	R	R	R	V	C	A	R	C	A															*Gavelinella beccariiformis*
C	R	R	V	R	V		R	V	C	V	R			R															*Gyroidinoides girardana*
C		R	V	V	V		R	V		V				V															*Clavulinoides asper whitei*
R		R	V	R	R	R	V	R																					*Hoeglundina eocenica*
R						V	R	R																					*Bolivinoides delicatulus*
V	V	V	R	R	R																								*Gavelinella lellingensis*
	R			V	R	R	R	R	R	R	R	C	R	R	V	R	V	R	R	C	R	C	R	R	R	V		.	*Hoeglundina scalaris*
	V	V	V						V	V		R		V	R		V				V		V				V	V	*Pyramidulina vertibralis*
	C		R	R	R	R	R	V		R	C	A	V	C	A	C	C	C	R	V	R	V	V	V	V	V	V		*Verneuilina aegyptiaca*
	R	V	R	R	V	V	V	V		R	R	V	V	V	R	V	V	V	V	V	R	R	V	V	V		V		*Lenticulina turbinata*
I	Angulogavelinella avnimelechi - Nuttallides truempyi																			H.scalaris -L. midwayensis			Loxostomoides applinae						BENTHIC SUBZONES
Gavelinella danica																													BENTHIC ZONE

TEXT-FIGURE 3

Distribution chart of Paleocene benthic foraminifers of study area. Symbols: . = present (1), V= very rare (6- 20), C= common (21-50), A= abundant (≥50), I= *C. pseudoacutus – S. dentata*, *= *Pr. eugubina*, **= *Ps. pseudobulloides*.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
PALEOCENE																													AGE
DANIAN				THANETIAN																									
DAKHLA															TARAWAN	ESNA													FORMATION
*	**	P. trinidadensis		P. uncinata			M. angulata			Igorina pusilla pusilla						Globanomalina pseudomenardii					M. velascoensis								PLANKTIC FORAM ZONES
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	SAMPLE NO.
	R	V		R	V	V	R	R	R		V					V	R	C	R	V			R		R		V		Bathysiphon vitta
	V	V		V	V				V		R		V		R		V	V			V	V	V	V			V		Pyramidulina latejugata
	R	V	V			R	R	R	V	R	V			V		V	V	R	V	R	R	C	R	R	V				Alabamina midwayensis
	V	V		V	V						V	V	V	R	V		V			V					V				Glandulina laevigata
	R	R	V	C	R	R	V	R	R	R	R	R	V	R	C	V					R	V							Anomalinoides praeacuta
	V	V	V		V	V	V	V		V	V									V									Neoflabellina delicatissima
	V						V	R	R									R	R	V									Bathysiphon varans
		V	V		V		V	R	V	V	V			V	V					R									Rotamorphina cushmani
	R	C	V	R	R	R	R	R	C	R	C	R		R	R	V													Gyroidinoides globosus
	V	R		R	R	R	C	R	C	R	C	V	V	R	R	V													Cibicidoides dayi
	V	V		V			V	V			V	V			V	V													Astacolus rectus
	V			R			V	V		V	V	V	V	V	R														Dorothia retusa
	V		R	V	R		V																						Gyroidina megastoma
		R	.	V	V	R	R	R	C	C	C	V	R	R	R	R	R	R	V	R	R	R	C	V	R	V	V	R	Cibicidoides succedens
		V			V		R	V	V	V	V	R	V		R	R	V	V	V	V	R	V			V	V		V	Pullenia angusta
		V			V							V	V		R	V	R	R	V	V	V				V	V	V		Spiroplectinella esnaensis
		V		V			R	V	V	V	V			V							V				V	R			Praebulimina reussi
		V	V			R	R	C	R	R	R	R		R	R	R	R	R	R	R	R	C							Alabamina wilcoxensis
		V	V	V	V	V		V		V	V				V						V	V							Vaginulinopsis midwayensis
			V			R	V			V	R					V	R	R	R	R			R	R	R		R	R	Osangularia plummerae
			V	R	V	R	V	V		V	V	V					V			V	R	R	R	V	V	V		V	Marginulinopsis tuberculata
			V	R	V	R	V	V							V	V	.		V		V			V					Verneuilina cretacea
			V			V		V			V	V	V		V			V		V									Nodosaria limbata
			R				V					R		V			V	V		V									Cibicidoides hyphalus
			V				V	V							V			V											Pyrulina cylindroides
				V	R	R	V	R	V	R	R	V			R		R	R		V	R	V	.		R	R		R	Osangularia expansa
				V						V		V			V							V	V						Globobulimina (?) suteri
				V			V			V		V			V			V											Globulina lacrima lacrima
						V						V	V	V	R		R	R	V		R	V	V	V		V			Gaudryina limbata
						V	V	V			R			V	V														Globulina ampulla
							R	V	V	V	V	V		V	R	R	R	R	R	R	R	R			V	V	V		Valvalabamina planulata
							V	V				V		V	V	V	V	V		V			V			V			Hemirobulina hamuloides
							V			V				V			V			V									Dorothia bulbosa
							V	V	R				R		R		V												Bolivinopsis spectabilis
								V						V	V	V		R	V							R			Globimorphina trochoides
									V						V		R	R		V					R	V	R		Bathysiphon cf. discretus
									V		V				V				R		V						R		Bathysiphon eocenicus
									V		V	R		R	V														Zeauvigerina aegyptiaca
										V	V					V	V		V	V	R	V	R	R	A	C	C	R	Loxostomoides applinae
										V	R	V			V	V	V	V	V	V			V		R	V	R		Quinqueloculina aff. stelligera
										V	V			V	V							V							Ellipsoidella kugleri
											R	R	V	C	C	R	C	V	R	R	V	V	V	V	R	R	V	R	Hanzawaia gr. ammophila
											V				R		V				V				V		V		Gaudryina inflata
											R	C		C	R									V	R	R			Gaudryina textulariformis
											V	V		V	R	V	V	V		V	V	V							Pleurostomella naranjoensis
												V	V	R	R	R	V	R	V	V		V			V	R	R	V	Parrella desertorum
												V	V			V				V		V	V			V			Ellipsoglandulina chilostoma
												R	V	R	C			V							V	V			Pullina eocenica
												C	R	V	V			V								.			Buliminella grata
												R	V	R	R		R			V	V		.						Alabamina obtusa
												C	R	R	C														Pullenia coryelli
																R	R	R	R	R	V	V	V	V	R	R	R	R	Eponides lotus
																R	R	R		V		R	R	R	R	R	R	R	Bulimina gr. trigonula
																V			R				V	V	V	R		V	Gaudryina triangularis
																V		V		V						C	V		Globocassidulina globosa
																	R	C	R	R	R	R	R	V	R	R	V	R	Valvulineria aegyptiaca
																	R		R	V		V				V		V	Spiroloculina cretacea
																	R	R	V		R		V				R		Gaudryina rectangulata
																					V	V	V	V	V	V	R	R	Lenticulina mexicana alticostata
																							R	V	R	V	R	.	Bathysiphon paleocenicus
I	Angulogavelinella avnimelechi - Nuttallides truempyi																			H.scalaris -L. midwayensis			Loxostomoides applinae						BENTHIC SUBZONES
Gavelinella danica																													BENTHIC ZONE

TEXT-FIGURE 3
Continued.



TEXT-FIGURE 4
General faunal characteristics of the Paleocene sequence in both studied sections "O" and "S" eastwards from El Sheikh Fadl, Eastern Desert, Egypt.

Gavelinella danica (Brotzen) is considered a total range zonal marker for the whole Paleocene sequence because of its wide distribution and abundance in the studied samples. This species was recorded in different regions of Egypt and abroad by Said and Kenawy (1956); Nakkady (1959); Berggren (1974); Berggren and Aubert (1975); Saperson and Janal (1980); Luger (1985); Anan and Hewaidy (1986); Anan (1987); Hewaidy (1987); and El-Dawy et al. (1992). The stratigraphic distribution and paleobathymetry of Paleocene taxa allowed subdivision of the *Gavelinella danica* Total Range Zone into four subzonal assemblages. These subzones are defined and described herein from oldest to youngest as;

1- *Cibicidoides pseudoacutus – Spiroplectinella dentata* Subzone:

Definition: Interval from the last occurrence of *Bolivinoides draco draco* (Marsson) to the first appearance of *Angulogavelinella avnimelechi – Nuttallides truempyi* Subzone.

Age and Correlation: The *Cibicidoides pseudoacutus – Spiroplectinella dentata* interval subzone is Early Paleocene (Danian) in age and correlates with the *Parvularugoglobigerina eugubina* (P1a) planktic foraminiferal zone of Blow 1969, Berggren and Van Couvering 1974, and Toumarkine and Luterbacher 1985.

Stratotype: Outcrop of the lowermost marl bed of Dakhla Formation (S1) at km 151, eastwards of El Sheikh Fadl village, Eastern Desert, Egypt.

Characteristics: This subzone is characterized by *Cibicidoides pseudoacutus* and *Spiroplectinella dentata* in association with abundant *Gavelinella danica, Anomalinoides welleri, Cibicidoides susanaensis, Clavulinoides asper whitei, Gaudryina pyramidata,* lenticulinids, gavelinellids, and fursenkoinids.

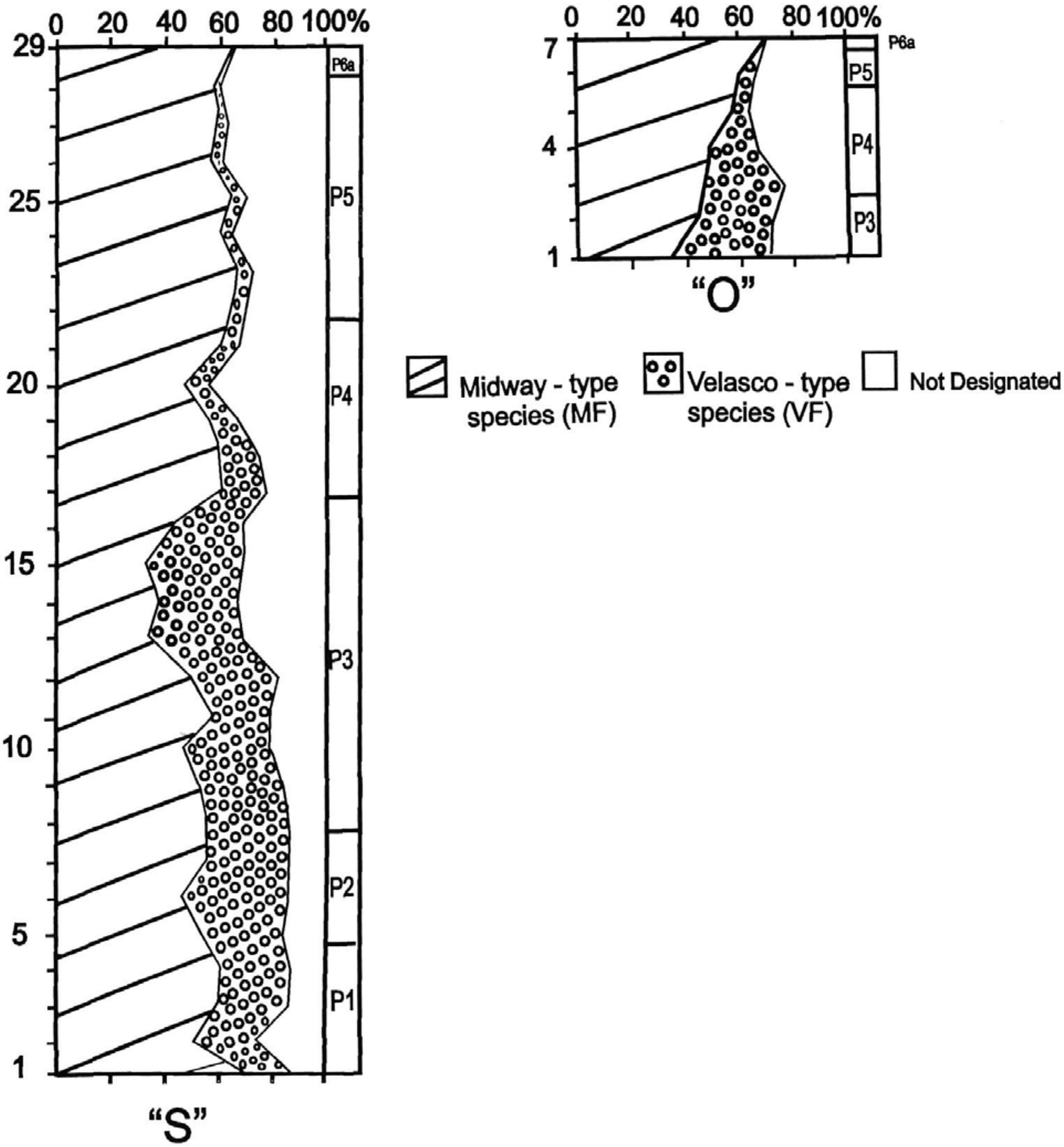
Remarks: The assemblages characteristic for *Cibicidoides pseudoacutus -Spiroplectinella dentata* Subzone are reported here and sporadically throughout the Paleocene section. They are approximately equivalent to the lowermost benthic assemblage of El Haria Formation of El Kef section, Tunisia (Saint - Marc 1992). The upper limit of this subzone is well defined by the last appearance of the nominate taxa and the beginning of the overlying subzone.

2- *Angulogavelinella avnimelechi – Nuttallides truempyi* Subzone:

Definition: Interval of the range of *Angulogavelinella avnimelechi – Nuttallides truempyi*, from the last appearance of *Cibicidoides pseudoacutus* to the last occurrence of the present subzone.

Age and Correlation: The subzone spans the middle Danian to early Late Paleocene age and correlates with the *Parasubbotina pseudobulloides, Praemurica trinidadensis, P. uncinata, Morozovella angulata, Igorina pusilla pusilla,* and the lower part of *Globanomalina pseudomenardii* (P1b to base of P4) planktic foraminiferal zones.

Stratotype: Outcrops of the topmost Dakhla, Tarawan, and Esna formations, at km151 section (Samples S2 - 20), and lower part

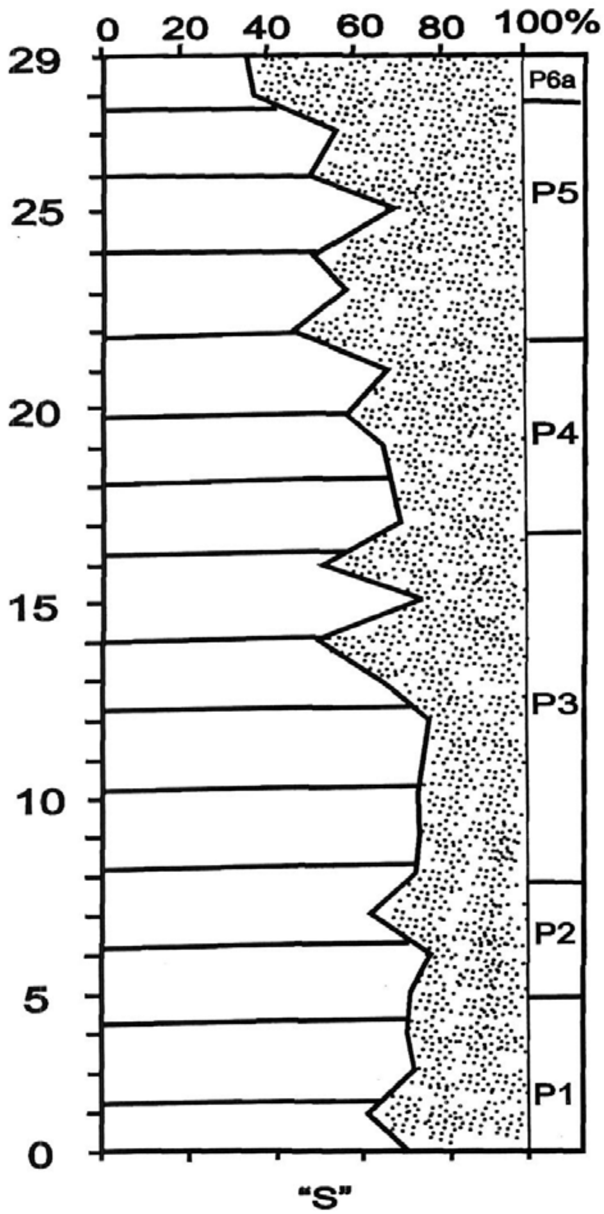


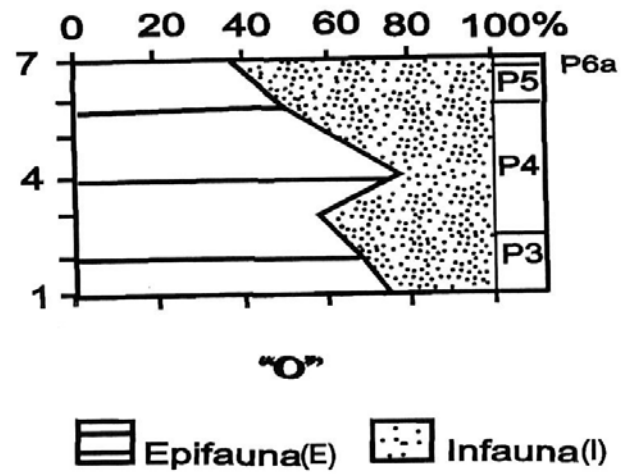
TEXT-FIGURE 5
Total abundances of Midway – and Velasco type species (MF and VF) through both studied sections (O and S). Note the general shallowing of Paleocene sea towards the Late Paleocene (top of P4) due to decrease of VF species upwards the succession and increase of MF ones.

of Esna Formation at km 140 section (Samples O1-4) in the study area.

Characteristics: The *Angulogavelinella avnimelechi–Nuttallides truempyi* Range Subzone is typified from the underlying and overlying subzone by diverse benthic assemblages of which the *Angulogavelinella avnimelechi, Nuttallides truempyi*, and *Gavelinella beccariiformis* are a conspicuous part. Associated benthic taxa include; *Buliminella grata, Coryphostoma midwayensis, Eponides plummerae, Gaudryina pyramidata, Gavelinella dayi, Pullenia coryelli, Spiroplectinella dentata, Gyroidinoides depressus, Gavelinella danica*, polymorphinids, nodosariids, pleurostomellids, and lenticulinids.

Remarks: This subzone is occupying a thick interval covering the Dakhla, Tarawan, and lower part of Esna formations (Sections "S" and lower half of "O"). It is bathymetrically distinguished from the earlier subzone by including the true Paleocene bathyal and abyssal benthic foraminiferal assemblages. It contains mixed components of the familiar Velasco - and Midway - type faunas (Berggren and Aubert 1975). Paleobathymetric ranges of some Velasco- type taxa are exten-





TEXT-FIGURE 6
Total abundances of epi- and infaunal morphotype ratios (E and I) in both studied sections (O and S). Note the general dominance of epifaunal morphotype through the most Paleocene greatest depths (P1, P2, P3, P4, and basal part of P5) giving rise to well-oxygenated conditions, on the contrary from other infaunal species which dominate the latest Paleocene (P6a) assemblages.

sive (e.g., bathyal: *A. avnimelech*, and *Dorothia oxycona trinitatensis*; bathyal-abyssal: *G. beccariiformis, N. truempyi*, and *Gyroidinoides globosus*). Other Midway - type taxa are occupying the neritic Shelf (e. g., *Lenticulina turbinata, Anomalinoides welleri, Stilostomella midwayensis, Osangularia plummerae*, etc.). This subzone may be correlatable with deep-sea oceanic regions.

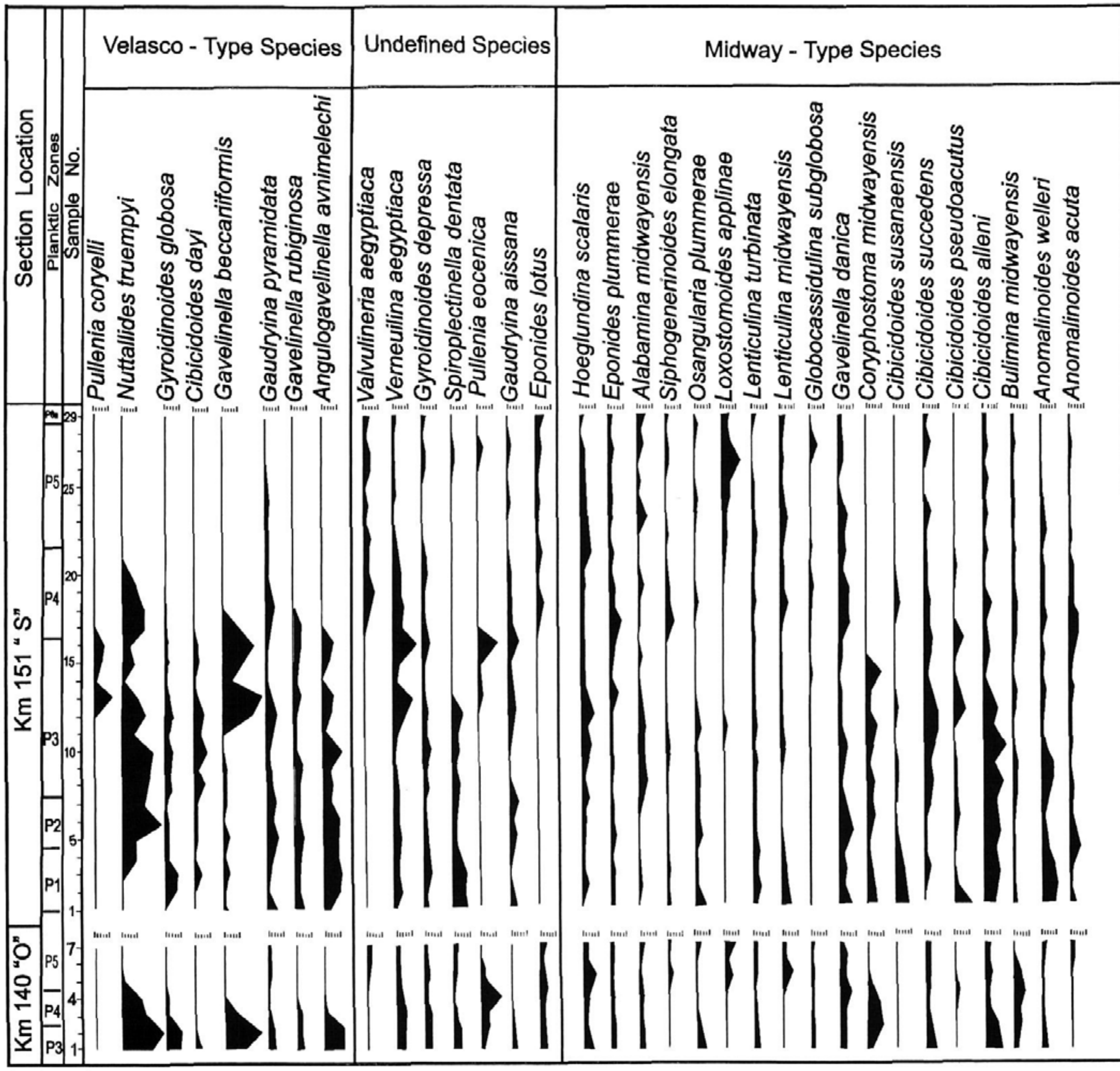
3- *Hoeglundina scalaris – Lenticulina midwayensis* Subzone:

Definition: Interval of the range of the nominate taxa between the last occurrence of *Angulogavelinella avnimelechi - Nuttallides truempyi* and the first appearance of *Loxostomoides applinae* .

Age and Correlation: The *Hoeglundina scalaris–Lenticulina midwayensis* interval subzone is Late Thanetian in age and correlates with the uppermost part of *Globanomalina pseudomenardii* (P4 Zone) to the lowermost part of *Morozovella velascoensis* (P5 Zone) planktic foraminiferal zones.

Stratotype: Outcrops of the Esna Formation of both studied sections (Samples; S21-23, and O5) in the study area.

Characteristics: The *Hoeglundina scalaris – Lenticulina midwayensis* interval subzone is distinguished by the presence of *Hoeglundina scalaris, Lenticulina midwayensis, Cibicidoides succedens, Alabamina midwayensis, Cibicidoides alleni, Gavelinella danica, Eponides plummerae*, anomalinids, bagginids, and eponidids.



TEXT-FIGURE 7
Frequencies of most common species grouped according neritic (Midway-type) and bathyal (Velasco-type) environments. One bar equals 10% of the total assemblage.

Remarks: The assemblage characteristic to the *Hoeglundina scalaris – Lenticulina midwayensis* interval occurs at the central part of Esna Formation in both studied sections. This subzonal assemblage exhibits close affinities with Midway – type faunas. It equates approximately with the benthic assemblage of *pseudomenardii* and *velascoensis* of El Haria Formation, El Kef section of Tunisia (Saint-Marc 1992). Therefore, it differs from the former *Angulogavelinella avnimelechi – Nuttallides truempi* Subzone in having a low diversified and shallower sea faunal assemblage.

4- *Loxostomoides applinae* Subzone:

Definition: Interval from the last occurrence of *Hoeglundina scalaris–Lenticulina midwayensis* to the last appearance of *Loxostomoides applinae.*

Age and Correlation: The *Loxostomoides applinae* Subzone is Late Thanetian age and correlates with the upper part of the *Morozovella velascoensis* (P5 Zone).

Stratotype: Outcrops of the Esna Formation of both studied sections (Samples; S24-29; and O6-7) in the study area.

Characteristics: The *Loxostomoides applinae* Subzone is characterized by the presence of the nominate species in conjunction with the *Bathysiphon paleocenicus, Eponides lotus, Valvulineria aegyptiaca, V. scrobiculata, Cibicidoides alleni, Bulimina gr. trigonalis*, lenticulinids, osangulariids, and few miliolids.

Remarks: The *Loxostomoides applinae* Subzone is occupying the uppermost part of both studied sections. This subzone is comparable with the *velascoensis* zonal benthic assemblage of El Haria Formation of El Kef section in Tunisia (Saint-Marc 1992). It is recorded as well by some authors in Egypt (e.g.; Anan and Hewaidy 1986; and Hewaidy 1987). It includes some Midway - type species in association with other undefined ones and few miliolids (text-figure 3). However, it denotes to the shallowest water depth in the whole Paleocene succession of the study area.

All biostratigraphic relationships are illustrated in text-figure 2.

PALEOBATHYMETRY

A tentative paleobathymetric analysis for the Paleocene foraminiferal assemblages of El Sheikh Fadl – Ras Gharib traverse has been achieved during the present investigation. It is based in part on the estimation of some foraminiferal parameters [e. g., total foraminiferal number (TFN), planktic ratio (% P), and number of benthic species (NBS, species diversity, text-figure 4], and in another on comparison with paleobathymetric information (e. g., Berggren 1974; Berggren and Aubert 1975; Van Morkhoven et al. 1986; Saint - Marc 1992; and Speijer 1994). The Paleocene benthic taxa exhibits here a close affinity with the Midway - and Velasco - type faunas of the Gulf Coastal Plain of Texas and Upper Lizard Spring of Mexico, respectively (Berggren and Aubert 1975). Therefore, the Midway - to Velasco - type faunal ratio (% MF/VF, text-fig. 5) is calculated. These faunas are recorded before in Sinai Peninsula by Said and Kenawy (1956); and Speijer (1994).

On the other hand, an attempt to recognize the paleoenvironmental changes related to oxygen content requires the use of epifaunal (plano- biconvex and trochospiral forms), infaunal (uni-, bi-, and triserial; planispiral and cylindrical forms) benthic morphotypes (% E/I) of Corliss (1985) are also estimated (text-fig. 6).

The paleobathymetric analysis of the present Paleocene samples will be briefly discussed in view of the previously mentioned benthic foraminiferal biostratigraphic assemblages. However, four benthic foraminiferal groups can be bathymetrically distinguished as;

Group 1 (Sample S-1: *Parvularugoglobigerina eugubina* Zone): Generally, in all the studied samples, planktic foraminifera (text-fig. 4) predominate the benthic assemblages (average about 33% to 90%). This group includes the highest values of total foraminiferal number (987 individuals at S section only), planktic ratio (80%), and a reasonable diversified benthic taxa (56 species). The assemblage of this group is dominated by *Cibicidoides pseudoacutus, Spiroplectinella dentata, Cibicidoides alleni, C. susanaensis, Anomalinoides welleri, Lenticulina muensteri, Gaudryina pyramidata*, and *Gavelinella danica*. The Midway-type fauna attains 73%, and the Velasco - type fauna amounts to 16% (with an average of 4.6 %, text-fig. 5). Estimation of epifaunal to infaunal morphotypes (text-fig. 6) shows the highest value for its ratio, where it reaches 2.9% . The paleobathymetric ranges of the present benthic assemblage denote to an average of about 30-500m. water depth during the formation of this group (text-fig. 8).

The above mentioned characters of faunal abundances, MF to VF, and morphotypes (% E / I), indicate an open marine middle to upper bathyal environment, with oxygenated bottom water conditions.

Group 2 (Samples S2-20 and O1-4: *Parasubbotina pseudobulloides – Globanomalina pseudomenardii* Zones): Assemblage of this group is marked by slightly lower foraminiferal number (with an average of 859 and 918 individuals at S and O sections, respectively) than group 1, and the decrease of epifaunal to infaunal morphotype ratio upwards (average about 2.4% and 2.5%). The planktic ratios have averages of 91.2% and 89%, number of benthic species 59.9 and 58, and the Midway- to Velasco type faunal ratios are marked by the minimum values in both sections, where they reach 2.3% and 1.5%.

This group reveals the maximum depth of the Paleocene sea in the study area as indicated by the increase of planktic ratio, highly diversified benthic fauna, and abundance of Velasco – type species. It displays the co-existence of both the Midway- and Velasco- type faunas, which indicate an intermediate bathymetric depth of probably bathyal to deeper environment (200-3000m.). The most common Midwayan species are; *Cibicidoides alleni, Anomalinoides welleri, Coryphostoma midwayensis, Gavelinella danica*, and others. The highly abundant Velascoan species are:

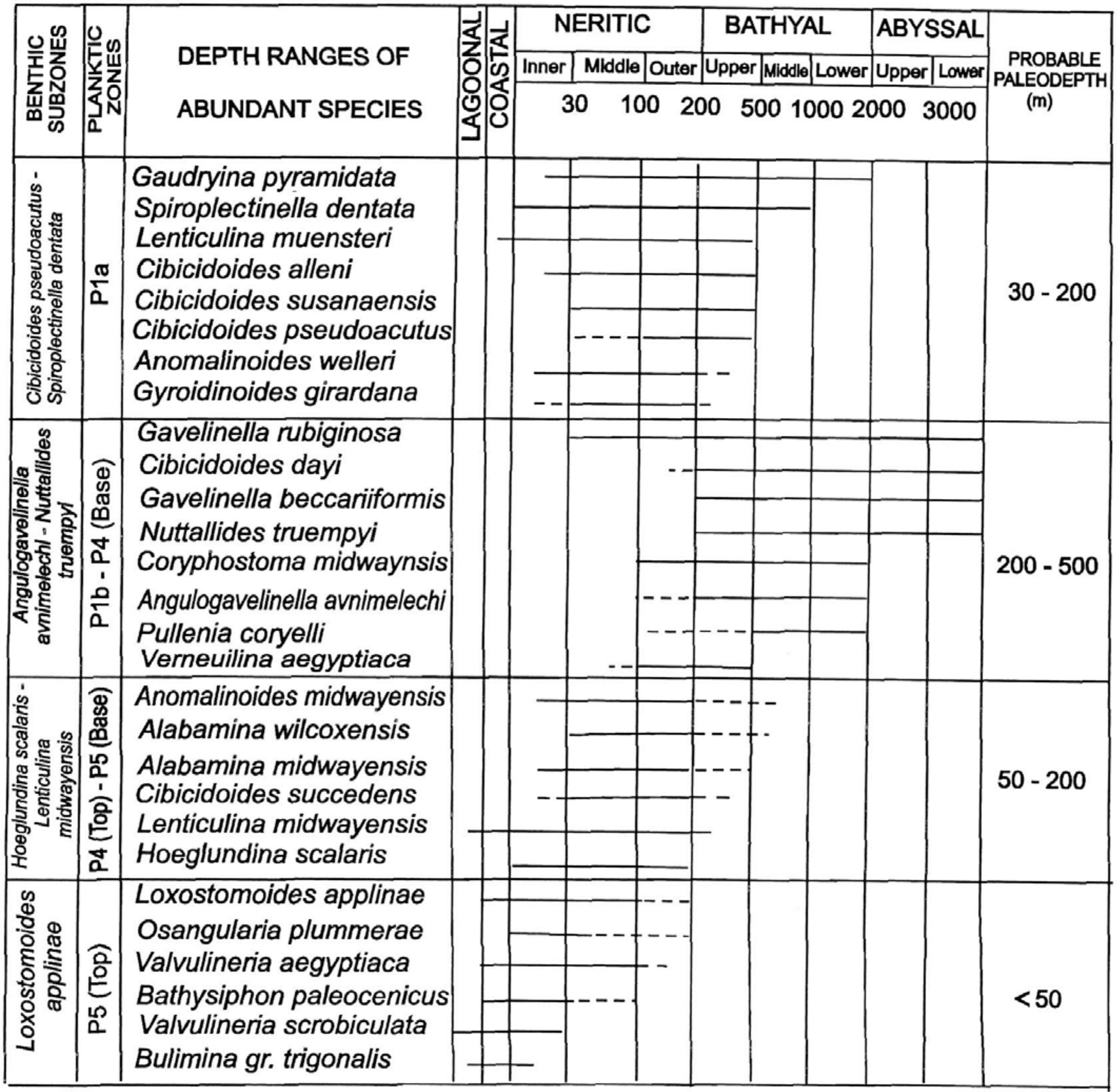
Angulogavelinella avnimelechi, Gavelinella beccariiformis, and *Nuttallides truempi* (text-fig. 7).

However, the relatively low foraminiferal number and epifaunal to infaunal ratio, the highest planktic percent, diversified benthic assemblage, and the predominance of Velasco- type fauna denote a bathyal and deeper environment with well-oxygenated conditions.

Group 3 (Samples S21-23 and O5: *Globanomalina pseudomenardii - Morozovella velascoensis* Zones): This group witnesses a general decrease in the total foraminiferal numbers of both studied sections (656 and 760 individuals at S and O sections), planktic ratios (71.7 % and 69 %), benthic species (48 and 56 species, text-fig. 4), and epifaunal to infaunal morphotype ratios (1.5 % and 1.6 %), on the contrary from the Midway - to Velasco - type faunal ratios (12.6 % and 9.7 %), which increase towards the top of studied sections (text-figs.5 and 6). It is dominated by the Midwayan type species as; *Hoeglundina scalaris, Lenticulina midwayensis, Alabamina midwayensis, Anomalinoides midwayensis, and Gavelinella danica* (text-fig. 7). Most common Velascoan species of the underlying group disappeared.

Therefore, the low values of foraminiferal numbers, planktic ratios, diversities, and oxygen deficiency are pointing to shallowing conditions of middle to outer neritic shelf (average of 30-200m. water depth) environment (text-fig. 8).

Group 4 (Samples S24-29 and O 6-7: *Morozovella velascoensis* Zone): In this group, the various bathymetric parameters are somewhat similar in both studied sections in; the foraminiferal numbers (with an average of 518 and 671 individuals at S and O sections), planktic ratio 53.8 % and 56 %), and the number of



TEXT-FIGURE 8
Paleobathymetric ranges of most abundant Paleocene benthic assemblages in various subzones and the probable paleodepths (modified after Van Morkhoven et al. 1986 and Saint-Mark 1992) in the study area.

benthic species (38 and 41 species, text-fig. 4). The Midway - to Velasco - type faunal ratios attain its maximum values (19.9% and 23.1%), while the epifaunal to infaunal morphotype ratios reach its minimum ones (1.1% and 0.8%, text-figs. 5, 6).

The most frequent species in this group are; *Loxostomoides applinae, Valvulineria aegyptiaca, V. scrobiculata, Osangularia plummerae, Bulimina gr. trigonalis,* and *Bathysiphon paleocenicus* (text-fig. 7). The presence of these fauna indicates the shallowest conditions all over the Paleocene Series of study area (regression phase). Therefore, an inner to littoral (with water depth of about 50m) environment is suggested for this group (text-fig. 8). This shallowing was accompanied with poor oxygen conditions in the latest Paleocene times (due to the dominance of infaunal species), the approximate extinction of the whole Velacoan–type faunas, and the ferrugination of some benthic genera such as *Valvulineria, Cibicidoides*, and *Lenticulina* sp.

DISCUSSION AND CONCLUSIONS

The Paleocene sequence of El Sheikh Fadl – Ras Gharib traverse could be differentiated into Dakhla, Tarawan, and Esna formations. The Dakhla Formation is referred to the Danian – Middle Paleocene, while the Tarawan to the late Middle Paleocene, and the Esna to the Late Paleocene ages.

The planktic and benthic foraminiferal elements are rich and diversified in the investigated Paleocene succession. Therefore, all the well - known planktonic foraminiferal zones are recognized, beginning from the *Parvularugoglobigerina eugubina* Zone (P1a) to the *Morozovella velascoensis* Zone (P5).

The distribution and paleobathymetric significance of the Paleocene benthic foraminiferal assemblages are allowed to propose a local biostratigraphic scheme. The Paleocene succession is distinguished into the *Gavelinella danica* Total Range Zone, which is subdivided into four subzones from older to younger as; *Cibicidoides pseudoacutus – Spiroplectinella dentata, Angulogavelinella avnimelechi – Nuttallides truempyi, Hoeglundina scalaris – Lenticulina midwayensis,* and *Loxostomoides applinae* Subzones.

Relying on the estimated foraminiferal parameters and previous paleobathymetric information, four benthic foraminiferal groups are recognized for the Paleocene Series of the present study as:

1) The *eugubina* zonal group is characterized by *Cibicidoides pseudoacutus, Spiroplectinella dentata, Cibicidoides alleni, Anomalinoides welleri, Cibicidoides susanaensis*, and *Gaudryina pyramidata,* developed in an open marine, middle to upper bathyal environment with relatively well - oxygenated conditions.

2) The *pseudobulloides – pseudomenardii* (lower part) Zones present mainly Velasco - type faunas, with *Angulogavelinella avnimelechi, Gavelinella beccariiformis, Nuttallides truempyi, Cibicidoides alleni, Anomalinoides welleri, Coryphostoma midwayensis*, and *Gavelinella midwayensis*. Microfauna suggests a gradual deepening from the *eugubina* Zone to bathyal and deeper environment with also, well - oxygenated bottom water conditions.

3) The *peudomenardii* (upper part) and *velascoensis* (lower part) Zone distinguish a regressive sea movement due to the dominant Midway – type faunas, which indicate a middle to outer shelf paleobathymetry during this interval. The assemblage is characterized by *Hoeglundina scalaris, Lenticulina midwayensis, Alabamina midwayensis, Anomalinoides midwayensis*, and *Gavelinella danica*. It is developed in oxygen deficienct conditions.

4) The upper part of the succession (*M. velascoensis* Zone) shows an inner to littoral assemblage predominated by *Loxostomoides applinae, Valvulineria aegyptiaca, V. scrobiculata, Osangularia plummerae, Bulimina gr. trigonalis*, and *Bathysiphon paleocenicus*. Therefore, shallowing conditions prevailed in the latest Paleocene times and were accompanied by the lowest oxygen content.

ACKNOWLEDGMENTS

Thanks are due to Prof. Drs. M. G. Barakat and A. S. El - Dawoody (Department of Geology, Cairo Univerity) for their critical review of the manuscript. Thanks are extended to the Late Prof. Dr. A. I. Kenawy (Department of Geology, Assiut University) for fruitful discussions on the benthic foraminiferal biostratigraphy. Mr. A. I. Abdel Naser is gratefully acknowledged for his technical assistance in photographing the identified fauna.

PLATE 1

1 *Bathysiphon paleocenicus* n. sp., From S-24, ×50, MUGD F 17.

2 *Bolivinopsis spectabilis* Grzybowski, From S-8, ×150, MUGD F 18.

3 *Spiroplectinella dentata* (Alth), From S-1, ×100, MUGD F 19.

4 *Gaudryina pyramidata* Cushman, From S-3, ×75, MUGD F 20.

5 *Gaudryina inflata* Israelsky, From O-2, ×100, MUGD F 21.

6 *Verneuilina aegyptiaca* Said and Kenawy, From S-3, ×150, MUGD F 22.

7 *Dorothia bulbosa* Israelky, From S-15, ×150, MUGD F 23.

8 *Marssonella oxycona trinitatensis* Cuhman and Renz, From S-6, ×100, MUGD F 24.

9 *Quinqueloculina sp.* aff. *Q. stelligera* Schlumberger, rom S-18, ×200, MUGD F 25.

10 *Nodosaria* (?) *longiscata* d'Orbigny, From S-13, ×150, MUGD F 26.

11 *Pyramidulina latejugata* (Guembel), From S-9, ×75, MUGD F 27.

12 *Neoflabellina delicatissima* (Plummer), From S-7, ×100, MUGD F 28.

13 *Lenticulina midwayensis* (Plummer), From S-24, ×75, MUGD F 29.

14 *Lenticulina pseudomamilligera* (Plummer), From S-6, ×100, MUGD F 30.

15 *Hemirobulina hamuloides* (Brotzen), From S-13, ×200, MUGD F 31.

16 *Lagena hispida* Reuss, From S-11, ×150, MUGD F 32.

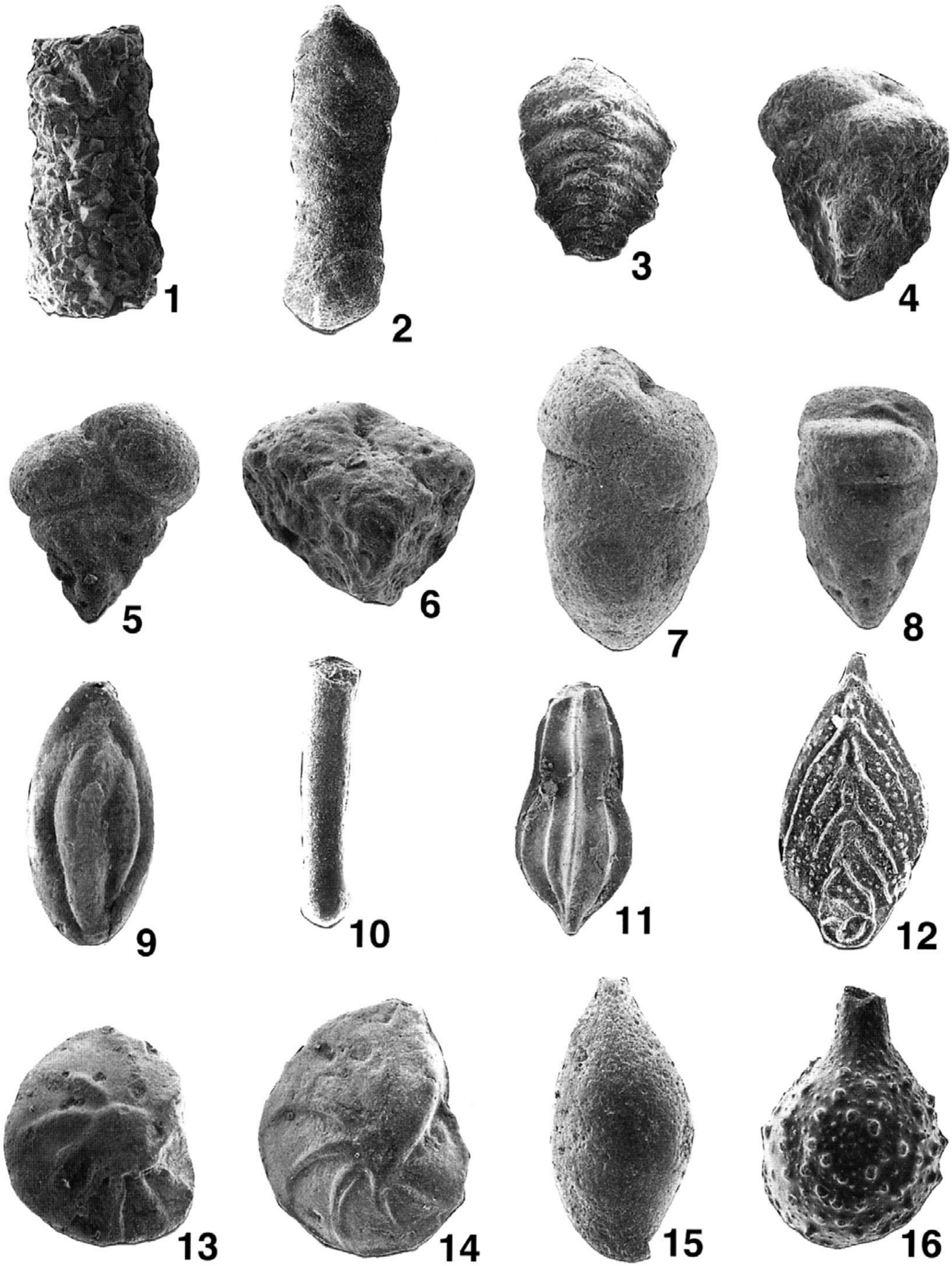

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PLATE 2

1 *Loxostomoides applinae* (Plummer), From S-26, ×150, MUGD F 33.

2 *Siphogenerinoides eleganta* (Plummer), From S-18, ×200, MUGD F 34.

3 *Coryphostoma midwayensis* (Cushman), From O-3, ×150, MUGD F 35.

4 *Bolivinoides delicatulus* Cushman, From S-8, ×200, MUGD F 36.

5 *Ellipsoidella kugleri* (Cushman and Renz), From S-11, ×150, MUGD F 37.

6 *Stilostomella midwayensis* (Cushman and Todd), From S-7, ×200, MUGD F 38.

7 *Globulina ampulla* Reuss, From S-8, ×200, MUGD F 39.

8 *Guttulina trigonula* (Reuss), From S-9, ×200, MUGD F 40.

9 *Hoeglundina scalaris* (Franke), From S-7, ×150, MUGD F 41.

10 *Globocassidulina subglobosa* (Brady), From S-27, ×200, MUGD F 42.

11 *Bulimina midwayensis* Cushman and Parker, From S-13, ×200, MUGD F 43.

12 *Bulimina gr. trigonalis* Ten Dam, From S-12, ×200, MUGD F 44.

13 *Rotamorphina cushmani* Finlay, From S-10, ×150, MUGD F 45.

14 *Valvulineria scrobiculata* (Schwager), From S-29, ×150, MUGD F 46.

15 *Eponides plummerae* Cushman, From S-7, ×150, MUGD F 47.

16 *Cibicidoides alleni* (Plummer), From S-3, ×100, MUGD F 48.

17 *Cibicidoides pseudoacutus* (Nakkady), From S-1, ×150, MUGD F 49.

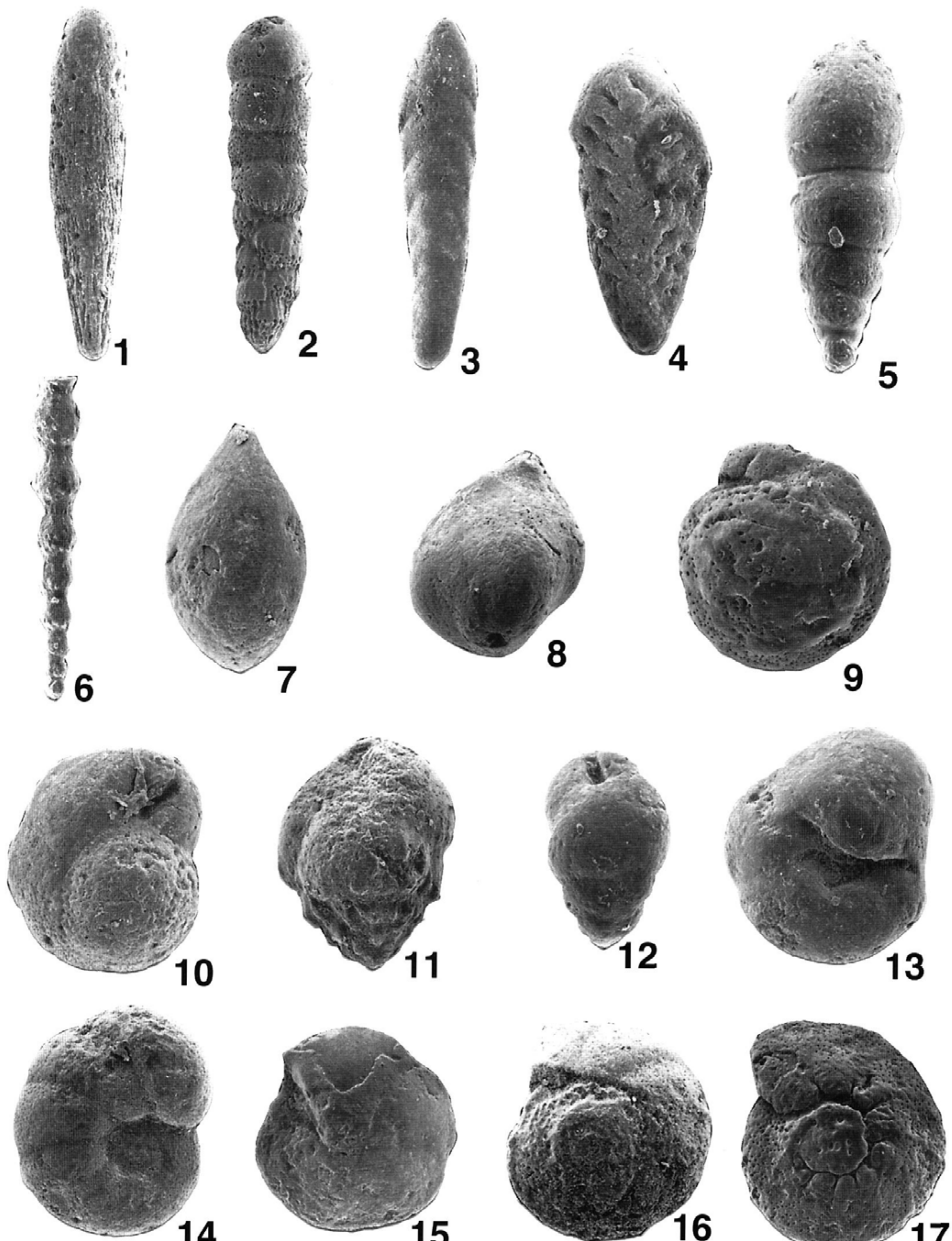
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PLATE 3

1 *Cibicidoides susanaensis* (Browning), From S-1, ×150, MUGD F 50.

2 *Nuttallides truempyi* (Nuttall), From S-3, ×200, MUGD F 51.

3 *Globimorphina trochoides* (Reuss), From S-19, ×200, MUGD F 52.

4 *Chilostomelloides eocaenica* Cushman, From S-1, ×100, MUGD F 53.

5 *Pullenia coryelli* White, From S-13, ×200, MUGD F 54.

6 *Alabamina midwayensis* Brotzen, From S-7, ×150, MUGD F 55.

7 *Osangularia plummerae* Brotzen, From S-6, ×200, MUGD F 56.

8 *Anomalinoides acuta* (Plummer), From S-4, ×150, MUGD F 57.

9 *Anomalinoides welleri* (Plummer), From S-9, ×150, MUGD F 58.

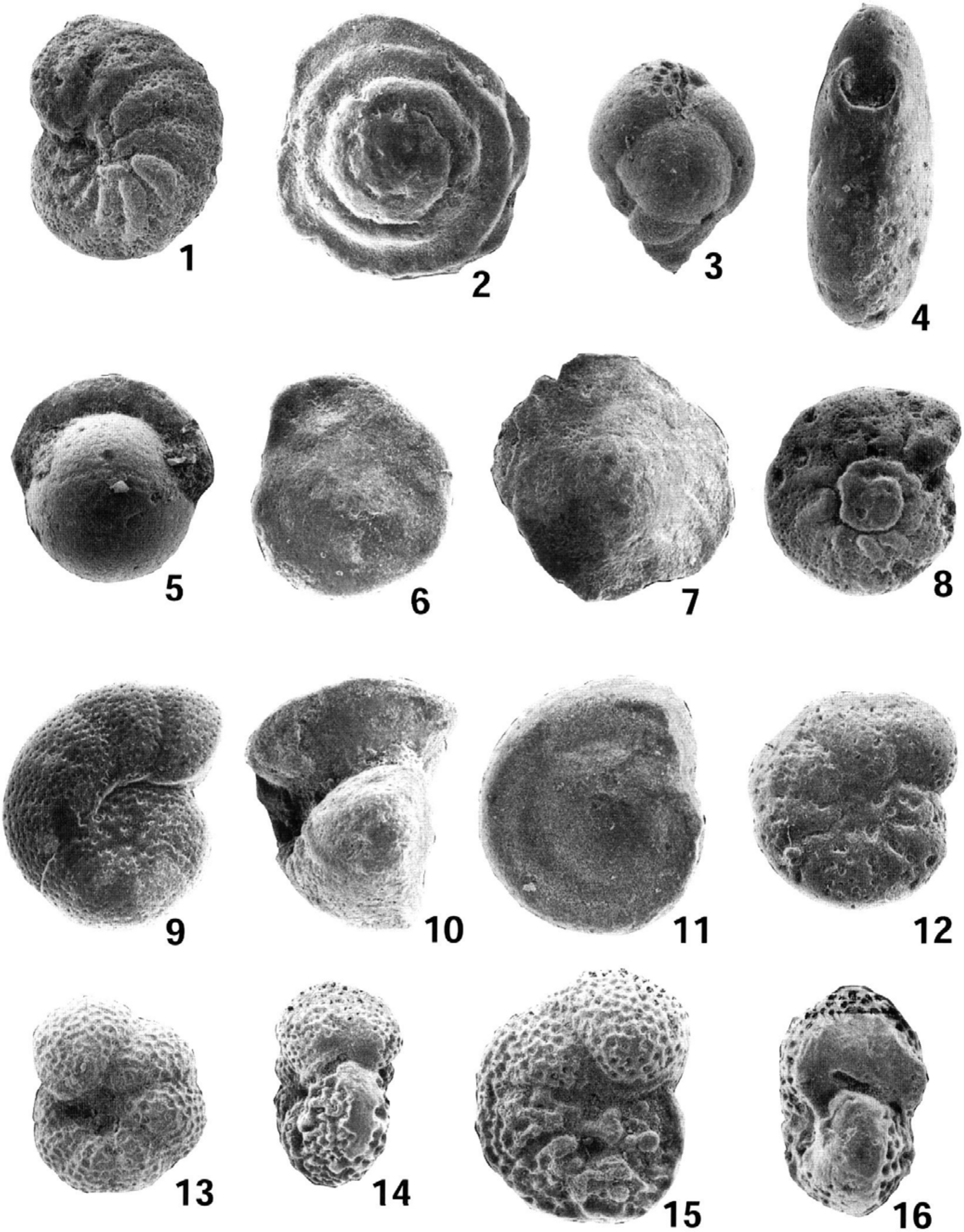
10 *Gyroidinoides subangulata* (Plummer), From S-8, ×200, MUGD F 59.

11 *Angulogavelinella avnimelechi* (Reiss), From S-4, ×150, MUGD F 60.

12 *Gavelinella beccariiformis* (White), From S-12, ×200, MUGD F 61.

13, 14 *Gavelinella danica* (Brotzen), From S – 3; 13, ×150; 14, ×100, MUGD F 62, 63.

15-16 *Gavelinella rubiginosa* (Cushman), From S-3; 15, ×100; 16, ×150, MUGD F 64, 65.



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ANNOTATED SPECIES LIST

This paper is not a taxonomic study and the mentioned taxa of the present work are common and cosmopolitan, where some of them are illustrated in three plates. 120 diagnostic and stratigraphically important benthic foraminiferal species and subspecies are identified and listed below following the classification of Loeblich and Tappan (1988). They are assorted hereunder with a reference to where their characteristics and illustrations are given in a detailed taxonomic study. Some modern references have been added to complete synonymies. Only one species is described as new.

Suborder TEXTULARIINA Deluge and Hérouard, 1896

Bathysiphon paleocenicus El Dawy **n. sp.**
Plate 1, figure 1

Description: Test free, medium to large, cylindrical; wall coarsely agglutinated, with some crystallined grains,cemented with ferruginous material; surface rough; aperture consists of open end of wide tube.

Remarks: Bathysiphon paleocenicus differs from *B. californicus* Martin (1964), from the Santonian – Maastrichtian strata of California, in having a large and wider diameter of tube. Also, it varies from *B. varans* Sliter (1968), in possessing a rougher surface texture without any transverse constrictions. Very rare to rare in the studied section (S).

Dimension of holotype: Length 1.9mm., breadth 0.75mm.

Type locality: At 151km, from El Sheikh Fadl village, Eastern Desert, Egypt.

Type sample: Sample S:24 (at 151kms section).

Type stratum: Late Paleocene (P5), *Loxostomoides applinae* Zone.

Name: Name of pecies is derived from the age of studied Series.

Depository: Minia University, Geology Department, (holotype MUGD F 17) Minia, Egypt.

Bathysiphon arenaceus Cushman
Bathysiphon arenaceus CUSHMAN 1927, p.129, pl.1, fig. 2.- SHAHIN 1990, p. 498, pl. 6, fig. 1.

Bathysiphon cf. discretus (Brady)
Rhabdammina discretus BRADY 1881, p. 489.
Bathysiphon cf. *discretus* (Brady) BOLLI et al. 1994, p.65, fig.18, 1-2..

Bathysiphon eocenicus Cushman and Hanna
Bathysiphon eocenicus CUSHMAN and HANNA 1927, p.210, pl.13, figs. 2-3.

Bathysiphon varans Sliter
Bathysiphon varans SLITER 1968, p. 40, pl.1, fig. 4.

Bathysiphon vitta Nauss
Bathysiphon vitta NAUSS 1947, p. 334, pl. 48, fig. 4.
Bathysiphon vitta Nauss.- SLITER 1968, p. 40, pl. 1, fig. 3.

Bolivinopsis spectabilis (Grzybowski)
Plate 1, figure 2

Spiroplecta spectabilis GRZYBOWSKI 1898, p. 293, pl.12, fig.12.
Bolivinopsis spectabilis (Grzybowski) BOLLI et al. 1994, p. 82, fig. 21. 32-33.

Spiroplectinella dentata (Alth)
Plate 1, figure 3

Textularia dentata ALTH 1850, p. 262, pl. 13, fig. 13.
Spiroplectammina dentata (Alth) CUSHMAN and RENZ 1947a, p. 37, pl. 11, fig. 3.
Spiroplectinella dentata (Alth) BOLLI et al. 1994, p. 83, fig.22. 4-7.

Spiroplectinella esnaensis (Le Roy)
Spiroplectammina esnaensis LE ROY 1953, p. 50, pl. 1, figs.11-12. - AUBERT and BERGGREN 1976, p. 409, pl. 1, fig. 6.

Spiroplectinella knebeli (Le Roy)
Spiroplectammina knebeli LE ROY 1953, p. 51, pl. 2, figs. 10-11.- AUBERT and BERGGREN 1976, p. 409, pl.1, fig. 7.

Gaudryina aissana ten Dam and Sigal
Gaudryina aissana TEN DAM and SIGAL 1950, p. 31, pl. 2, fig. 2.- SHAHIN 1990, p. 499, pl. 6, figs. 25-26.

Gaudryina pyramidata Cushman
Plate 1, figure 4

Gaudryina laevigata FRANKE var. *pyramidata* CUSHMAN 1926, p. 587, pl. 16, fig. 8.
Gaudryina pyramidata Cushman.- BOLLI et al. 1994, p.90, fig. 24, 4-6.

Gaudryina inflata Israelsky
Plate 1, figure 5

Gaudryina inflata ISRAELSKY 1951, p. 16, pl. 6, figs. 1-2.- AUBERT and BERGGREN 1976, p. 410, pl.1, fig.11.

Gaudryina limbata Said and Kenawy
Gaudryina limbata SAID and KENAWY 1956, p.123, pl.1, fig.23.

Gaudryina rectangulata Martin
Gaudryina rectangulata MARTIN 1943, p.104, pl. 5, fig. 4.- AUBERT and BERGGREN 1976, p. 409, pl. 1, fig. 9.

Gaudryina textulariformis Nakkady and Talaat
Gaudryina textulariformis NAKKADY and TALAAT, in: Nakkady 1959, p. 457, pl. 6, fig.3.- SHAHIN 1990, p. 499, pl. 6, fig. 34.

Gaudryina triangularis Cushman
Gaudryina triangularis CUSHMAN 1948, p. 123, pl. 7, fig. 24.

Verneuilina aegyptiaca Said and Kenawy
Plate 1, figure 6

Verneuilina aegyptiaca SAID and KENAWY 1956, p. 122, pl. 1, fig. 16.

Verneuilina cretacea Karrer
Verneuilina cretacea KARRER, in: Nakkady 1959, p. 456, pl. 1, fig. 3.- SHAHIN 1990, p. 499, pl. 6, fig. 19.

Tritaxia midwayensis (Cushman)
Clavulinoides midwayensis CUSHMAN 1936, p. 21, pl. 3, figs. 9, 15.
Tritaxia midwayensis (Cushman) BERGGREN and AUBERT 1975, p. 142, pl. 1, fig. 1d; pl. 12, fig. 9.

Dorothia bulbosa Israelsky
Plate 1, figure 7

Dorothia bulbosa ISRAELSKY 1951, p. 23, pl. 9, figs. 33-35; pl. 11, fig. 17.- BOLLI et al. 1994, p. 92, fig. 24. 28.

Dorothia bulletta (Carsey)
Gaudryina bulletta CARSEY 1926, p. 28, pl. 4, fig. 4.
Dorothia bulletta (Carsey) SLITER 1968, p. 49, pl. 3, fig. 11.

Dorothia pupa (Reuss)
Textularia pupa REUSS 1860, p. 232, pl. 13, fig. 4.
Dorothia pupa (Reuss) SLITER 1968, p. 50, pl. 4, fig. 1.

Dorothia retusa (Cushman)
Gaudryina retusa CUSHMAN 1926b, p. 588, pl. 16, fig. 10.
Dorothia retusa (Cushman) SLITER 1968, p. 50, pl. 4, fig. 2.

Marssonella oxycona oxycona (Reuss)
Gaudryina oxycona REUSS 1860, p. 229, pl. 12, fig. 3.
Marssonella oxycona oxycona (Reuss) BOLLI et al.1994,p.94, fig.25. 5-6.

Marssonella oxycona trinitatensis Cushman and Renz
Plate 1, figure 8

Marssonella oxycona (Reuss) var. *trinitatensis* CUSHMAN and RENZ 1946, p.22, pl. 2, fig. 29.
Marssonella oxycona trinitatensis CUSHMAN and RENZ, in: Bolli et al. 1994, p. 94, fig. 25. 3-4.

Clavulinoides asper whitei (Cushman and Jarvis)
Clavulina aspera CUSHMAN var. *whitei* CUSHMAN and JARVIS 1932, p. 19, pl. 5, figs. 6-8.
Clavulinoides asper whitei (Cushman and Jarvis) SAID and KENAWY 1956, p. 125, pl. 1, fig. 38.

Suborder MILIOLINA Delage and Hèrouard, 1896

Spiroloculina cretacea Reuss
Spiroloculina cretacea REUSS 1854, p. 72, pl. 26, fig. 9.- SLITER 1968, p. 51, pl. 4, fig. 4.

Quinqueloculina sp*.** aff. ***Q. stelligera Schlumberger
Plate 1, figure 9

Quinqueloculina stelligera SCHLUMBERGER 1893, p. 68.
Quinqueloculina sp. aff. *Q. stelligera* SCHLUMBERGER, in: Le Roy 1953, p. 46, pl.8, figs. 28-29.

Suborder LAGENINA Delage and Hèrouard, 1896

Dentalina colei Cushman and Dusenbury
Dentalina colei CUSHMAN and DUSENBURY 1934, p. 54, pl. 17, figs. 10-12.- AUBERT and BERGGREN 1976, p. 413, pl.2, fig. 9.

Laevidentalina gracilis (d'Orbigny)
Nodosaria (Dentalina) gracilis D'ORBIGNY 1840, p. 14, pl. 1, fig. 5.
Laevidentalina gracilis (d'Orbigny) BOLLI et al. 1994, p. 100, fig. 26. 14.

Nodosaria limbata d'Orbigny
Nodosaria limbata D'ORBIGNY 1840, p. 12, pl. 1, fig. 1.

Nodosaria (?) ***longiscata*** d'Orbigny
Plate 1, figure 10

Nodosaria longiscata D'ORBIGNY 1846, p. 32, pl. 1, figs. 10-12.
Nodosaria (?) *longiscata* D'ORBIGNY in: Bolli et al. 1994, p. 102-103, fig. 26. 35-36.

Pseudonodosaria manifesta (Reuss)
Glandulina manifesta REUSS 1851, p. 22, pl. 1, fig. 4.
Pseudonodosaria manifesta (Reuss) LUGER 1985, p. 81, pl. 4, fig. 9.- ISMAIL 1991, p. 231, pl. 1, fig. 15.

Pyramidulina latejugata (Guembel)
Plate 1, figure 11

Nodosaria latejugata GUEMBEL 1868, p. 619, pl.1, fig.32.
Pyramidulina latejugata (Guembel) BOLLI et al.1994, p. 103, fig. 27.3-4.

Pyramidulina paupercula (Reuss)
Nodosaria paupercula REUSS 1845, p. 26, pl. 12, fig. 12.- SAID and KENAWY 1956, p. 133, pl. 2, fig. 33.

Pyramidulina vertebralis (Batsch)
Nodosaria (Orthoceras) vertebralis BATSCH 1791, p. 3, pl. 2, fig. 6.
Nodosaria vertebralis (Batsch) PLUMMER 1927, p. 88, pl. 5, fig. 10.
Pyramidulina vertebralis (Batsch) AUBERT and BERGGREN 1976, p. 413, pl. 2, fig. 9.

Lenticulina discrepans (Reuss)
Cristellaria (Robulina) discrepans REUSS 1863, p. 78, pl. 9, fig. 7.
Lenticulina discrepans (Reuss) BOLLI et al. 1994, p. 107, fig. 28. 11, 13-15.

Lenticulina mexicana alticostata (Cushman and Barksdale)
Robulus mexicanus (Cushman) var. *alticostatus* (Cushman and Barksdale) NAKKADY 1950,p. 412, pl. 4, fig. 4.

Lenticulina midwayensis (Plummer)
Plate 1, figure 13

Cristellaria midwayensis PLUMMER 1927, p. 95, pl. 13, fig. 5.
Lenticulina midwayensis (Plummer) AUBERT and BERGGREN 1976, p. 414, pl. 2, fig. 16.

Lenticulina muensteri (Roemer)
Lenticulina muensteri ROEMER 1839, p. 48, pl. 22, fig. 29.

Lenticulina pseudomamilligera (Plummer)
Plate 1, figure 14

Cristellaria pseudomamilligera PLUMMER 1927, p. 98, pl. 7, fig. 11
Lenticulina pseudomamilligera (Plummer) BERGGREN and AUBERT 1975, p. 143, pl. 16, fig. 8.

Lenticulina turbinata (Plummer)
Lenticulina turbinata PLUMMER 1927, p. 93, pl. 6, fig. 4.
Lenticulina turbinata (Plummer) AUBERT and BERGGREN 1976, p. 415, pl. 3, fig. 4.

Marginulinopsis tuberculata (Plummer)
Cristellaria subaculeata Cushman var. tuberculata PLUMMER 1927, p. 101, pl. 7, fig. 2; pl. 14, fig. 6.
Marginulinopsis tuberculata (Plummer) AUBERT and BERGGREN 1976, p. 416, pl. 3, fig. 6.

Neoflabellina delicatissima (Plummer)
Plate 1, figure 12

Frondicularia delicatissima PLUMMER 1927, p. 120, pl. 5, fig. 4.

Astacolus rectus (d'Orbigny)
Cristellaria recta D'ORBIGNY 1840, p. 28, pl. 2, figs. 23-25.

Hemirobulina hamuloides (Brotzen)
Plate 1, figure 15

Marginulina hamuloides BROTZEN 1936, p. 68, pl. 4, figs. 10-11.

Marginulina sp. Berggren and Aubert
Marginulina sp. Berggren and Aubert 1975, pl. 16, fig. 1.

Vaginulinopsis midwayana (Fox and Ross)
Vaginulina midwayana FOX and ROSS 1942, p. 669.

Lagena hispida Reuss
Plate 1, figure 16

Lagena hispida REUSS 1863, p. 335, pl. 6, figs. 77-79.

Reussoolina apiculata apiculata (Reuss)
Oolina apiculata REUSS 1851, p. 22, pl. 2, fig. 1.
Reussoolina apiculata apiculata (Reuss) BOLLI et al.1994, p.121, fig.32. 34.

Globulina ampulla (Jones)
Plate 2, figure 7

Polymorphina ampulla JONES 1852, p. 267.

Globulina lacrima lacrima (Reuss)
Polymorphina (*Globulina*) *lacrima* REUSS 1845, p. 40, pl. 12, fig. 6; pl. 13, fig. 23.
Globulina lacrima REUSS, in: Cushman and Renz 1946, p. 34, pl. 5, fig. 22.

Guttulina trigonula (Reuss)
Plate 2, figure 8

Polymorphina (*Guttulina*) *trigonula* REUSS 1845, p.40, pl. 13, fig. 48.

Pyrulina cylindroides (Roemer)
Polymorphina cylindroides ROEMER 1838, p. 385, pl. 3, fig. 26.
Pyrulina cylindroides (Roemer) BOLLI et al. 1994, p.123, fig. 33, 21-22.

Ramulina navarroana Cushman
Ramulina navarroana CUSHMAN 1938, p. 43, pl. 7, figs. 10-11.

Oolina globosa (Montagu)
Vermiculum globosum MONTAGU 1803, p. 523.
Lagena globosa (Montagu) ANAN and HEWAIDY 1986, p. 21, pl. 2, fig. 2.

Glandulina laevigata (d'Orbigny)
Nodosaria (*Glandulina*) *laevigata* D'ORBIGNY 1826,p. 252, pl. 10, figs. 1-3.

Hoeglundina eocenica (Cushman and Hanna)
Hoeglundina eocenica (Cushman and Hanna) BERGGREN and AUBERT 1975,pl. 3, fig. 4; pl. 10, fig. 7; pl. 19, fig. 10.

Hoeglundina scalaris (Franke)
Plate 2, figure 9

Epistomina scalaris FRANKE 1927, p. 39, pl. 4, fig. 6.

Suborder ROTALIINA Delage and Hérouard 1896

Loxostomoides applinae (Plummer)
Plate 2, figure 1

Bolivina applini PLUMMER 1926, p. 69, pl. 4, fig. 1

Bolivinoides delicatulus Cushman
Plate 2, figure 4

Bolivinoides decorata (Jones) var. *delicatula* CUSHMAN 1927, p. 90, pl. 12, fig. 8.
Bolivinoides delicatulus Cushman, in: VAN MORKHOVEN ET AL. 1986, p. 337, pl. 110.

Zeauvigerina aegyptiaca Said and Kenawy
Zeauvigerina aegyptiaca SAID and KENAWY 1956, p. 141, pl. 4, fig.1.

Globocassidulina subglobosa (Brady)
Plate 2, figure 10

Cassidulina subglobosa BRADY 1881, p. 60 (not figured).
Globocassidulina subglobosa (Brady) SPEIJER and ZWAAN 1994, p. 150, pl. 3, fig. 5.

Praebulimina reussi (Morrow)
Bulimina reussi MORROW 1934, p. 195, pl. 29, fig. 12.

Siphogenerinoides eleganta (Plummer)
Plate 2, figure 2

Siphogenerinoides eleganta PLUMMER 1927, p. 126, pl. 8, fig. 1.

Bulimina midwayensis Cushman and Parker
Plate 2, figure 11
Bulimina arkadelphiana var. *midwayensis* CUSHMAN and PARKER 1936, p. 42, pl. 7, figs. 9-10.

Bulimina gr. trigonalis ten Dam
Plate 2, figure 12

Bulimina trigonalis TEN DAM 1944, p. 112, pl. 3, figs. 16-17.

Globobulimina (?) suteri (Cushman and Renz)
Bulimina (*Desinobulimina*) *suteri* CUSHMAN and RENZ 1946, p. 38, pl. 6, fig. 15.
Globobulimina (?) *suteri* (Cushman and Renz) BOLLI et al. 1994, p. 137, fig. 36. 34-36.

Buliminella grata Parker and Bermúdez
Buliminella grata PARKER and BERMÚDEZ 1937, p. 515, pl. 59, fig. 6.

Coryphostoma midwayensis (Cushman)
Plate 2, figure 3

Bolivina midwayensis CUSHMAN 1936, p. 50, pl. 7, fig. 12.

Ellipsoglandulina chilostoma (Rzehak)
Glandulina laevigata d'Orbigny var. *chilostoma* RZEHAK 1895, p. 19, pl. 7, fig. 6.

Ellipsoidella kugleri (Cushman and Renz)
Plate 2, figure 5

Nodosarella kugleri CUSHMAN and RENZ 1946, p.42, pl.6, figs. 30,33.
Ellipsoidella kugleri (Cushman and Renz) BOLLI et al.1994, p.140, fig.37, 29-33.

Pleurostmella naranjoensis Cushman and Bermudez,
Pleurostmella naranjoensis CUSHMAN and BERMÚDEZ 1937, p. 16, pl. 1, figs. 59-60.

Pleurostomella paleocenica Cushman
Pleurostomella paleocenica CUSHMAN 1947, p. 86, pl. 18, figs. 14, 15.

Stilostomella midwayensis (Cushman and Todd)
Plate 2, figure 6

Nodosaria spinulosa PLUMMER (not Nautilus spinulosa Montagu) 1927, p. 84, pl. 4, fig. 19.
Ellipsonodosaria midwayensis CUSHMAN and TODD 1946, p. 61, pl. 10, fig. 25.
Stilostomella midwayensis (Cushman and Todd) BERGGREN and AUBERT 1975, pl. 9, fig. 8; pl. 10, fig. 5.

Stilostomella paleocenica (Cushman and Todd)
Ellipsonodosaria paleocenica CUSHMAN and TODD 1946, p. 61, pl. 10, fig. 26.
Stilostomella paleocenica (Cushman and Todd) HILTERMANN 1972, p. 349, pl. 2, figs. 17,18.- BERGGREN and AUBERT 1975, pl. 2, fig. 2.

Rotamorphina cushmani Finlay
Plate 2, figure 13

Rotamorphina cushmani FINLAY 1939, p. 325, pl. 28, figs. 130-133.

Valvulineria aegyptiaca Le Roy
Valvulineria aegyptiaca LE ROY 1953, p. 53, pl. 9, figs. 21-23.

Valvulineria scrobiculata (Schwager)
Plate 2, figure 14

Anomalina scrobiculata SCHWAGER 1883, p. 129, pl. 29, fig. 18.
Valvulineria scrobiculata (Schwager) NAKKADY 1959, p. 460, pl. 2, fig. 5.- SPEIJER and ZWAAN 1994, p. 112, pl. 4, figs. 1-3.

Eponides lotus (Schwager)
Pulvinulina lota SCHWAGER 1883, p. 132, pl. 28, fig. 9.
Eponides lotus (Schwager) CUSHMAN 1932, p. 71, pl. 9, fig. 8.

Eponides lunatus Brotzen
Eponides lunatus BROTZEN 1948, p. 77, pl. 10, figs. 17-18. - LE ROY 1953, p. 30, pl. 9, figs. 24-26.

Eponides mariei Said and Kenawy
Eponides mariei SAID and KENAWY 1956, p. 148, pl. 5, fig. 2.

Eponides megastoma (Grzybowski)
Pulvinulina megastoma GRZYBOWSKI 1896, p. 303, pl. 11, fig. 9.
Eponides megastoma (Grzybowski) AUBERT and BERGGREN 1976, p. 426, pl. 7, fig. 3.

Eponides plummerae Cushman
Plate 2, figure 15

Eponides plummerae CUSHMAN 1948, p. 44, pl. 8, fig. 9.

Cibicidoides alleni (Plummer)
Plate 2, figure 16

Truncatulina alleni PLUMMER 1927, p. 144, pl. 10, fig. 4.
Cibicidoides alleni (Plummer) AUBERT and BERGGREN 1976, p. 431, pl. 10, fig. 2.

Cibicidoides dayi (White)
Planulina dayi WHITE 1928, p. 300, pl. 41, fig. 3.
Cibicidoides dayi (White) HILLEBRANDT 1962, p. 113, pl. 10, figs. 1-3.

Cibicidoides hyphalus (Fisher)
Cibicidoides hyphalus FISHER 1969, p. 197, pl. 3.
Cibicidoides hyphalus (Fisher) VAN MORKHOVEN et al. 1986, p. 359, pl. 116.

Cibicidoides pseudoacutus (Nakkady)
Plate 2, figure 17

Anomalina pseudoacuta NAKKADY 1950, p. 691, pl. 90, figs. 29-32.

Cibicidoides succedens (Brotzen)
Cibicides succedens BROTZEN 1948, p.80, pl. 12, figs. 1,2; textfig. 21.- HULSBOS et al. 1989, p. 270, pl. 2, figs. 5,6.

Cibicidoides susanaensis (Browning)
Plate 3, figure 1

Cibicidoides susanaensis (Browning) AUBERT and BERGGREN 1976, p. 432, pl. 11, fig. 2.

Parrella desertorum Le Roy
Parrella desertorum LE ROY 1953, p. 43, pl. 3, figs. 17-19.

Nuttallides truempyi (Nuttall)
Plate 3, figure 2

Eponides truempyi NUTTALL 1930, p. 287, pl. 24, figs. 9, 13, 14.
Nuttallides truempyi (Nuttall) VAN MORKHOVEN et al. 1986, p. 288, pl. 96.

Pullenia angusta Cushman and Todd
Pullenia quinqueloba (Reuss) var. *angusta* CUSHMAN and TODD 1943, p. 10, pl. 2, figs. 3,4.
Pullenia angusta CUSHMAN and TODD, in: Bolli et al. 1994, p.151, fig.41.21-22.

Pullenia coryelli White
Plate 3, figure 5

Pullenia coryelli WHITE 1929, p. 56, pl. 5, fig. 22.- CUSHMAN and RENZ 1946, p. 47, pl. 7, fig. 9.

Pullenia eocenica Cushman and Siegfus
Pullenia eocenica CUSHMAN and SIEGFUS 1939, p. 31, pl. 7, fig.1.

Pullenia quinqueloba (Reuss)
Nonionina quinqueloba REUSS 1851, p. 71, pl. 5, fig. 31.
Pullenia quinqueloba (Reuss) PLUMMER 1927, p. 136, pl. 8, fig.12.- JENKINS and MURRAY 1981, p. 258, pl. 8,9, figs. 3, 4.

Chilostomelloides eocaenica Cushman
Plate 3, figure 4

Chilostomelloides eocaenica CUSHMAN 1926, p. 78, pl. 11, fig. 20.- AUBERT and BERGGREN 1976, p. 427, pl. 7, fig. 11.

Globimorphina trochoides (Reuss)
Plate 3, figure 3

Globigerina trochoides REUSS 1845, p. 36, pl. 12, fig. 22.
Globimorphina trochoides (Reuss) CUSHMAN and JARVIS 1932, p. 49, pl. 5, fig. 3.
Globimorphina trochoides (Reuss) BOLLI et al.1994, p. 153, fig. 42. 6-7.

Alabamina midwayensis Brotzen
Plate 3, figure 6

Alabamina midwayensis BROTZEN 1948, p. 99, pl.16, figs. 1, 2.- AUBERT and BERGGREN 1976, p.428, pl.8, fig. 3.

Alabamina obtusa (Burrows and Holland)
Pulvinula exigua (Brady) var. *obtusa* BURROWS and HOLLAND 1897, p. 49, pl 2, fig. 25.
Alabamina obtusa (Burrows and Holland) AUBERT and BERGGREN 1976, p. 429, pl. 8, fig. 4.

Alabamina wilcoxensis Toulmin
Alabamina wilcoxensis TOULMIN 1941, p.603, pl.81, figs.10-14; text-figs.4 a-c.

Valvalabamina planulata (Cushman and Renz)
Gyroidina planulata CUSHMAN and RENZ 1941, p.23, pl. 4, fig. 1.
Valvalabamina planulata (Cushman and Renz) SPEIJER and ZWAAN 1994, p. 160, pl. 7, fig. 3.

Osangularia expansa (Toulmin)
Parrella expansa TOULMIN 1941, p. 604, textfig. 3, p. 605, textfigs. 4f, 4g.

Osangularia plummerae Brotzen
Plate 3, figure 7

Osangularia plummerae BROTZEN 1940, p. 30, text-fig. 8.- BERGGREN and AUBERT 1975, p. 147, pl. 3, fig. 6a-g; pl. 9, fig. 2; pl. 10, fig. 4; pl. 13, fig. 11; pl. 14, fig. 10; pl. 17, fig. 6; pl. 18, fig. 3.- SCHNITKER 1979, p. 382, pl. 8, figs. 13-15.

Anomalinoides acuta (Plummer)
Plate 3, figure 8

Anomalina ammonoides (Reuss) var. *acuta* PLUMMER 1927, p. 149, pl. 10, fig. 2.
Anomalinoides acuta (Plummer) BERGGREN and AUBERT 1975, p.149, pl. 5, fig. 4 a-d; pl. 8, figs. 3 a,b; pl. 9, fig. 1; pl. 12, fig. 5; pl. 13, fig. 8; pl. 17, fig. 5; pl. 18, fig. 2; pl. 19, fig. 2.

Anomalinoides midwayensis (Plummer)
Truncatulina midwayensis PLUMMER 1927, p. 141, pl. 9, fig. 7.
Anomalinoides midwayensis (Plummer) AUBERT and BERGGREN 1976, p.430, pl. 9, fig. 3.

Anomalinoides praeacuta (Vasilenko)
Anomalina praeacuta VASILENKO 1950, p. 208, pl. 5, figss. 2, 3.

Anomalinoides praespissiformis (Cushman and Bermúdez)
Anomalinoides praespissiformis (Cushman and Bermúdez) BERGGREN and AUBERT 1975, p. 150-151.

Anomalinoides welleri (Plummer)
Plate 3, figure 9

Truncatulina welleri PLUMMER 1926, p.143, pl. 9, fig. 6.
Anomalinoides welleri (Plummer) BOLLI et al. 1994, p. 158, fig. 44. 23-25.

Gyroidinoides depressus (Alth)
Rotalina depressa ALTH 1850, p. 266, pl. 13, fig. 21.
Gyroidinoides depressa (Alth) CUSHMAN and JARVIS 1932, p. 46, pl. 14, fig.1.- CUSHMAN and RENZ 1946, p. 44, pl. 7, figs. 16,17.- SAID and KENAWY 1956, p. 149, pl. 5, fig. 11.
Gyroidinoides depressus (Alth) BOLLI et al. 1994, p. 159, fig. 44. 29-30, 32-34.

Gyroidinoides girardanus (Reuss)
Rotalina girardana REUSS 1851, p. 73, pl. 5, fig. 34.
Gyroidina girardana (Reuss) LE ROY 1953, p. 35, pl.5, figs. 10-12.- SAID and KENAWY 1956, p. 148, pl. 5, fig. 7.
Gyroidinoides girardanus (Reuss) LUGER 1985, p. 110, pl. 8, figs. 2, 3.- ANAN and HEWAIDY 1986, p. 21, pl. 3, fig. 10.

Gyroidinoides globosus (Hagenow)
Nonionina globosa HAGENOW 1842, p. 574.
Gyroidina globosa (Hagenow) CUSHMAN and JARVIS 1932, p. 47, pl. 14, figs.3, 4.- CUSHMAN and RENZ 1946, p. 44, pl. 7, fig. 15.- SAID and KENAWY 1956, p. 149, pl. 5, fig. 5.
Gyroidinoides globosus (Hagenow) BOLLI et al. 1994, p.159, fig. 45. 1-3.

Gyroidinoides subangulata (Plummer)
Plate 3, figure 10

Rotalina soldani d' Orbigny var. *subangulata* PLUMMER 1926, p. 154, pl. 12, fig. 1.
Gyroidina subangulata (Plummer) LE ROY 1953, p. 35, pl. 3, figs. 23-25.- SAID and KENAWY 1956, p. 149, pl. 5, fig. 9.
Gyroidinoides subangulata (Plummer) BERGGREN and AUBERT 1975, p. 148, pl. 3, fig. 2.

Angulogavelinella avnimelechi (Reiss)
Plate 3, figure 11

Pseudovalvulineria avnimelechi REISS 1952, p. 269, text-fig. 2.
Angulogavelinella avnimelechi (Reiss) AUBERT and BERGGREN 1976, p.431, pl. 10, fig. 1.- LUGER 1985, p. 111, pl. 8, figs. 8, 9.- VAN MORKHOVEN et al. 1986, p. 344, pl. 112.

Gavelinella beccariiformis (White)
Plate 3, figure 12

Rotalia beccariiformis WHITE 1928, p. 287, pl. 39, figs. 2- 4.
Anomalina beccariiformis (White) CUSHMAN and RENZ 1946, p. 48, pl. 8, figs. 21, 22.
Gavelinella beccariiformis (White) AUBERT and BERGGREN 1976, p. 431, pl. 10, fig. 1- TJALSMA and LOHMANN 1983, p. 12, pl. 6, figs. 1-3.- THOMAS 1990, p. 590, pl. 3, fig. 5.- BOLLI et al. 1994, p. 161, fig. 46. 4-6.

Gavelinella danica (Brotzen)
Plate 3, figures 13-14

Anomalinoides danica BROTZEN 1948, p. 87, pl. 14, figs. 1-3.
Gavelinella danica (Brotzen) BERGGREN and AUBERT 1975, p. 155-156, pl. 6, fig. 3; pl. 11, fig. 1; pl. 13, fig. 1; pl. 14, fig. 4; pl. 17, fig. 7; pl. 19, fig. 4.

Gavelinella lellingensis (Brotzen)
Gavelinella lellingensis BROTZEN 1948, p. 75, pl. 11, figs. 1, 2, text-fig. 20.- AUBERT and BERGGREN 1976, p. 433, pl.12, fig. 2.

Gavelinella rubiginosa (Cushman)
Plate 3, figures 15-16

Anomalina rubiginosa CUSHMAN 1926, p. 607, pl. 21, fig. 6.
Gavelinella rubiginosa (Cushman) AUBERT and BERGGREN 1976, p. 433, pl. 12, fig. 9.- LUGER 1985, p. 112, pl. 9, fig. 6.

Hanzawaia gr. ammophila (Gümbel)
Rotalia ammophila GÜMBEL 1868, p. 652, pl. 2, fig. 90.
Hanzawaia ammophila (Gümbel) VAN MORKHOVEN et al.1986, p. 168-171, pl. 56.