

# The new genus *Bolivilongella* (Family Bolivinoididae) from the Miocene of the Mango-2 well, Mediterranean Sea, Egypt

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**ABSTRACT:** A new genus, *Bolivilongella* n.gen, and two new species belonging to the family Bolivinoididae are described from the Miocene of the Mango-2 well, Mediterranean Sea, Egypt. A comparison is made between other genera such as *Bolivina*, *Bolivinoides*, *Bolivinella* and *Bolivinita* that display some degree of similarity. Based on the specific characters, two new species: *Bolivilongella longata* n.sp. of Langhian age, and *Bolivilongella semilongata* n.sp. of Burdigalian age are here described.

**Keywords:** Foraminifera, Taxonomy, new taxa, Miocene, Egypt.

## INTRODUCTION

The Nile Delta of Egypt is considered one of the most important deltas in the world due to its hydrocarbon potential (Sestini 1995; Selim et al. 2022). There are some offshore discoveries in the Oligocene–Miocene successions of the Mediterranean Sea. These successions contain huge numbers of planktonic and benthic foraminifera in most wells producing gas. The planktonic foraminifera have been studied by Kotb et al. (2024) and are used to subdivide the sequence into several biozones. Planktonic foraminifera are found in a large proportion, which may sometimes exceed the proportion of benthic foraminifera. Furthermore, benthic foraminifera were also studied by a number of authors (Papp and Schmid 1864; Souaya, 1965, 1966; Bolli et al. 1994; Ismail and Abdelghany 1999; Abul-Nasr and Salama 1999; Ismail et al. 2010; Hayward et al. 2012, Ismail 2012; Sallam 2013; Sanchez et al. 2014; Roozpeykar and Moghaddam 2016). In the present study, we found some benthic foraminifera that do not resemble any species recorded in the previous studies either on a local level in Egypt or on a regional level in the world. Accordingly, we reviewed the treatise of Loeblich and Tappan (1987), in order to find species that have similar features. Unfortunately, we did not find forms that have the same features as our specimens, but we note that some genera (*Bolivina*, *Bolivinoides*, *Bolivinella* and *Bolivinita*) have similar morphology to our material. Therefore, we propose a new genus (*Bolivilongella*) and new two species (*Bolivilongella longata* and *Bolivilongella semilongata*) based on the comparison of the generic features between the referred genera and the new one.

## MATERIAL AND METHODS

The current study is based on the examination of twenty-two (22) ditch cutting samples selected from the Mango-2 well, covering the interval from 1851 m to 2040 m (Oligocene–Miocene). This well is an exploratory well drilled by Total Proche Orient (T.P.O) and lies at a latitude of 31°32'36.60"N and a

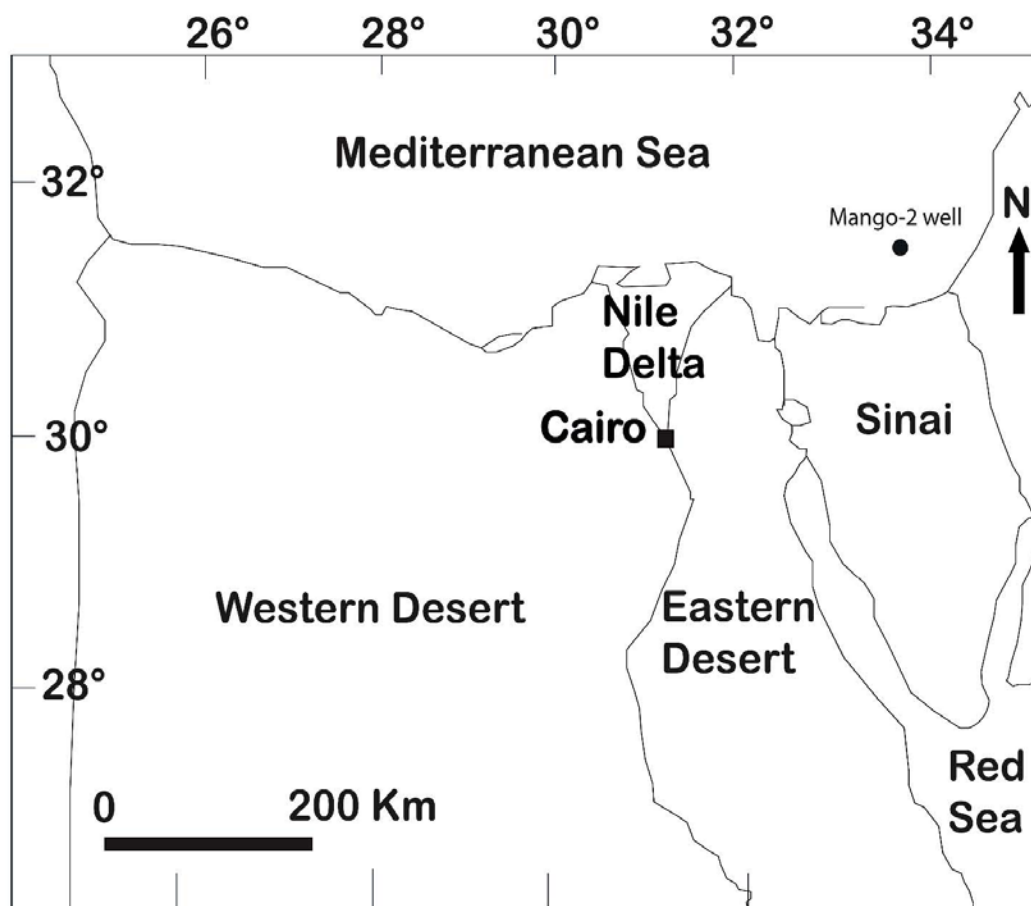
longitude of 33°39'21.70"E (text-fig. 1). The exploration well penetrated Quaternary sediments, Cenozoic rocks, a thin Upper Cretaceous interval, Lower Cretaceous Albian rocks, Upper Jurassic rocks, and bottomed at a depth of 4655 m in the Lower Jurassic.

The foraminiferal species (either planktonic or benthic) were extracted by soaking samples in distilled hot water with sodium bicarbonate and few drops of H<sub>2</sub>O<sub>2</sub>, which was gently agitated for 20 to 30 minutes and then washed through a sieve (a stainless-steel U.S. Standard Sieve with mesh openings of 63 µm). This process effectively removes persistent clay-sized particles or any residue. A stereomicroscope with a 100× lens (sum of oculars and objectives) was used to examine the residue for foraminifera. The identified microfossils were picked and placed into separate slides to be photographed using a JEOL JSM-6010 LA Scanning Electron Microscope.

The types of the identified genus and species were deposited in Ismail's collection (under the numbers Mango benth 1 to Mango benth 7) in the Geological Museum of the Geology Department, Faculty of Science, Ain Shams University, Abbassia, 1566, Cairo, Egypt.

## LITHOSTRATIGRAPHY

The studied Oligocene–Miocene succession is subdivided into three rock units: Sidi Salem, Qantara and Tineh (text-fig. 2). The Sidi Salem Formation was firstly described by Rizzini et al. (1976) and overlies the Qantara Formation. It consists of grey, brownish grey, reddish brown highly fossiliferous shale and mudstone, with a depth ranges from 1851 to 1860 m (9 m thick). This interval was represented by four samples with abundant foraminiferal content, especially planktonic species that played a great role in establishing the Langhian age (Kotb et al. 2024). The Qantara Formation was described by El Heiny and Morsi (1992) and has a wide areal distribution in the off-



TEXT-FIGURE 1  
Location map showing the studied well.

shore area of the north Nile Delta. This formation overlies the Tineh Formation and underlies the Sidi Salem Formation. It is characterized by brownish grey, reddish brown blocky highly fossiliferous shales. It extends from 1860–1932 m with a total thickness of 72 m in the studied well. This formation was represented by seven samples and has been assigned a Burdigalian–Langhian age, based on the abundant planktonic foraminifera (Kotb et al. 2024). The Tineh Formation was introduced by Rossi et al. (1983) and is composed of gray, dark gray, black, greenish gray, and brownish gray highly fossiliferous mudstone with traces of white amorphous anhydrite. The Tineh Formation occurs between 1932 and 2040 m with a total thickness of 108 m. This interval is represented by eleven samples with abundant foraminiferal content, especially planktonic species that assign it a Rupelian–Burdigalian age.

#### TAXONOMIC DISCUSSION

There are four genera; *Bolivina*, *Bolivinella*, *Bolivinita* and *Bolivinoides* (Plate 1) that are similar in some characters but differ from the new genus in some essential details (Table 1). *Bolivilongella* and *Bolivinoides* have rhomboidal outlines but in the former, the surface of the test is completely covered by continuous undulating longitudinal costae, while in the latter, with strong tubercles and longitudinal costae that may bifurcate distally. Therefore, the new genus is placed in the family *Bolivinoidea* because it possesses a surface with heavy longitudinal costae. On the other hand, the outline of the oth-

er genera ranges from elongate, ovoid to triangular in *Bolivina*, to compressed, flabelliform to subquadrate in *Bolivinella* and elongate, cuneiform in *Bolivinita*. Also, the chambers of all mentioned genera are biserial except in *Bolivilongella* and are completely obscured by surface ornamentation. The new genus *Bolivilongella* is characterized by continuous undulating longitudinal costae, but the surface in *Bolivinita* is smooth and slightly nodose, while in *Bolivina* it is ornamented by irregularly anastomosing imperforate costae and in *Bolivinella* the longitudinal costae are broken up into nodes and become paired along the median line of the test. Specimens of the new genus were recorded in two samples from the Mango-2 well; at depths of 1881 m and 1902 m with specific differences between them (text-fig. 2). This led us to propose two new species of the new genus: *Bolivilongella longata* and *Bolivilongella semilongata*.

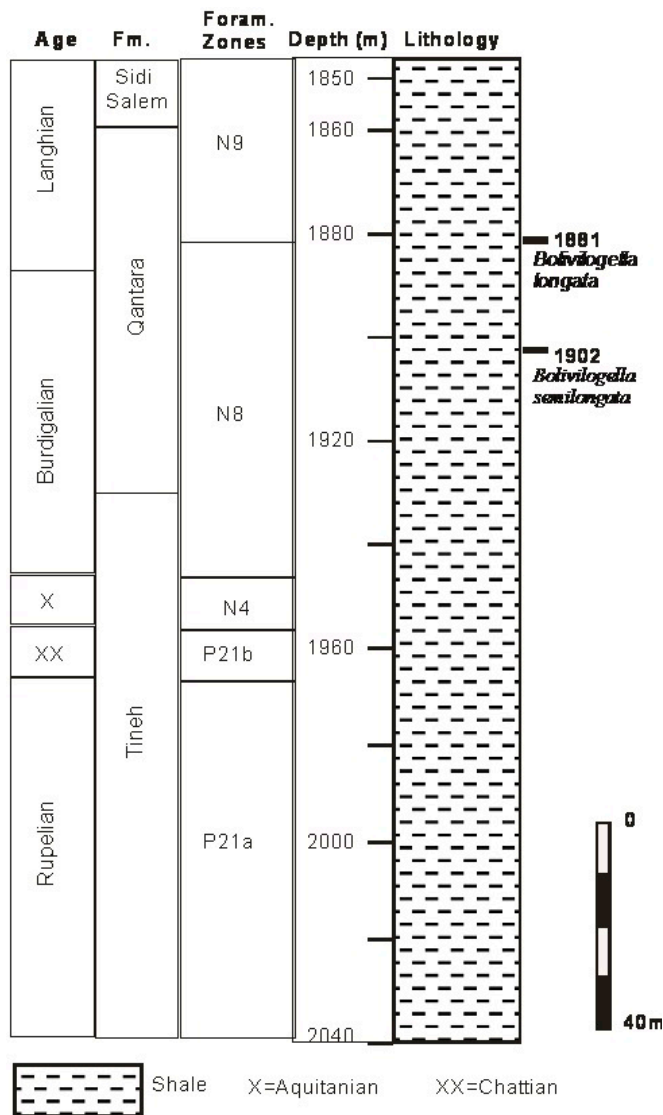
Family BOLIVINOIDIDAE Loeblich and Tappan 1984

Genus *Bolivilongella* Ismail, Boukhary, Sharabi and Kotb, n. gen.

*Type species: Bolivilongella longata* Ismail, Boukhary, Sharabi and Kotb, n. gen, n. sp.

Plate 1, fig. 5.

*Etymology (Derivation of name):* the first part of the name *Bolivi-* is due to the similarity with the genus *Bolivinoides* in outline and the second part *-longella* is due to the character of



TEXT-FIGURE 2  
The stratigraphic column of Mango-2 well.

continuous undulated longitudinal costae.

*Type locality:* Mango-2 well, depth 1881 m.

*Type level:* Qantara Formation, Miocene.

*Diagnosis:* It is characterized by continuous undulated longitudinal costae.

*Description:* Test rhomboidal in outline, flaring, laterally compressed with a raised central part. Chambers are broad and completely covered by ornamentation, initially biserial becoming loosely biserial in the younger stage. Sutures are commonly obscured by the surface ornamentation. Surface is ornamented by with continuous undulated longitudinal costae without intermission. Aperture is an elongate narrow areal opening.

*Range and occurrence:* It is found at depths 1881 m and 1902 m, in the Qantara Formation of Burdigalian – Langhian of Mango-2 well.

There are two species were identified in the present material:

***Bolivilongella longata*** Ismail, Boukhary, Sharabi and Kotb, n. gen. n. sp.  
Plate 1, fig. 5.

*Etymology (Derivation of name):* The undulated longitudinal costae occupy most of the test.

*Holotype:* Plate 1, fig. 5. (Repository number, Mango benth 1).

*Paratypes:* 2 specimens. (Repository numbers, Mango benth 2-3).

*Type locality:* Mango-2 well, depth 1881 m.

*Type level:* Qantara Formation, middle Miocene (Langhian).

*Diagnosis:* It is characterized by thicker continuous undulated longitudinal costae and the uppermost part of the test is covered by wide condensed pores.

*Description:* Test rhomboidal in outline, flaring, laterally compressed with a raised central part. Chambers are broad and completely covered by ornamentation, initially biserial becoming loosely biserial in the younger stage. Sutures are commonly obscured by the surface ornamentation. The longitudinal costae extend mostly all over the test except the uppermost part of the test is covered by wide condensed pores. Aperture is an elongate narrow areal opening. Also, the longitudinal costae tend to be thicker than that in *B. semilongata*.

*Range and occurrence:* It is found at depth 1881 m, in the Qantara Formation of middle Miocene (Langhian) age in the Mango-2 well.

***Bolivilongella semilongata*** Ismail, Boukhary, Sharabi and Kotb, n. gen. n. sp.  
Plate 1, fig. 6.

*Etymology (Derivation of name):* The undulated longitudinal costae are shorter than that in *B. longata*.

*Holotype:* Plate 1, fig. 6. (Repository number, Mango benth 4).

*Paratypes:* 3 specimens. (Repository numbers, Mango benth 5-7).

*Type locality:* Mango-2 well, depth 1902 m.

*Type level:* Qantara Formation, early Miocene (Burdigalian).

*Diagnosis:* It is characterized by finer continuous undulated longitudinal costae with the upper third of the test is covered by fine pores.

*Description:* Test rhomboidal in outline, flaring, laterally compressed with a raised central part. Chambers are broad and completely covered by ornamentation, initially biserial becoming loosely biserial in the younger stage. Sutures are commonly obscured by the surface ornamentation. The longitudinal costae occupy the lower two-thirds of the test and the upper third is covered by fine pores. Also, the longitudinal costae tend to be finer than that in *B. longata*. Aperture is an elongate narrow areal opening.

TABLE 1

A comparison of new genus *Bolivilongella* with other related genera.

Genus Character	<i>Bolivilongella</i>	<i>Bolivina</i>	<i>Bolivinoides</i>	<i>Bolivinella</i>	<i>Bolivinita</i>
<b>Test</b>	rhomboidal in outline, flaring, laterally compressed with a raised central part.	elongate, ovoid to triangular in outline, somewhat compressed,	Large, robust, rhomboidal in outline, flaring, laterally compressed	compressed, flabelliform to subquadrate in outline, biserial throughout, globular	elongate, cuneiform in outline, compressed, sides flat, margins truncate.
<b>Chambers</b>	broad and completely covered by ornamentation, initially biserial becoming loosely biserial in the younger stage.	chambers broad and low, biserial throughout,	biserial chambers, broad and low, increasing rapidly in breadth as added	small early chambers, later ones increasing rapidly in breadth.	biserial chambers of somewhat greater breadth than height.
<b>Sutures</b>	commonly obscured by the surface ornamentation	septa flush to slightly depressed	sutures oblique, slightly depressed, commonly obscured by the surface ornamentation	sutures thickened and limbate, later ones strongly recurved laterally	sutures oblique, flush on the flat sides, slightly indented on the margins
<b>Ornament</b>	surface with continuous undulated longitudinal costae without intermission	surface ornamented - with irregularly anastomosing imperforate costae, or costae may have an occasional pore	surface with strong tubercles and longitudinal costae that may bifurcate distally	surface ornamented by the nonperforate limbate sutures that may be broken up into nodes, with paired longitudinal costae.	surface smooth, slightly nodose or with a few short longitudinal ribs in the early stage.
<b>Aperture</b>	an elongate narrow areal opening	a narrow loop at the base of the apertural face, bordered by a thickened and imperforate rim on one margin	an elongate narrow opening, basal in the early stage and areal in later chambers with smooth border.	aperture cribrate, consisting of four to ten tiny openings near the base of the apertural face.	basal, elliptical extending up the apertural face one margin bending inward to form a folded tooth plate.
<b>Age</b>	Miocene	U. Cretaceous (Maastrichtian) to Holocene	U. Cretaceous (U. Santonian) to Paleocene	Eocene to Holocene	M. Miocene to Holocene

**Range and occurrence:** It is found at a depth of 1902 m, in the Qantara Formation of early Miocene (Burdigalian) age in the Mango-2 well.

## CONCLUSIONS

A survey of benthic foraminiferal literature revealed that a new genus *Bolivilongella* (family Bolivinoididae) was recovered from Miocene samples of the Mango-2 well, Mediterranean Sea, Egypt. A taxonomic comparison was made between the new genus *Bolivilongella* and the other related genera; *Bolivina*, *Bolivinella*, *Bolivinita* and *Bolivinoides*, which show some similarity with the new one. The new genus is placed in the family Bolivinoididae because its surface is covered with heavy longitudinal costae. The main characteristic features of *Bolivilongella* (Burdigalian – Langhian) are the ornamentation with continuous undulating longitudinal costae without intermission and rhomboidal outline, flaring, laterally compressed test with a raised central part. Also, the specific characters of the individuals led us to propose two new species: *Bolivilongella longata* n.sp. (Langhian) with thicker undulated longitudinal costae and *Bolivilongella semilongata* n.sp. (Burdigalian) with finer and shorter undulated longitudinal costae.

## ACKNOWLEDGMENTS

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## REFERENCES

- ABD-ALLAH, M. A., MOUSTAFA, A. R. and HASHEM, W. A., 2004. Structural characteristics and analysis of the Gebel El Halal Fold, Northeast Sinai, Egypt. *Earth Sci. Ser., Middle East Research Centre, Ain Shams University, Sciences Research Series*, 18: 1–26.
- ABUL-NASR, R. A. and SALAMA, G. R., 1999. Paleogeology and depositional environments of the Miocene rocks in western Sinai, Egypt. *Middle East Research Centre, Ain Shams University, Sciences Research Series*, 13: 92–134.
- BOLLI, H. M., BECKMANN, J.-P. and SAUNDERS, J. B., 1994. Benthic foraminiferal biostratigraphy of the south Caribbean region. Cambridge: Cambridge University Press, 408 pp.
- EL-HEINY, I. and MORSI, S., 1992. Stratigraphic correlation of Neogene sediments in the eastern Nile Delta and Gulf of Suez, Egypt. In: *Egyptian General Petroleum Company 11th Exploration and Production Conference*, 1: 166–163.
- HAYWARD, B. W., KAWAGATA, S., SABAA, A. T., GRENFELL, H. R., VAN KERCKHOVEN, L., JOHNSON, K. and THOMAS, E., 2012. The Last Global Extinction (Mid-Pleistocene) of Deep-Sea Benthic Foraminifera (Chrysalogoniidae, Ellipsoidalidae, Glandulodosariidae, Plectofrondiculariidae, Pleurostomellidae, Stilostomellidae), their Late Cretaceous-Cenozoic History and Taxonomy. *Cushman Foundation for Foraminiferal Research Special Publication*, 43: 408 pp.
- ISMAIL, A. A., 1984. Quantitative well logging analysis on some subsurface Successions in the Nile Delta area. *M. SC. Thesis, Geology Department, Faculty of Science, Ain Shams University, Cairo*,





# PLATE 1

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| <p>1 <i>Genus Bolivina</i>, d'Orbigny 1839 (type species <i>Bolivina plicata</i>), from Loeblich &amp; Tappan, 1988, p. 498, pl. 547, fig. 1.</p> <p>2 <i>Genus Bolivinoides</i> Cushman 1927, from Loeblich &amp; Tappan, 1988, p. 500, pl. 551, fig. 9.</p> <p>3 <i>Genus Bolivinella</i> Cushman 1927, from Loeblich &amp; Tappan, 1988, p. 501, pl. 553, fig. 1.</p> | <p>4 <i>Genus Bolivinita</i> Cushman 1927, from Loeblich &amp; Tappan, 1988, p. 503, pl. 554, fig. 6.</p> <p>5 <i>Bolivilongella longata</i> holotype, Ismail, Boukhary, Sharabi and Kotb, n. gen. n. sp. side view, sample no. 1881, Qantara Formation, Langhian.</p> <p>6 <i>Bolivilongella semilongata</i> Ismail, Boukhary, Sharabi and Kotb, n. gen. n. sp., side view, sample no. 1902, Qantara Formation, Burdigalian.</p> |
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Egypt, 214 pp.

- , 2012. Late Cretaceous-Early Eocene benthic foraminifera from Esh El Mallaha area, Egypt. *Revue de Paléobiologie*, 31 (1): 15–50.
- ISMAIL, A.A. and ABDELGHANY, O., 1999. Lower Miocene foraminifera from some exposures in the Cairo-Suez district, Eastern Desert, Egypt. *Journal of African Earth Sciences*, 28 (3): 507–526.
- ISMAIL, A.A., BOUKHARY, M., ABDEL NABY, A. I., 2010. Subsurface stratigraphy and micropaleontology of North Abu Qir area, Nile Delta, Egypt. *Geologia Croatica*, 63 (1): 1–26.
- KOTB, O., ISMAIL, A. A., BOUKHARY, M. and SHARABI, S., 2024. Oligocene–Middle Miocene biostratigraphy of the Mango-2 well, North El Fayrouz Offshore Field, Mediterranean Sea, Egypt. *Stratigraphy*, 21 (2): 79–100.
- LOEBLICH, A. R. and TAPPAN, H., 1987. *Foraminiferal genera and their classification*. New York: Van Nostrand and Reinhold Co., 970 pp.
- MOUSTAFA, A. R. and KHALIL, M. H., 1989. North Sinai structures and tectonic evolution. *Earth Science Series*, 3: 215–231.
- PAPP, A. and SCHMID, M. E., 1985. The fossil foraminifera of the Tertiary Basin of Vienna. Revision of the monograph by Alcide d'Orbigny (1846). *Abhandlungen der geologischen Bundesanstalt*, 37: 1–311.
- RIZZINI, A., VEZZANI, F. and MILAD, G., 1976. Stratigraphy and sedimentation of Neogene Quaternary section in the Nile Delta area, A. R. E. *Marine Geology*, 27: 327–348.
- ROOZPEYKAR, A. and MOGHADDAM, I. M., 2016. Benthic foraminifera as biostratigraphical and paleoecological indicators: An example from Oligo-Miocene deposits in the SW of Zagros basin, Iran. *Geoscience Frontiers*, 7: 125–140.
- ROSSI, S., AUROUX, C. and MASCLE, J., 1983. The Gulf of Taranto (Southern Italy): Seismic stratigraphy and shallow structure. *Marine Geology*, 51 (3–4): 327–346.
- SALLAM, M., 2013. Benthic foraminifera from the Oligocene offshore Nile Delta, Egypt and its Implications. *Micropaleontology*, 59 (2-3): 167–175.
- SANCHEZ, D., BERGGREN, W. A. and LISKA, R. D., 2014. Lower to Middle Miocene planktonic and benthic foraminifera from the Carapita Formation, Eastern Venezuela Basin and Cipero Formation, Southwestern Trinidad. *Micropaleontology*, 60 (2): 109–174.
- SELIM, S. S., ABDEL-MOATY, H. S. and DARWISH, M., 2022. Sedimentology and reservoir characteristics of delta plain reservoirs: an example from Messinian Abu Madi Formation, Nile Delta. *Marine and Petroleum Geology*, 139: Article 105623.
- SESTINI, G., 1995. Egypt. In: Kulke, H., Ed., *Regional petroleum geology of the world, part II: Africa, America, Australia and Antarctica*. Beiträge zur regionalen Geologie der Erde, Band 22: Stuttgart: Gebrüder Bornträger Verlagsbuchhandlung, 66–87.
- SOUAYA, F. J., 1965. Miocene foraminifera of the Gulf of Suez region, U.A.R. – Part 1 Systematics (Astrohizoidae-Buliminoidae). *Micropaleontology*, 11 (3): 301–334.
- , 1966. Miocene foraminifera of the Gulf of Suez region, U.A.R. - Part 2 (Rotalioidea). *Micropaleontology*, 12 (1): 34–64.
- YOUSEF, M., MOUSTAFA, A. R. and SHANN, M., 2010. Structural setting and tectonic evolution of offshore North Sinai, Egypt. *Geological Society, London, Special Publications*, 341: 65–84.