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RESEARCH ARTICLE

Preliminary results from the Finike Seamounts foraminifer assemblages, Eastern Mediterranean Sea

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Abstract

The Finike Seamounts, located in the Eastern Mediterranean Sea, are a Special Environmental Protection Area and offer new information on the foraminifers. In this study, two surface samples from two stations located at 1800m and 2200 m water depth were studied for their foraminifer assemblages. Although abundant in planktic foraminifers, the Finike Seamounts display a very poor, small in size but diverse benthic foraminifer assemblage as a common feature encountered in seamount ecosystems. In total 22 planktic foraminifer species belonging to one suborder, two superfamilies, four families, and 13 genera were identified. Among these identified species, interestingly, any keeled globorotalid forms were not encountered. Regarding benthic foraminifers, in total 38 species belonging to six suborders, 15 superfamilies, 23 families, and 27 genera were identified. The presence of miliolids among benthic foraminifers points to a possible sediment supply from the infralittoral depths.

Keywords: Planktic foraminifers, benthic foraminifers, taxonomy, ecosystem, Eastern Mediterranean Sea, Finike Seamounts

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Introduction

Seamounts are ubiquitous, topographically distinct but, in terms of calcareous microorganisms, understudied seafloor structures and are commonly investigated for their commercial fish communities. Nevertheless, marine calcifiers such as foraminifers, which make part of marine food web, are scarcely studied in such environments (Heinz *et al.* 2004; Stefanoudis *et al.* 2016).

Foraminifers, being a geological archive preserved in the sediments encoding the chemical composition of the ambient seawater in which they calcify, can be important tools to investigate past climate and ecological conditions of the seamounts through their geological evolution (Hamilton 1953; Mel'nikov *et al.* 2007; Coletti *et al.* 2019) and present-day conditions (Heinz *et al.* 2004; Shi *et al.* 2020). These detailed studies on foraminifers help reveal not only the ecological conditions in terms of trophic level, oxygenation, etc. and climate but also sediment transport sources to the depositional environment as benthic foraminifers are used as depth indicators (Murray 2006). While planktic foraminifers serve as food for pelagic communities, benthic foraminifers, making part of meiofauna, play an important role in the benthic food web (Lipps and Valentine 1970; Gooday *et al.* 1992). They also contribute to global carbon cycling (Gooday *et al.* 1992; Fabry *et al.* 2008; Davis *et al.* 2017; Manno *et al.* 2018). During the calcification process, they produce carbon dioxide (CO_2) and export inorganic carbon (Legendre and Le Fevre 1995; Salter *et al.* 2014; Manno *et al.* 2018). Through downward transport of foraminiferal soft tissue thus exporting organic carbon, they contribute biological carbon pump (Meilland *et al.* 2016; Davis *et al.* 2017). Therefore, taxonomic identification of planktic foraminifers to understand surface and subsurface water conditions (i.e. temperature, nutrient) and benthic foraminifer species to document seafloor ecosystems is useful for a better understanding of these submarine features. To this extent, the Finike Seamounts area, located in the Eastern Mediterranean, is one of the least studied seamounts and is among the Special Environmental Protection Areas to protect its pristine habitat (Öztürk *et al.* 2012).

The Finike Seamounts area is a large faulted and tilted block that was formed as a result of complex multiphase tectonics and comprises three seamounts linking the Hellenic Arc and Cyprus: Anaximander, Anaxagoras and Anaximenes (Figure 1) (ten Veen *et al.* 2004). The region is still undergoing a deformation governed by strike-slip faulting and shows affinity with the Florence Rise (Zitter *et al.* 2003). The deepest surrounding basins of the Finike Seamounts are Rhodes Basin (4000 m) in the east (Rhodes Basin) and Finike Basin (3000 m) in the west and the summit of the seamount reaches 1200 m (Yücel *et al.* 2016). Some valuable studies were conducted on the Finike Seamounts, documenting, for example, its benthic features based on Copepoda communities (George *et al.* 2018). It has been of interest for its mud volcano cold seeps and gas hydrate reservoirs for economic purposes (Woodside *et al.* 1998; Lykousis *et al.* 2009; Perissoratis *et al.* 2011).

However, such formations are special chemosynthetic habitats where primary producers thrive and require protection and sustainable management (Taviani 2014). Furthermore, governing Rhodes Gyre forming in the Rhodes Basin (Figure 1) provides very fertile grounds for the organisms that habit in the Finike Seamounts as it drives a constant upwelling carrying nutrient-rich deep waters to the surface unlike other parts of the nutrient-poor Eastern Mediterranean Sea (Salihoğlu *et al.* 1990; van Leeuwen *et al.* 2022).

In terms of foraminifers, although many important studies were conducted from shallower depths of the Turkish seas for modern benthic foraminifer assemblages (e.g., Chendeş *et al.* 2004; Kırcı-Elmas 2013; Meriç *et al.* 2014, 2016, 2017, 2018, 2020; Yalçın *et al.* 2004; Yokeş *et al.* 2014 among others); deeper waters are scarcely studied (Fontanier *et al.* 2018). Planktic foraminifers have been reported only in geological records (e.g., Quaternary – last 2.58 million years) from sediment cores (Kırcı-Elmas 2006; Sakınç 2008; Sakınç and Artüz 2019 among others) or land sections (e.g. Glover 1995; Kanbur and Öğretmen 2022; Öğretmen 2022; Öğretmen *et al.* 2018a, b; Yıldız *et al.* 2003 among others), and recent assemblages have been studied only in the Sea of Marmara (Hakyemez and Toker 1997) and Gulf of Saros (northern Aegean Sea) (Meriç *et al.* 2004). Such studies in the Eastern Mediterranean Sea henceforth the Finike Seamounts are only in their infancy. This work aims at documenting the benthic and planktic foraminifers of the bathyal zone from the recent sediments of the Finike Seamounts, Eastern Mediterranean Sea for the first time. The results of this study present first insights into the benthic and pelagic ecological conditions of the Finike Seamounts based on present planktic and benthic foraminifers in the surface sediments.

Materials and Methods

The samples were collected with a beam trawl from two stations: 1) 1800m (sample BT-2) and 2) 2200m (sample BT-1) of water depth (Figure 1), with R/V Yunus S in September 2021. These deep sediments are characterized by homogeneous, brown-colored clayey mud. Samples were washed through a 63-µm sieve separately with tap water without any prior acid treatment. The residual material was dried in the furnace at 60°C. Foraminifers were handpicked with a brush using a stereomicroscope. Sample preparation and microscope studies were performed at the Eastern Mediterranean Center for Oceanography and Limnology (EMCOL) and Eurasia Institute of Earth Sciences at Istanbul Technical University and Süleyman Demirel University.

A quantitative assessment was not performed due to the low number of samples. However, when possible approximately 300 planktic foraminifer individuals were counted to identify all possible species representing the assemblage (Fatela and Taborda 2002). Such practice was not possible for benthic foraminifers because of very low abundance. Taxonomic identification was performed following Loeblich and Tappan (1988), Kennett and Srinivasan (1983), and Schiebel and

Hemleben (2017) and AGIP (1982), Schweizer *et al.* (2011), Milker and Schmiedl (2012), Holbourn *et al.* (2013), and Meriç *et al.* (2014) for benthic foraminifers. Databases such as WoRMS, www.microtaxa.org and www.foraminifera.eu were utilized for further visual comparison. Scanning electron microscope (SEM) images of the selected species representing the assemblages were taken at the Izmir Institute of Technology and displayed in Figures 3 and 5 for planktic and benthic foraminifers, respectively.

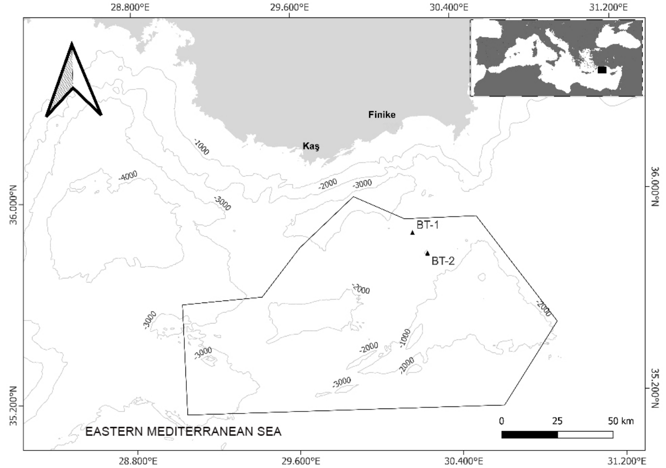

Figure 1. Map showing the location of sampling stations

Results

Besides very well-preserved planktic and benthic organisms, were found pteropods, ostracods, and molluscs in the studied samples (Figure 2). While the planktic organisms (planktic foraminifers and pteropods) were very abundant, benthic fauna was strikingly poor in the samples. In this study, we focused on planktic and benthic foraminifers. In total 22 planktic and 38 benthic foraminifer species were identified and reported below.

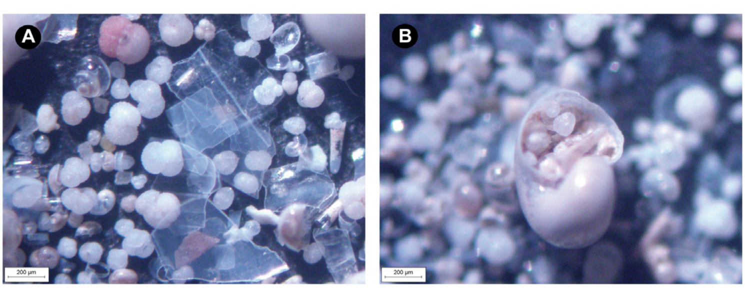

Figure 2. A. General view of raw material (BT-1),
B. A pteropod specimen filled with clay, other smaller organisms and/or their broken pieces.

Systematic taxonomy of planktic foraminifers

Order Foraminiferida d'Orbigny, 1826
Suborder Globigerinina Delage and Hérouard, 1896
Superfamily Globigerinoidea Carpenter *et al.* 1862
Family Globigerinidae Carpenter *et al.* 1862
Genus *Beella* Banner and Blow, 1960
Beella digitata (Brady, 1879)
Figure 3a

Diagnosis: Cancellate wall, medium to high trochospiral; globular to elongate four to five chambers in the last whorl rapidly increasing in size as added; sutures distinct and depressed; wide and deep umbilicus, interiomarginal umbilical-exteriomarginal aperture with a thick lip.

Genus *Globigerina* d'Orbigny, 1826
Globigerina bulloides d'Orbigny, 1826
Figures 3b and 3c

Diagnosis: Small to medium test, smooth wall with spine pedestals, low to medium trochospiral with final spherical-subglobular chambers, increasing uniformly as added; four chambers in the final whorl; distinct, depressed, and radial sutures; deep wide umbilicus, umbilical aperture.

Comments: *Globigerina bulloides* forma *cariacoensis* (Figure 3c) (synonym: *Globigerina megastoma cariacoensis* Rögl and Bolli, 1973*)* was categorized as a morphological variant of *G. bulloides* (Brummer and Kučera 2022).

Globigerina falconensis Blow, 1959
Figure 3d

Diagnosis: Medium test, wall cancellate; low trochospiral, slightly compressed; four chambers in the final whorl, chambers increasing slowly in size as added; four chamber in the final whorl; final chamber slightly smaller than the penultimate; radial, depressed sutures; small but deep umbilicus, umbilical, interiomarginal aperture.

Genus *Globigerinella* Cushman 1927
Globigerinella calida (Parker, 1962)
Figures 3e and 3f

Diagnosis: Wall cancellate, low trochospiral; globular to slightly radially ovate chambers, rapidly increasing in size as added; four to five chamber in the final whorl; sutures strongly depressed; umbilical wide and deep; aperture extraumbilical-peripheral.

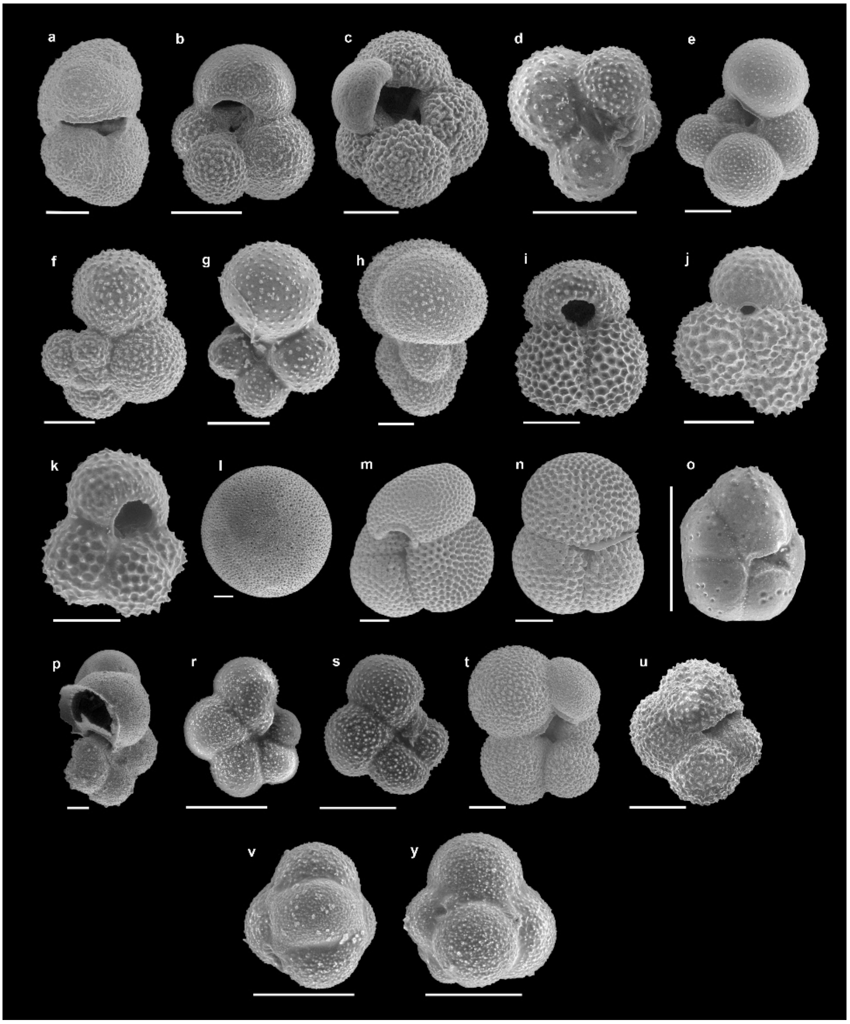

Figure 3. SEM images of planktic foraminifer species of the Finike Seamounts. **a.** *B. digitata*, umbilical view (BT-2). **b.** *G. bulloides*, umbilical view (BT-1). **c.** *G. bulloides* forma *cariacoensis*, umbilical view BT-1). **d.** *G. falconensis*, umbilical view (BT-1). **e.** *Ge. calida*, umbilical view (BT-1). **f.** *Ge. calida*, spiral view (BT-1). **g.** *Ge. radians*, umbilical view (BT-1). **h.** *Ge. siphonifera*, peripheral view (BT-1). **i.** *Gs. ruber,* umbilical view (BT-2). **j.** *Gs. tenellus,* spiral view (BT-1). **k.** *Gb. rubescens,* umbilical view (BT-1). **l.** *Orbulina universa* (BT-1). **m.** *T. sacculifer* forma *sac,* umbilical view (BT-1). **n.** *T. sacculifer* forma *trilobus,* umbilical view (BT-1). **o.** *Tb. clarkei*, umbilical view (BT-1). **p.** *H. pelagica,* side view (BT-1). **r.** *Gr. scitula*, umbilical view (BT-2). **s.** *D. anfracta*, umbilical view (BT-2). **t.** *N. dutertrei*, umbilical view (BT-1). **u.** *N. pachyderma*, umbilical view (BT-2). **v.** *Gt.glutinata*, umbilical view (BT-1). **y.** *Gt. uvula*, umbilical view (BT-1). Scale bar is 100 µm.

Globigerinella radians (Egger, 1893)
Figure 3g

Diagnosis: Wall cancellate, low trochospiral to pseudoplanispiral; globular to slightly radially ovate chambers rapidly increasing in size as added, four to five chambers in the final whorl; depressed sutures; wide and deep umbilicus, equatorial aperture.

Globigerinella siphonifera (d'Orbigny, 1839)
Figure 3h

Diagnosis: Wall cancellate, trochospiral to planispiral; globular chambers; increasing slowly in size as added; five chambers in the final whorl; depressed sutures; umbilicus deep and wide; equatorial aperture.
Comments: This species shows bilateral symmetry in the side view (Figure 3h).

Genus *Globigerinoides*
Globigerinoides elongatus (d'Orbigny, 1826)

Diagnosis: Wall cancellate; trochospiral, globular chambers, four chambers in the final whorl; strongly depressed sutures; deep and wide umbilicus; primary umbilical and supplementary sutural apertures.
Comments: This species is similar to *Gs. ruber* (Figures 3f and 4), but the last chamber is depressed.

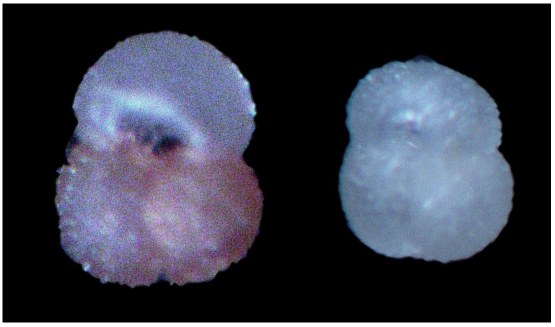

Figure 4. *Globigerinoides ruber rosa* on the left side and *G. ruber alba* on the right side. Specimens are not to scale.

Globigerinoides ruber (d'Orbigny, 1839)
Figure 3i

Diagnosis: Wall cancellate; test medium, low to high trochospiral; globular chambers, three chambers in the final whorl increasing in size as added; sutures depressed; wide, deep or narrow umbilicus; primary umbilical aperture and secondary sutural apertures.
Comments: *Gs. ruber alba* (white) is globally distributed and *Gs. ruber rosa* (pink) is restricted to the Mediterranean Sea, central Atlantic Ocean, and Caribbean Sea. (Figure 4) (Schiebel and Hemleben 2017).

Globigerinoides tenellus Parker, 1958

Figure 3j

Diagnosis: Test small, wall cancellate; low trochospiral; globular chambers, four chambers in the final whorl increasing in size as added; sutures depressed; large and wide umbilicus; large primary umbilical aperture with rim; single, small supplementary sutural aperture with a thin rim.

Genus *Globoturborotalita* Hofker, 1976

Globoturborotalita rubescens (Hofker, 1976)

Figure 3k

Diagnosis: Test small; wall cancellate; low to medium trochospiral; globular chambers, four chambers in the final whorl increasing moderately in size as added; depressed sutures; wide and deep umbilicus; single, small umbilical aperture with a lip; high rounded arch.

Comment: This species is very similar to *Gs. tenellus* and can be distinguished by the absence of secondary aperture (Figures 3j and 3k) (Schiebel and Hemleben 2017).

Genus *Orbulina* d'Orbigny, 1839

Orbulina universa d'Orbigny, 1839

Figure 3l

Diagnosis: Cancellate wall, spherical terminal chamber enveloping the early chambers.

Genus *Trilobatus* Spezzaferri *et al.* 2015

Trilobatus sacculifer Spezzaferri *et al.* 2015

Figures 3m and 3n

Diagnosis: Test medium to big, wall cancellate; low to moderate trochospiral; globular chambers, three to six chambers in the final whorl; sutures moderately depressed; wide and deep umbilicus; primary umbilical and supplementary sutural apertures.

Comments: This species includes forma sac like, quadrilobatus, and trilobus. Although, there is a little consensus on the recognition of *T. quadrilobatus* as a form of *T. sacculifer* (André *et al.* 2013; Spezzaferri *et al.* 2015).

Genus *Turborotalita* Blow and Banner, 1962

Turborotalita clarkei (Rögl and Bolli, 1973)

Figure 3o

Diagnosis: Test very small, surface smooth, low trochospiral; globular five chambers in the last whorl; sutures moderately depressed, curved on the spiral side, radial on the umbilical side; umbilical-extraumbilical aperture with a small flap.

Comments: This species is rarely recorded due to its minute size, however it is quite abundant in modern ocean (Boltovskoy 1991; Chernihovsky *et al.* 2020).

Family Hastigerinidae Bolli, Loeblich and Tappan, 1957
Genus *Hastigerina* Thomson in Murray, 1876
Hastigerina pelagica (d'Orbigny, 1839)
Figure 3p

Diagnosis: Test large, wall cancellate, planispiral; chambers subglobular to elongate increasing in size as added, five to six chambers in the last whorl; sutures moderately depressed; over the surface triradial spines present; interiomarginal umbilical-extraumbilical aperture with a thin lip.

Family Globorotaliidae Cushman, 1927
Genus *Globorotalia* Cushman, 1927
Globorotalia scitula (Brady, 1882)
Figure 3r

Diagnosis: Test medium to small, wall smooth; low trochospiral, subcircular periphery; five to six chambers in the last whorl increasing in size as added; sutures depressed, curved on the spiral side, radial on the umbilical side; interiomarginal slit-like umbilical-extraumbilical aperture with thin lip.

Genus *Dentigloborotalita* Brummer, 1988
Dentigloborotalita anfracta (Parker, 1967)
Figure 3s

Diagnosis: Test small, low trochospiral; flat spiral side; chambers globular, four to five chambers at the last whorl increasing slowly in size as added; sutures depressed; narrow and shallow umbilicus; aperture umbilical-extraumbilical with a lip.

Genus *Neogloboquadrina* Bandy, Frerichs and Vincent, 1967
Neogloboquadrina dutertrei (d'Orbigny, 1839)
Figure 3t

Diagnosis: Test large, quadrate in shape, cancellate wall, trochospiral; globular-subglobular five to six chambers in the final whorl slightly increasing in size as added; sutures weakly depressed; wide and deep umbilicus with a plate, aperture umbilical-extraumbilical.

Neogloboquadrina pacyhderma (Ehrenberg, 1861)
Figure 3u

Diagnosis: Test medium, cancellate wall, low trochospiral, globular-subglobular four to four and a half chambers in the final whorl slightly increasing in size as added except for the kummer-form chamber; sutures weakly depressed; narrow deep umbilicus, slit-like umbilical-extraumbilical aperture with a thick lip.
Comments: This species is distinguished from *N. incompta* by coiling direction as *N. pachyderma* shows predominantly sinistral coiling (Schiebel and Hemleben 2017).

Superfamily Globigerinitoidea Bermúdez, 1961
Family Globigerinitidae Bermúdez, 1961
Genus *Globigerinita* Brönnimann, 1951
Globigerinita glutinata (Egger, 1893)
Figure 3v

Diagnosis: Test small, wall finely pustulose, low-medium trochospiral; globular four chambers in the final whorl; sutures weakly depressed; narrow deep umbilicus; umbilical aperture; often a bulla present.

Globigerinita uvula (Ehrenberg, 1861)
Figure 3y

Diagnosis: Test small, wall smooth, high trochospiral; globular three to four chambers in the final whorl slowly increasing in size as added; sutures weakly depressed; narrow and deep umbilicus; interiomarginal umbilical aperture with a lip.

Systematic taxonomy of benthic foraminifers

Order Foraminiferida d'Orbigny, 1826
Suborder Miliolida Delage and Hérouard, 1896
Superfamily Milioloidea Ehrenberg, 1839
Family Cornuspiridae Schultze, 1854
Genus *Cornuspira* Schultze, 1854
Cornuspira planorbis Schultze, 1854
Figure 5a

Diagnosis: Porcelaneous wall; discoidal planispiral test; globular proloculus is followed by tubular chambers forming three-four whorls; terminal rounded aperture at the end of tubular chamber.

Family Cribrolinoididae Haynes, 1981
Genus *Adelosina* d'Orbigny, 1826
Adelosina sp.
Figure 5b

Diagnosis: Porcelaneous wall; leaf-like, fusiform, slightly elongate shape, very compressed in lateral view; bicarinate periphery; tubular chamber form; chambers coiled around proloculus and increasing in length as added; depressed sutures; reniform terminal aperture on a neck.

Family Hauerinidae Schwager, 1876
Genus *Cycloforina* Łuczkowska, 1972
Cycloforina contorta (d'Orbigny, 1846)
Figure 5c

Diagnosis: Porcelaneous wall; ovate-subrectangular periphery; tubular chamber form; terminal aperture on a short neck with rim.

Genus *Miliolinella* Wiesner, 1931
Miliolinella sp.
Figure 5d

Diagnosis: Porcelaneous wall; smooth surface; rounded periphery; inflated chambers, chamber arrangement quinqueloculine; terminal aperture with plate-like tooth.

Miliolinella subrotunda (Montagu, 1803)
Figure 5e

Diagnosis: Porcelaneous wall; smooth surface; rounded periphery; ovate apertural view; inflated chambers, chamber arrangement quinqueloculine to planispiral; terminal arch shaped aperture with a flap.

Genus *Quinqueloculina* d'Orbigny, 1826
Quinqueloculina bosciana d'Orbigny, 1839
Figure 5f

Diagnosis: Porcelaneous and hyaline wall; elongate in shape; quinqueloculine chamber arrangement; loop-like aperture with a rim.

Quinqueloculina lata Terquem, 1876
Figure 5g

Diagnosis: Porcelaneous wall; subrectangular in shape; quinqueloculine chamber arrangement; terminal reniform aperture.

Quinqueloculina padana Perconig, 1954
Figure 5h

Diagnosis: Porcelaneous wall; smooth surface; elliptical in shape; quinqueloculine chamber arrangement; triangular aperture with a flap-like tooth.

Quinqueloculina schlumbergeri (Wiesner, 1923)
Figure 5i

Diagnosis: Porcelaneous wall; smooth surface; quinqueloculine chamber arrangement; triangular look from apertural view, narrow elongate terminal aperture.

Family Spiroloculinidae Wiesner, 1920
Genus *Spiroloculina* d'Orbigny, 1826
Spiroloculina depressa d'Orbigny, 1826
Figure 5j

Diagnosis: Porcelaneous wall; leaf-like, fusiform shape, very compressed in lateral view; tubular chamber form; chambers coiled around proloculus and increasing in length as added; depressed sutures; terminal aperture on a short neck.

Genus *Triloculina* d'Orbigny, 1826
Triloculina plicata Terquem, 1878
Figure 5k

Diagnosis: Porcelaneous smooth test, ovate; three inflated tubular chambers increasing in size as added and ornamented with costae; carinate chambers separating one from another; short neck, subrounded terminal aperture with a bifid tooth.

Superfamily Nubecularioidea Jones, 1875
Family Fischerinidae Millett, 1898
Genus *Wiesnerella* Cushman, 1933
Wiesnerella auriculata (Egger, 1893)
Figure 5l

Diagnosis: Porcelaneous wall; ovate in shape and carinate; on the surface striae present; distinct sutures, terminal loop-shaped large aperture with thick rim on a neck.

Suborder Nodosariida Calkins, 1926
Superfamily Nodosarioidea Ehrenberg, 1838
Family Nodosariidae Ehrenberg, 1838
Genus *Laevidentalina* Loeblich and Tappan, 1986
Laevidentalina haueri (Neugeboren, 1856)
Figure 5m

Diagnosis: Wall calcareous and hyaline; smooth surface; elongate test, slightly arcuate in lateral view; uniserial chamber arrangement with oblique sutures; terminal radial aperture; apical pseudospine present.

Suborder Rotaliida Delage and Hérouard, 1896
Superfamily Buliminoidea Jones, 1875
Family Buliminidae Jones, 1875
Genus *Bulimina* d'Orbigny, 1826
Bulimina aculeata d'Orbigny, 1826
Figure 5n

Diagnosis: Calcareous hyaline wall, ovate test, chambers inflated, from triserial to uniserial chamber arrangement; sutures depressed; loop-shaped basal aperture with rim; larger to shorter pseudospines from earlier to later chambers are present and then absent on the later chambers.

Bulimina marginata d'Orbigny, 1826
Figure 5o

Diagnosis: Calcareous hyaline wall, ovate test, chambers inflated, from triserial to uniserial chamber arrangement; sutures depressed; loop-shaped basal aperture with rim; basal short pseudospines are present.

Superfamily Cassidulinoidea d'Orbigny, 1839
Family Bolivinitidae Cushman, 1927
Genus *Bolivina* d'Orbigny, 1839
Bolivina difformis (Williamson, 1858)
Figure 5p

Diagnosis: Calcareous hyaline wall; elongate test shape; biserial chamber arrangement; chambers increasing in size as added and end with spinose projections; sutures depressed; basal loop-like aperture.

Bolivina pseudoplicata Kacharava, 1982
Figure 5q

Diagnosis: Calcareous hyaline wall; elongate test shape; biserial chamber arrangement, ornamented with costae; chambers increasing in size as added; sutures depressed; basal loop-like aperture.

Bolivina spathulata (Williamson, 1858)
Figure 5r

Diagnosis: Calcareous hyaline wall; elongate test shape; very compressed peripheral view; biserial chamber arrangement increasing in size as added; depressed and curved sutures; basal loop-like aperture.

Bolivina subspinescens Cushman, 1922
Figure 5s

Diagnosis: Calcareous hyaline wall; elongate test shape; reticulate ornamentation; biserial chamber arrangement increasing in size as added; depressed sutures; loop-like basal aperture; apical pseudospine present.

Family Cassidulinidae d'Orbigny, 1839
Genus *Globocassidulina* Voloshinova, 1960
Globocassidulina crassa (d'Orbigny, 1839)
Figure 5t

Diagnosis: Calcareous wall, test smooth, ovate in shape, rounded periphery; inflated chambers, biserial chamber arrangement; sutures oblique and depressed; slit-like long aperture.

Globocassidulina subglobosa (Brady, 1881)
Figure 5u

Diagnosis: Calcareous wall, test smooth, ovate in shape, rounded periphery; inflated chambers, biserial chamber arrangement; sutures oblique and depressed; elongate, subrounded aperture.

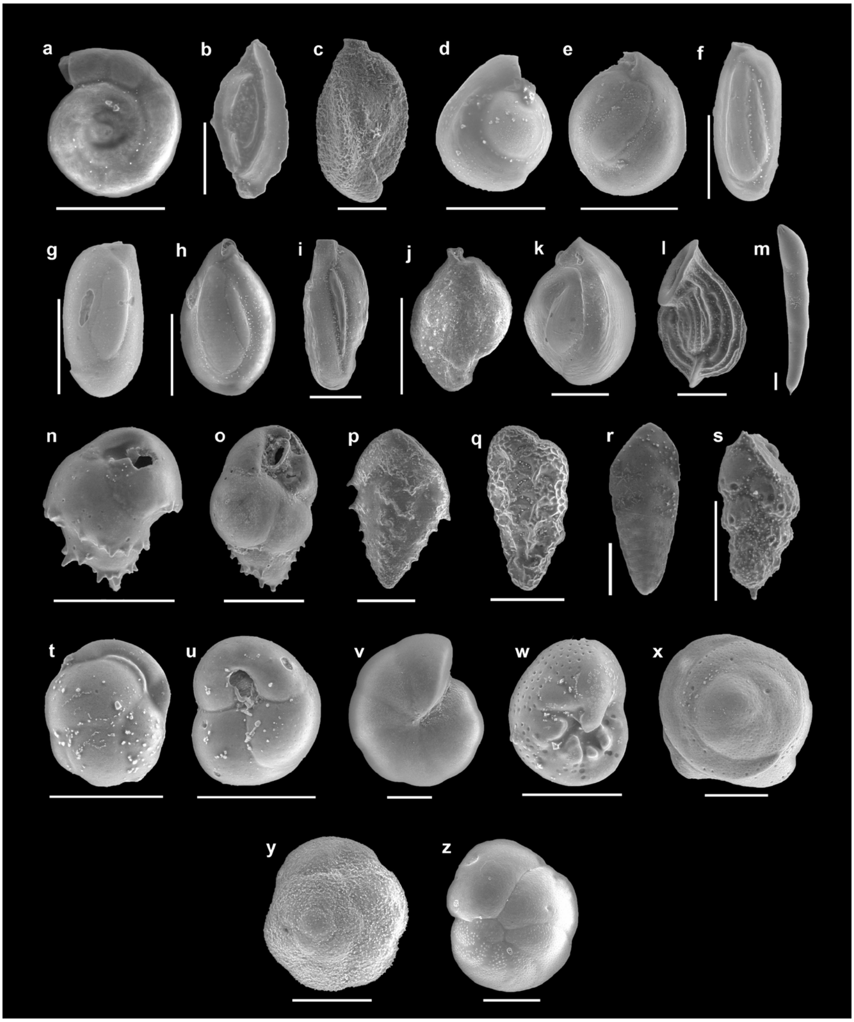

Figure 5. SEM photos of benthic foraminifers of the Finike Seamounts. **a.** *C. planorbis* (BT-2). **b.** *Adelosina* sp. (BT-2). **c.** *C. contorta* (BT-1). **d.** *Miliolinella* sp. (BT-2). **e.** *M. subrotunda* (BT-1). **f.** *Q. bosciana* (BT-2). **g.** *Q. lata* (BT-2). **h.** *Q. padana* (BT-2). **i.** *Q. schlumbergeri* (BT-2). **j.** *S. depressa* (BT-2). **k.** *T. plicata* (BT-2). **l.** *W. auriculata* (BT-1). **m.** *L. haueri* (BT-1). **n.** *B. aculeata* (BT-1). **o.** *B. marginata* (BT-2). **p.** *B. difformis* (BT-2). **q.** *B. pseudoplicata* (BT-2). **r.** *B. spathulata* (BT-2). **s.** *B. subspinescens* (BT-1). **t.** *G. crassa* (BT-1). **u.** *G. subglobosa*, umbilical view (BT-1). **v.** *H. soldanii*, umbilical view (BT-2). **w.** *V. bradyana,* umbilical view (BT-1). **x.** *N. terquemi,* spiral view (BT-1). **y.** *E. concameratus*, spiral view (BT-2). **z.** *D. bertheloti,* umbilical view (BT-2). Scale bars=100µm.

Superfamily Chilostomelloidea Brady, 1881
Family Gavelinellidae Hofker, 1956
Genus *Hansenisca* Loeblich and Tappan, 1987
Hansenisca soldanii (d'Orbigny, 1826)
Figure 5v

Diagnosis: Wall calcareous, trochospiral, envolute and flat spiral side, involute and convex umbilical side; crescentic chambers gradually increasing in size as added; sutures depressed and backward curved on the umbilical side, flush on the spiral side; interiomarginal slit-like aperture.

Superfamily Discorboidea Ehrenberg, 1838
Family Cancrisidae Chapman, Parr and Collins, 1934
Genus *Valvulineria* Cushman, 1926
Valvulineria bradyana (Fornasini, 1900)
Figure 5w

Diagnosis: Calcareous wall, rounded in shape; trochospiral; chambers gradually increasing in size as added; sutures depressed and curved on the spiral side, nearly radial to curved on the umbilical side; involute in the umbilical side with depressed umbilicus; interiomarginal aperture umbilical-extraumbilical with a large flap.

Family Discorbidae Ehrenberg, 1838
Genus *Neoconorbina* Hofker, 1951
Neoconorbina terquemi (Rzehak, 1888)
Figure 5x

Diagnosis: Wall calcaerous hyaline, coarsely perforate; high trochospiral evolute spiral side, convex involute umbilical side, chambers increasing in breadth as added; sutures depressed; open umbilicus; interiomarginal imbilical-extraumbilical aperture.

Family Eponididae Hofker, 1951
Genus *Eponides* Montfort, 1808
Eponides concameratus (Williamson, 1858)
Figure 5y

Diagnosis: Wall calcareous; test rounded in outline, trochospiral; planoconvex to biconvex; spiral side evolute, umbilical side involute; spiral side postulate, with backward curved sutures; aperture interiomarginal and extraumbilical arch.

Superfamily Discorbinelloidea Sigal, 1952
Family Discorbinellidae Sigal, 1952
Genus *Discorbinella* Cushman and Martin, 1935
Discorbinella bertheloti (d'Orbigny, 1839)
Figure 5z

Diagnosis: Wall calcareous; trochospiral, planoconvex; broad chambers rapidly increasing in size as added; sutures backward curved; flat umbilical side with umbilical flap; interiomargial aperture at the periphery.

Superfamily Glabratelloidea Loeblich and Tappan, 1964
Family Glabratellidae Loeblich and Tappan, 1964
Genus *Glabratella* Dorreen, 1948
Glabratella sp.
Figure 6a

Diagnosis: Wall calcareous, high trochospiral, rounded periphery, triangular lateral view; globular chambers increasing in size as added; sutures curved and depressed on the spiral side; umbilical side ornamented with radial striae and pustules; flat umbilical side with depressed umbilicus; interiomarginal slit-like aperture.

Family Rosalinidae Reiss, 1963
Genus *Rosalina* d'Orbigny, 1826
Rosalina globularis d'Orbigny, 1826
Figure 6b

Diagnosis: Calcareous hyaline wall, coarsely perforate; planoconvex to concavoconvex, rounded periphery; convex and evolute spiral side, slightly concave and involute umbilical side; crescentic chambers rapidly increasing in size as added; thickened depressed and curved sutures; open umbilicus; interiomarginal extraumbilical slit-like aperture.

Genus *Gavelinopsis* Hofker, 1951
Gavelinopsis praegeri (Heron-Allen and Earland, 1913)
Figure 6c

Diagnosis: Calcareous hyaline wall, finely perforate; low trochospiral; evolute and concave spiral side; involute and convex umbilical side; crescentic chambers rapidly increasing in size as added; thickened depressed sutures on the spiral side; interiomarginal extraumbilical slit-like aperture.

Superfamily Nonionoidea Schultze, 1854
Family Nonionidae Schultze, 1854
Genus *Nonionella* Cushman, 1926
Nonionoides turgida (Williamson, 1858)
Figure 6d

Diagnosis: Calcareous wall; low trochospiral, depressed and ovate in shape; elongate chambers increasing in length as added in the final whorl; sutures depressed; interiomarginal aperture.

Superfamily Planorbulinoidea Schwager, 1877
Family Cibicididae Cushman, 1927
Genus *Cibicidoides* Thalmann, 1939
Cibicidoides variabilis (d'Orbigny, 1826)
Figure 6e

Diagnosis: Calcareous wall, trochospiral to planispiral, rounded periphery; flat spiral side, convex umbilical side; chambers lobate and are added regular to chaotic at later stages of the growth; sutures depressed; slit-like curved aperture located at peripheral margin.

Cibicidoides wuellerstorfi (Schwager, 1866)
Figure 6f

Diagnosis: Calcareous wall; coarsely perforate on the spiral side, finely perforate on the umbilical side; rounded periphery; compressed, very low trochospiral; evolute; ten-twelve chambers in the last whorl rapidly increasing in size as added; chambers separated by distinct, thickened strongly curved sutures; slit-like equatorial aperture.

Superfamily Rotalioidea Ehrenberg, 1839
Family Elphidiidae Galloway, 1933
Genus *Elphidium* Montfort, 1808
Elphidium ustulatum Todd, 1957
Figure 6g

Diagnosis: Calcareous wall; rounded to slightly elliptical, compressed test; rounded periphery; not inflated, narrow, seven to eleven chambers; distinct, incised, nearly radial sutures; very large double umbilical plug; aperture is not visible.

Family Haynesinidae Mikhalevich, 2013
Genus *Haynesina* Banner and Culver, 1978
Haynesina depressula (Walker and Jacob, 1798)
Figure 6h

Diagnosis: Calcareous wall; planispiral, biumbilical with depressed umbilici; inflated chambers gradually increasing in size as added; radial and slightly curved, towards umbilicus incised sutures; pustulate umbilicus; interiomarginal arch shaped aperture.

Suborder Polymorphinida Mikhalevich, 1980
Superfamily Polymorphinoidea d'Orbigny, 1839
Family Ellipsolagenidae A. Silvestri, 1923
Genus *Fissurina* Reuss, 1850
Fissurina sp.
Figure 6i

Diagnosis: Calcareous hyaline wall, ovate in shape, lenticular in lateral view; single chambered; elongate long slit-like terminal aperture, two apical basal projections.

Fissurina staphyllaeria Schwager, 1866
Figure 6j

Diagnosis: Calcareous hyaline wall, circular in shape, elliptical in lateral view; single chambered; elongate long slit-like terminal aperture, several apical basal projections.

Suborder Textulariida Delage and Hérouard, 1896
Superfamily Textularioidea Ehrenberg, 1838
Family Textulariidae Ehrenberg, 1838
Genus *Siphotextularia* Finlay, 1939
Siphotextularia concava (Karrer, 1868)
Figure 6k

Diagnosis: Wall finely agglutinated; biserial chamber arrangement increasing in size as added; sutures depressed and curved; slit-like aperture with a lip.

Figure 6. SEM photos of benthic foraminifers of the Finike Seamounts (continued). **a.** *Glabratella* sp., umbilical view (BT-1). **b.** *R. globularis*, spiral view (BT-1). **c.** *Gavelinopsis* sp., spiral view (BT-1). **d.** *N. turgida* (BT-2). **e.** *C. varabilis* (BT-1). **f.** *C. wuellerstorfi,* umbilical view (BT-1). **g.** *E. ustulatum* (BT-1). **h.** *H. depressula (*BT-1). **i.** *Fissurina* sp. (BT-1). **j.** *F. staphyllaeria* (BT-1). **k.** *S. concava* (BT-1). **l.** *A. scalaris* (BT-1). Scale bars=100µm.

Suborder Vaginulinida Mikhalevich, 1993
Family Vaginulinidae Reuss, 1860
Genus *Amphicoryna* Schlumberger in Milne-Edwards, 1881
Amphicoryna scalaris (Batsch, 1791)
Figure 6l

Diagnosis: Calcareous wall, elongate in shape; globular chambers, uniserial chamber arrangement, chambers increasing in size as added; ornamented with numerous striae; radiate aperture on a long neck; apical basal pseudospine may be present.

Discussion and Conclusion

In this study, in total 22 species of planktic foraminifers and 38 species of benthic foraminifers were identified. While planktic foraminifers were abundant although globorotalids were few, benthics were very low in number however display a diverse assemblage including several miliolids. Absence of agglutinated foraminifers might relate to disadvantageous substrate characteristics (Gooday 1989) and absence keeled globorotalids might relate to disadvantageous ecological subsurface water conditions concerning organic matter availability or subsurface water mass distribution (Schiebel and Hemleben 2017).

Presence of *Elphidium ustulatum* (Figure 6g) in the benthic foraminifer assemblage is puzzling. This species is commonly reported from the Arctic Region as a cold-water species in Plio-Pleistocene aged marine sediments older than Eemian (~127 000 – 106 000 years) (Gregory and Bridge 1979; Feyling-Hanssen 1980; Knudsen and Asbjörnsdóttir 1991; McNeil *et al.* 2001, among others) and had not been reported from the Mediterranean Region before. Furthermore, paleodepth profile of *E. ustulatum* is estimated to range as deep as 1200m according to McNeil *et al.* (2001). In this study, we report *E. ustulatum* from the surface sediments of the Eastern Mediterranean Sea collected around 2000m of water depth. Even though its presence might somehow relate to cold-water influx to the Mediterranean Basin from the North Atlantic, its presence in the Eastern Mediterranean should be investigated carefully comparing with the modern assemblage of the surrounding shallower locations taking into account the downward displacement/reworking possibility of the species to the depositional setting.

Autochthonous benthic foraminifer assemblage although low in number represents an environment of low oxygenation given the presence of stress tolerant taxa such as *Bolivina* spp. and *Bulimina aculeata* (Kaiho 1994; Murray 2006). Within this divers assemblage of benthic foraminifers, interesting part is the presence of miliolids which live in infralittoral-circalittoral water settings (Sgarrella and Moncharmont Zei 1993; Meriç *et al.* 2014; Lei and Li 2016). Such a diverse and numerous presence of miliolids is not a general attribute of deep-sea environments and seamount and has not been encountered also in other seamounts regions (e.g. Heinz *et al.* 2004). Hence, their presence at bathyal zone might point to downward displacement from the coastal parts to the bathyal depths and require further investigation to reveal their transportation mechanism to the sampling sites. In-detail investigation of this transportation mechanism in terms of sediment source region and triggering mechanism would enlighten the benthic ecosystem dynamics of the Finike Seamounts for a better understanding of sedimentation processes of the region, which eventually relate to downslope transport of nutrients and possibly other colonizing organisms including foraminifers as they are proved successful colonizers (Van Dover *et al*. 1988; Murray 2006).

A complementary study from shallower water depths of the study area and their benthic foraminiferal assemblage to locate the sediment source may aid in understanding bottom current rates and potential benthic colonization processes for other organisms, which influence ecosystem dynamics.

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Doğu Akdeniz Finike Denizaltı Dağları foraminifer topluluklarına dair ön bulgular

Öz

Doğu Akdeniz'de bulunan Finike Denizaltı Dağları, deniz koruma alanı olarak değerlendirilmekte ve foraminiferlere dair yeni bilgiler sunmaktadır. Bu çalışmada, 1800 ve 2200 metre derinliklerden iki istasyondan alınmış iki adet yüzey sedimanı örneği içerdikleri foraminifer topluluklarının tespiti için incelenmiştir. Planktik foraminiferler bol olsa da, Finike Denizaltı Dağları, denizaltı dağlarının genel özelliklerine paralel olarak, bentik foraminiferler açısından oldukça fakir, çok küçük boyutlu ancak çeşitli bir topluluğa sahiptir. Bir alttakım, iki üst familya, dört familya ve 13 cinse ait toplam 22 adet planktik foraminifer türü tanımlanmıştır. İlginç bir şekilde herhangi bir karen (keel) yapılı planktik foraminifere rastlanmamıştır. Bentik foraminiferlerden ise, altı alttakım, 15 üst familya ve 27 cinse ait toplam 38 tür tanımlanmıştır. Bentik foraminiferler arasında miliolidlerin varlığı, infralitoral kesimlerden muhtemel sediman taşınımına işaret etmektedir.

Anahtar kelimeler: Planktik foraminiferler, bentik foraminiferler, taksonomi, ekosistem, Doğu Akdeniz, Finike Denizaltı Dağları

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