Taxonomy of Miocene Bryozoans from As Sahabi area, Ajdabiyah Trough, NE Sirt Basin, Libya

Ahmed M. Muftah* and Yasser A. El-Safori

*Department of Earth Sciences, Faculty of Science, University of Benghazi, P. O. Box 9480, Benghazi, Libya.

bDepartment of Geology, Faculty of Science, University of Ain Shams, P.O. Box 11566 Cairo, Egypt.

Highlights

- Bryozoan taxa have retrieved from the formation "M" in As Sahabi area of Sirt Basin, Libya.
- Fourteen species are classified and described in this study.
- The assemblage is closely similar to the equivalent sediments from Egypt and Libya.
- According to the assemblage, a shallow marine environment with low energy condition has been interpreted.

ABSTRACT

The exposed Pre-Sahabi rock unit formation "M" at As Sahabi area in Sirt Basin is analyzed micro-paleontologically for bryozoans. Fourteen species belonging to eleven genera of bryozoan have been identified, described for the first time. In addition, the importance of the present study is to determine the paleo environmental occurrences as is performed herein with particular attention to their paleo geographical distribution. A comparison with the coeval sites from Siwa Oasis, the Cairo-Suez Road section in Egypt, as well as the Maradah Formation from Sirt Basin in Libya, has been revealed some similarities between these sites.

ARTICLE INFO

Article history:
Received 04 December 2018
Revised 26 June 2019
Accepted 29 June 2019
Available online 01 July 2019

Keywords:
As Sahabi, Bryoza, Tortonian, Sirt Basin, Libya, Taxonomy, Paleogeography.

* Corresponding author:
E-mail address: ahmed59muftah@gmail.com

A. M. Muftah

1. Introduction

The As Sahabi study area is located in the northeastern part of Sirt Basin, covering an area of ≈375km². It is bounded by longitudes 20° 48' 08" to 20° 54' 45" E and latitudes 30° 10' 58" to 30° 17' 36" N within a tectonic province called the Ajdabiya Trough (Fig. 1).

Fig. 1. Location of the As Sahabi area in Sirt Basin of Libya (Muftah, 2013).

The studied samples came from a small exposure profile at locality P53 called Inselberg Hill (Fig. 2). It is located at latitudes (30° 14' 5.78" N) and longitudes (20° 53' 54.18" E) along the western margin of the Sabkhat Al Quanyyin. It is the oldest exposed rock unit in As Sahabi area and belongs informally to formation "M", which consists of clay and fossiliferous semi consolidated carbonates (Fig. 2).

Thirteen samples were collected from the locality P53 exposure (Fig. 2) which are prepared according to standard micropaleontological techniques and examined for their bryozoan content.

Fig. 2. Inselberg Hill (P53) located at the western edge of Sabkhat Al Quunyyin (facing NW) (see Fig. 4 for lithology).

Selected bryozoan species are examined using a Jeol JSM 6360 Scanning Electron Microscope, at the University of Athens, Department of Historical Geology and Paleontology, for taxonomic and illustrative purposes. All materials (rock samples and micro paleontological slides) are stored in the micro paleontological section of the Earth Sciences Department of Benghazi University, Benghazi, Libya.
2. Geological setting and Stratigraphy of As Sahabi

2.1 Tectonics

The Sirt Basin is the largest and youngest sedimentary basin in Libya, with an NW-SE trending pattern, covering an area of about 300,000 km² (Fig. 3). It is bounded by the Hun graben to the west, a major fault of dip-slip nature including the Antelat uplift, which separates the basin from the Cyrenaica platform to the east, by the Mediterranean Sea to the north and by the major Tibisti Sirt uplift to the south (Fig. 3). Sirt Basin was formed in the Cenomanian, during which a series of NW-SE trending horsts and grabens were developed. The deeper part of the basin (troughs), including the Ajdabya (=Agedabia) trough where As Sahabi area is located, is considered as the eastern graben of the horst-graben system of Sirt Basin complex (El-Arnauti and El Sogher, 2004). This trough has received more than 15,000 ft. thick sequences of Mesozoic and Tertiary marine sediments, as they are recorded in the subsurface drilled oil wells in this Basin.

Fig. 3. Tectonic map of Sirt Basin shows the Ajdabya Trough and geological cross section through the Basin (after Roohi, 1993).

2.2 Stratigraphy of As Sahabi area

The Neogene strata in the As Sahabi area are exposed along the western edge of the Sabkhat Al Qunuyyin. The stratigraphy of these rocks has been introduced by De Heinzelin and El Arnauti (1982, 1983, and 1987); Gigka (1984) and Muftah et al. (2008b) from several surface exposures in As Sahabi area (Fig. 3). The exposed rock units are named informally, from bottom to top: formation "M", formation "P", and the Sahabi Formation. The latter is subdivided into five informal members (T, U1, UD, U2 and V) and formation "Z" as the topmost rock units at some localities (De Heinzelin and El Arnauti, 1987; Muftah, 2013, Muftah et al., 2013). However, El-Shawaihdi et al. (2014), El-Shawaihdi, et al. (2016) and El-Shawaihdi, et al. (2019) amended the lithostratigraphic nomenclatures of the As Sahabi area based on stable isotopes dating of few samples to modify formation "M" and regional correlation to introduced new "lower member" and "upper member" of Sahabi Formation, Qarrat Waddah Formation and formation "Z" (Fig. 3). The present study focuses only on the formation "M".

Formation "M" comprises of semi-consolidated lithofacies with maximum exposed thickness reaching up to 13 meters, among which the main bryozoan-productive horizon is accommodated (i.e. the lower two units) (Fig. 4). It is highly fossiliferous with most common invertebrate fossil groups, including echinoids, pelecypods, gastropods, corals and bryozoans in addition to several microfossil groups such as foraminifera, calcareous nannofossils and ostracods (De Heinzelin and El Arnauti, 1983; Willems and Meyrick, 1982; and Muftah et al., 2008a, b). Petrographically formation "M" is differentiated into the following five units, (Fig. 4), on the basis of the lithology, texture and fossil content; from bottom to top they are: i) Foraminifera-echinodermal packstone unit; ii) Sandy-pelletal packstone unit; iii) Gypsiferous dolostone unit; iv) Clay unit; and v) Fossiliferous limestone unit.
Fig. 3. Stratigraphic column of exposed rock units in As Sahabi area (Muftah et al., 2019, in press).

Fig. 4. Columnar section of Pre-Sahabi rock unit at P53 As Sahabi area (Muftah, 2013).
3. Taxonomy

Taxonomic study of all recorded species is based primarily on the classification of Bassler (1953) with modifications. In addition, description, micrometric measurements, distribution, and habitat for each species are given. The parameters, statistics and abbreviations, as well as the form in which are presented, are as follows:

- **Parameter**: Includes Zoarial diameter, Orifice diameter, Apertural or Opesial width, Apertural or Opesial length.
- **Range**: Mean ± Standard deviation.
- **Mean**: Mean value.
- **Number of measurements**: Number of measurements made.

**Measurements in mm**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dz</td>
<td>0.125</td>
<td>0.021</td>
<td>0.332</td>
</tr>
<tr>
<td>Do</td>
<td>0.062</td>
<td>0.021</td>
<td>0.132</td>
</tr>
<tr>
<td>Lz</td>
<td>0.402</td>
<td>0.021</td>
<td>0.418</td>
</tr>
<tr>
<td>Dp</td>
<td>0.060</td>
<td>0.021</td>
<td>0.082</td>
</tr>
</tbody>
</table>

**Measurements in μm**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dz</td>
<td>3.823</td>
<td>0.079</td>
<td>4.000</td>
</tr>
<tr>
<td>Do</td>
<td>0.263</td>
<td>0.010</td>
<td>0.301</td>
</tr>
<tr>
<td>Lz</td>
<td>1.434</td>
<td>0.157</td>
<td>1.591</td>
</tr>
<tr>
<td>Dp</td>
<td>0.101</td>
<td>0.031</td>
<td>0.133</td>
</tr>
</tbody>
</table>

**Description**: Zoarium erect, flat, internodes short and composed of 5–7 Autozooids, ornamented by dark common slit-like and few circular pseudopores and annual lines. Autozooids with a definite little salient, gently and frontally curved peristome and circular orifice. Gonozoid not observed. Non-cellular surface, gently curved, ornamented by the same pseudopores as the cellular one. Occurrences: Sirt Basin, Sahabi area, locality P53 formation “M”, Sample no. 7 (Fig. 4).

**Distribution**: Common in the cold waters of Europe and America, western Atlantic, Mediterranean Sea and West Africa.

**Habitat**: It is always dominant at 50 m, with a maximum depth of 300 m (Hayward and Ryland, 1985).

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### Bryozoans Distribution Chart of the P53 Section at As Sahabi Area

(R: Rare 1-2; C: Common 3-5; F: Frequent 6-10; A: Abundant >10)

<table>
<thead>
<tr>
<th>Age</th>
<th>Formation</th>
<th>Sample No.</th>
<th><strong>Críisia eburnea</strong></th>
<th><strong>Críisia elongata</strong></th>
<th><strong>Crista elongata</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>8-13</td>
<td>BARREN</td>
<td>7</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<td></td>
<td></td>
<td>4</td>
<td>C</td>
<td>R</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>C</td>
<td>R</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>C</td>
<td>C</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>F</td>
<td>C</td>
<td>F</td>
</tr>
</tbody>
</table>

**Fig. 5.** Bryozoans distribution chart of the P53 section at As Sahabi area.

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**Phylum**: Bryozoa Ehrenberg, 1831

**Order**: Cyclostomata Busk, 1852

**Family**: Críisidae Johnston, 1847

**Críisia eburnea** Linnaeus, 1758: 810.

**Críisia elongata** Milne-Edwards, 1838

(Pl. 1, Fig. 1)

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**Críisia elongata** Milne-Edwards, 1838: 203, pl. 7, Fig. 2; Braga and Barbin, 1988: 505, pl. 1, Fig. 2; Ziko and Hamza, 1987: 320, Fig. 2-4; Ziko and El-Sorogy, 1995: 82, Fig. 3: 1-2.

**Description**: Zoarium free, erect, articulated cylindrical stems with a tapering initial part, circular cross section and slightly depressed lateral parts, cellariiform (Críisid). Autozooidal tubes cylindrical, only obvious near apertures, biserially arranged in alternating manner. Frontal convex. Orifice circular; peristome thin, little salient. Distance between peristomes exceeds the internode distance. Dorsal convex, smooth. Ovicell subglobular located between nodes.

**Measurements**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dz</td>
<td>0.223</td>
<td>0.021</td>
<td>0.243</td>
</tr>
<tr>
<td>Do</td>
<td>0.402</td>
<td>0.025</td>
<td>0.423</td>
</tr>
<tr>
<td>Lz</td>
<td>0.490</td>
<td>0.018</td>
<td>0.498</td>
</tr>
<tr>
<td>Dp</td>
<td>0.275</td>
<td>0.012</td>
<td>0.286</td>
</tr>
</tbody>
</table>

**Occurrence**: Sirt Basin, As Sahabi area, locality P53 formation “M”, Sample nos. 1 - 5, 7 (Fig. 4).

**Distribution**: Eocene (France, and North America); Oligocene (France, Germany, and Italy); Miocene (Egypt, CSSR, France, Hungary, Italy, and Austria); Pliocene (Italy), Pleistocene (Egypt).

**Habitat**: Atlantic, Mediterranean, Red Sea, Japan, with a depth range of 0-59 m (Vavra, 1977).
**Crisis hornsii** Reuss, 1847

(Pl. 1, Fig. 2)

*Crisis hornsii* Reuss, 1847: 74, pl. 7, Fig. 21; Canu and Bassler, 1923: 704, pl. 141, Figs. 1-4; Vavra, 1977: 14; Ziko, 1994: 224; Ziko et al., 2000: 1465, Pl. 1, Fig. 1; El Safori, 2002: 426, Pl. 2, Fig. 3; Dukai et al., 2010: 40, pl.3, Fig. 4.

Description: Zoarium free, erect, subcylindrical stem, cellariiform (critsid). Frontal little convex, finely perforated. Autozooidal tubes little distinct, biseriately arranged in an alternating manner. Orifice circular; peristome thin, little salient, rounded. Dorsal little convex, Ovicell not observed.

Measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dz (3)</td>
<td>0.503-0.522 (0.015)</td>
</tr>
<tr>
<td>Lz</td>
<td>0.362-0.394 (0.020)</td>
</tr>
<tr>
<td>Do (2, 10)</td>
<td>0.065-0.078 (0.012)</td>
</tr>
<tr>
<td>Dp (2, 10)</td>
<td>0.083-0.089 (0.006)</td>
</tr>
</tbody>
</table>

Occurrence: Sirt Basin, As Sahabi area, locality P53 formation "M", Sample no. 3 (Fig. 4).

Distribution: Middle Miocene north of Western Desert and the western side of the Gulf of Suez; Eocene, Italy and North America; Oligocene of Germany, France, Italy and USA; Miocene of CSSR, Greece, Italy, Poland, Romania, Hungary, Portugal, Egypt; Pliocene – Pleistocene of Italy (Ziko, 1973; Vavra, 1977; El-Deria, 1996; El-Sorogy et al., 2001).

Habitat: Red Sea, Philippines at depth from 100 to 300m, temperature: 11.2°C (Canu and Bassler, 1929; Ziko et al., 2000; El-Sorogy et al., 2001).

Family: Heterocycloeciidae, Canu, 1919

**Tretocycloecia dichotoma** (Reuss, 1848)

(Pl. 1, Fig. 3)

*Tretocycloecia dichotoma* Vavra, 1977: 65; Vavra, 1979: 388, pl. 2, Fig. 2, Ziko, 1996: 69, pl. 7, Figs. 3, 4, 6, 7, 8, El Safori, 2002: 431, pl. 3, Fig. 3; Ziko et al., 2010: 92, pl. 4, Fig. 12, pl. 5, Fig. 1.

Description: Zoarium free, globular, vesicular, multilamellar, adeoni-iform. Autozooidal orifices subcircular, branching. Kenozooids very abundant arranged around autozooidal apertures in an irregular quincuncial pattern. Gonozooid not observed. numerous separated by smaller polygonal mesopores, no peristome.

Measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dz (2)</td>
<td>1.356-1.510 (0.083)</td>
</tr>
<tr>
<td>D (1,10)</td>
<td>0.084-0.095 (0.003)</td>
</tr>
<tr>
<td>Dp (1,10)</td>
<td>0.096-0.145 (0.088)</td>
</tr>
</tbody>
</table>

Occurrence: Sirt Basin, As Sahabi area, locality P53 formation "M", Sample no. 5 (Fig. 4).

Order Cheilostomata Busk, 1852

Suborder: *Anasca Levinskii*, 1909

Family: Steginoporellidae Bassler, 1953

**Steginoporella iberica reussii** Puyet and David, 1979.

*Steginoporella iberica reussii* Puyet and David, 1979: 780, pl. 4, Fig. 3, text Fig. 3; Vavra, 1980, 55.

Description: Zoarium encrusts a fragment of *Pecten* sp., often represented by fragmented parts. Unilamellar, membraniporiform. Autozooids elongated hexagonal, arranged in alternating longitudinal rows, separated by thin furrows. Mural rim convex, thick, salient, finely granulated. Cryptocyst almost flat, perforated; the distal part, elevated, imperfectated, grooved by two subsymmetrical, sub-circular opesiules, placed just below the proximal border. Opeia large, subterminal, semicircular, transverse, with rounded distal and slightly concave proximal border; peristome thick, raised. Bzooids rarely observed.

Measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lz (1,8)</td>
<td>0.856-1.047 (0.065)</td>
</tr>
<tr>
<td>L (1,8)</td>
<td>0.643-0.716 (0.048)</td>
</tr>
<tr>
<td>Lo (1,8)</td>
<td>0.124-0.2336 (0.093)</td>
</tr>
<tr>
<td>Is (1,8)</td>
<td>0.335-0.390 (0.013)</td>
</tr>
</tbody>
</table>

Distribution: Miocene (Vienna Basin-Austria, Rhone Basin).

Occurrence: Sirt Basin, As Sahabi area, locality P53 formation "M", Sample nos 1, 5 (Fig. 4).

Family: Calpenciidae Canu and Bassler, 1923

**Calpensia nobilis** (Esper, 1796)

**Cellepora nobilis** Esper, 1796: 145.

**Calpensia nobilis** Zahala and Maluquier, 1989: 90; Moissette, 1988: 96, pl. 4, Fig. 8; pl. 16, Figs. 11, 12; Hayward and McKinney, 2002: 31, Figs. 13 A-C.

Description: Colony encrusting unilamellar, multiserial. Autozooids distinct, elongated rectangular, arranged in alternating longitudinal rows, separated by thin furrows. Mural rim convex, thin, salient, granulated. Cryptocyst deep, little convex to flat, perforated and granulated, pierced by two small, rounded opesiules, placed at a little distance of opesium and close to mural rim. Opeia elliptical, transverse with rounded distal and concave to the little convex proximal border; peristome thick, salient. Ovicell not recognized.

Measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lz (1,10)</td>
<td>0.598-0.702 (0.024)</td>
</tr>
<tr>
<td>L (1,10)</td>
<td>0.390-0.464 (0.015)</td>
</tr>
<tr>
<td>Lo (1,10)</td>
<td>0.090-0.110 (0.010)</td>
</tr>
<tr>
<td>Is (1,10)</td>
<td>0.130-0.200 (0.010)</td>
</tr>
</tbody>
</table>

Occurrence: Sirt Basin, Sahabi area, locality P53 formation "M", Sample nos. 1, 2, 3 (Fig. 4).

Distribution: Miocene (Egypt, France, Italy, and Algeria); Pliocene (Italy and Tunisia); Pleistocene (Italy); Recent (the Mediterranean Sea and the Atlantic Ocean).

Family Thalamoporellidae Levinsen, 1902

**Thalamoporella zaltaniensis** El Safori and Muftah, 2019, (in Press)

Description: Zoarium encrusts and membraniporiform. Zoecia distinct, arranged in alternating longitudinal rows and separated by thin furrows. Mural rim thin, convex, slightly salient, granulated, basal part pierced by two and rarely one small spine with a thick base and abraded shaft. Cryptocyst shallow, little convex to flat, finely granulated and perforated, grooved by two small symmetrical rounded opesiules, placed just below the proximal border of the opesia. Opeia elliptical with rounded distal and concave to the little concave proximal border; peristome thick, salient. Ovicells are not observed.

Measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lz (2,7)</td>
<td>0.391-0.492 (0.036)</td>
</tr>
<tr>
<td>L (2,7)</td>
<td>0.187-0.282 (0.042)</td>
</tr>
<tr>
<td>Lo (2,7)</td>
<td>0.043-0.057 (0.013)</td>
</tr>
<tr>
<td>Is (2,7)</td>
<td>0.101-0.108 (0.006)</td>
</tr>
<tr>
<td>Lav (1,2)</td>
<td>0.558-0.565 (0.013)</td>
</tr>
<tr>
<td>l (1,2)</td>
<td>0.276-0.284 (0.006)</td>
</tr>
</tbody>
</table>

Occurrences: Sirt Basin, As Sahabi area, locality P53 formation "M", Sample no. 7 (Fig. 4).

Family: Cellariaeidae Fleming, 1828

**Cellaria salicornioides** Lamoroux, 1816

(Pl. 1, Fig 4)
**Cellaria salicornioides** Lamouroux, 1816: 127; Moisssette, 1988: 104, pl. 17, figs. 1, 2; Hayward and McKinney, 2002: 36, fig. 15F-K; Dubi et al., 2010: 36, pl. 2, Fig. 7.

Description: Colonies erect and branching, with cylindrical internodes consisting of alternating 8-10 autozooidal rows. Autozooids oval to hexagonal, with a regular quincuncial arrangement. Opeia subterminal, semicircular, mural rim short, bluntly tapered. Cryptocyst concave, finely granulated. Avicularia not common, distinct as large autozooid, with large subcircular rostrum. Ovicell is a simple round opening distal to the opeia.

Measurements:

- **Zd (1, 3)**: 0.730-0.832 (0.024) 0.760 mm
- **Lz (1, 10)**: 0.288-0.400 (0.024) 0.311 mm
- **Iz (1, 10)**: 0.266-0.311 (0.015) 0.297 mm
- **Lo (1, 10)**: 0.044-0.067 (0.010) 0.057 mm
- **Io (1, 10)**: 0.097-1.124 (0.010) 0.120 mm

Occurrences: Sirt Basin, As Sahabi area, locality P53 formation "M", Sample nos. 3 (Fig. 4).

Distribution: Miocene (Portugal, Spain, Italy), Pliocene (Portugal, Spain, Italy, and Tunisia); Pleistocene (Egypt, Algeria, and Italy).

Suborder Ascopora Levinsen, 1956

**Margaretta cereoides** Ellis and Solander, 1786

(P1, 1, Fig. 7)

**Cellaria cereoides** Ellis and Solander, 1786: 26, pl. 5, Figs. B-E.

**Margaretta cereoides** Buge and Debourle, 1977: 344, pl. 8, Figs. 3; Vavra, 1979: p. 603, pl. 1, Fig. 1; Ziko and Hamza, 1987: p. 305, Figs. 77; Schmid, 1989: p. 52, pl. 15, Figs. 4, 5, 7, 8; Ziko, 1996: p. 136, Figs. 4-5; El Safori, 2002: 450, pl. 7, Fig. 6; Dulai et al., 2010: 37, pl. 4, Fig. 3

Description: Zoarium free, erect, dishotomous, cylindrical stems, elliptical, arranged in alternating longitudinal rows separated by shallow furrows. Frontal convex, thick, tremocyst with numerous, large pores. Aperture subterminal, subcircular; proximal border concave; peristome thick, short. Avicularia peristomial, median, small, elongate, oval, sometimes not observed.

Measurements:

- **Lz (2, 10)**: 1.230-1.432 (0.095) 1.389 mm
- **Iz (2, 10)**: 0.464-0.497 (0.012) 0.477 mm
- **Lo (2, 10)**: 0.122-0.142 (0.024) 0.132 mm
- **Io (2, 10)**: 0.164-0.178 (0.017) 0.171 mm

Occurrence: Sirt Basin, As Sahabi area, locality P53 formation "M", Sample nos. 5, 7 (Fig. 4).

Distribution: Eocene (Spain, Italy, France, and Egypt); Oligocene (Italy, Germany, Austria, Poland, and USA); Miocene (Italy, France, Egypt, Austria, Poland, Romania, Libya, Algeria, and Morocco); Pliocene (Italy, North Africa, and Central America).

Habitat: Adriatic, Mediterranean, Pacific, and Red Sea; Atlantic in tropical and subtropical regions (Schmid, 1989).

Family: Celleporidae Busk, 1852

**Celleporaria desoi** (Cipolla, 1929)

(Fig. 6)

**Holoporella desoi** Cipolla, 1929: 379, pl. 43, Figs. 4-8, pl. 44, Figs. 2, 6; Annoscia, 1969: 88, pl. 1, Figs. 16-18.

**Celleporaria desoi** El Safori, 2002: 453, pl. 7, Fig. 8.

Description: Zoarium cap-shaped, large-sized, multiserial, multilayered with a pimply surface, sometimes ovoid (Fig. 6). Autozooids ovoid, distinct, irregularly arranged in rows, separated by thin furrows. Frontal thin, convex, finely granulated. Aperture subcircular, umbonate with a slightly concave narrow poster. Adventitious
avicularia suboral on the top of the apertures mucrons. Vicarious avicularia absent. Ovicells not observed.

Measurements:

- Lz (1, 10) 0.238-0.362 (0.074) 0.310 mm
- Lz (1, 10) 0.187-0.243 (0.120) 0.239 mm
- Lo (1, 10) 0.066-0.075 (0.093) 0.064 mm
- Io (1, 10) 0.065-0.093 (0.040) 0.082 mm

Occurrence: Sirt Basin, As Sahabi area, locality P53 formation "M". Sample nos. 5 (Fig. 4).

Distribution: Miocene (Egypt, and Libya).

**Fig. 6. Celleporaria desioi**, formation "M", P53 As Sahabi area (scale bar=2 cm).

**Celleporaria polythele** (Reuss, 1848)

*Cellepora polythele* Reuss, 1848: 77, pl. 9, Fig. 18.

*Holoporella polythele* Canu, 1912: 217, pl. 12, Figs. 1-5, pl. 13, Figs. 6, 7; Souaya, 1965: 1141, pl. 139, Figs. 1, 2.

*Celleporaria polythele* David et al., 1970: 45; El Safori, 2000: 405, fig. 5: 7; El Safori, 2002: 451.

Description: Zoarium free, massive, thick, globular, multilamellar, celledulariform. Autozooids crowded, distinct, salient, disoriented represented by variable sizes. Frontal oloyest, very convex, borderer by areolar pores, which are more definite in large Autozooids. Orifice subcircular; proximal border convex, obliques. Avicuicularia absent. Ovicells not observed. Distribution: Miocene (Egypt, Portugal, France, Italy, Austria, Poland, Guadalquivir, Spain, Algeria, Morocco); Pliocene (Spain, Italy).

4. Results and discussions

The Miocene bryozoans of North Africa and South Europe are represented in stratigraphic levels without specific new occurrences (Moissette, 1988; El Hajjaji, 1992). However, evidences for a bryozoan event during Badenian (a central Paratethys stage) of Middle Miocene time were recognized in several sections in North/South transect through the Paratethys (Zagorsek, 2015). As indicated by Holcová and Zágoršek (2008), the main factor for bryozoan accumulation is probably changes in trophic condition, together with high variability of temperature. Evidences from Paratethys Middle Miocene bryozoans without major occurrences in the bryozoan species but rather they show changes in growth from North (erect) to South (encrusting) along the Paratethys. The slight changes in bryozoan event can be recognized from their stratigraphic distributions and the domain of some species on certain horizons. El Safori (2002) recognized two bryozoan assemblage zones from Siwa Oasis accompanied by the water transgression of Middle Serravallian (Siwa sequence). These assemblages are close to equivalent assemblages from the Ar Raha Member of the Medial Paratethys stage (El Safori and Muftah, in press). The Pre-Sahabi succession of formation "M" is dated Late Tortonian based on the presence of foraminifers and calcareous nanofossils (Muftah et al., 2013) as well as Strontium isotopic dating (El-Shawaidhli et al., 2014) which represent the Late Serravallian 2nd bryozoan assemblage defined from Siwa. In additi, it is the equivalent to Serravallian-Tortonian bryozoan Member that defined from the Cairo-Suez Road section (Cherif and Yahia, 1977) on a stratigraphical basis.

A shallow neritic depositional environment for formation "M" has been interpreted by De Heinzelin and El-Arnauti (1982, 1983 and 1987) according to the lithological nature and faunal contents. The macro/microfossil contents suggest a depositional setting under transgressive inner neritic marine environment. The presence of low diversity bryozoans (Nellia tenella, Crisia spp., Celleporaria desioi, Calapensia sp., Cellaria sp., Scrupocellaria elliptica and Steginoporella iberica reussi) at some levels is clearly indicative of shallow water with low rate of sedimentation (Lagaaij and Gautier, 1965; El Safori, 2000). The presence of the membranous type *Cel-
laporaria desioi is very characteristic in this formation (Fig. 6), along with the associated species that listed in Fig. 5 are indicating the shallow marine environment of low energy conditions (Lagazzi and Gautier, 1965; El Safori, 2000). On the other hand, only three species of the above-mentioned list (Nellia tenella, Scrupocel- la elliptica and Crispa sp) are reported from the locality P96c Profile of Sahabi Formation in members "U1" and "UD" (Mutah, 2013). The presence of these three species alone indicates low energy shallow marine environment of less than 50 m.

5. Conclusions

The shallow marine carbonates of formation "M", the Late Mio- cene (Tortonian) pre-Sahabi Formation at P53 in the As Sahabi area, Sirt Basin contained low diverse and bryozoan remains. A descriptive taxonomy has been performed for fourteen species from this measured Tortonian formation "M". The reported assemblage is closely similar to that described by Cherif and Yahia, (1977) in Cairo-Suez roadcut section and partly to which represents the 2nd bryozoan assemblage defined from Siwa (El-Safori, 2002) and from the Al-Rahlah Member of Maradah Formation El-Safori and Mutah, 2019 (in press). Most of the bryozoan taxa described herein are indicative to shallow marine warm water with low sedimentation energy. The concerned taxa more or less inhabit wide geographical distribution with shallow marine environment.

Acknowledgments

We would like to thank East Libya Neogene Research Project (ELNRP) for the logistic support of the field trip. Our gratitude is also to Ain Shams University, Athens University and Benghazi University for giving us all means of support to produce this paper.

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Plate 1

Explanation of Plate 1 (Scale bar = 100 µm)

1. *Crisia elongata* (Linnaeus, 1758)
2. *Crisia hornesi* Reuss, 1847
3. *Tretocycloecia dichotoma* (Reuss, 1848)
4. *Cellaria salicornioides* Lamoroux, 1816
5. *Nelia tenella* (Lamarck, 1816)
6. *Scrupocellaria elliptica* (Reuss, 1848)
7. *Margaretta cereoides* (Ellis and Solander, 1786)
8. *Schedocleidochasma incisa* (Reuss, 1874)