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RESEARCH ARTICLE

GEOGRAPHIC DISTRIBUTION AND ENVIRONMENTAL SETTING OF *CLAVULINA PSEUDOPARISENSIS* ANAN AROUND THE ARABIAN PENINSULA

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ABSTRACT

The recent agglutinated small benthic foraminiferal species *Clavulina pseudoparisensis* Anan are common in the five coastal areas around the Arabian Peninsula: the Egyptian Red Sea coast between Qusseir-Marsa Alam, the Saudi Arabian Red Sea coast in Jeddah, the north Socotra Island of Yemen, the Abu Dhabi coast of the United Arab Emirates (UAE), and the east coast of Qatar of the Arabian Gulf. The taxonomy is presented and discussed. The warmer environment of the Red Sea, and also the other studied areas, favor precipitation of organic binding material for the sand grains of the arenaceous tests, which favor the forms thriving in shallow and warm environment. The recorded *C. pseudoparisensis* in wide geographic distribution in the Red Sea, Arabian Sea, and Arabian Gulf around the Arabian Peninsula indicates an open marine environment between these localities.

KEYWORDS

Benthic foraminifera, *Clavulina*, Arabian Peninsula, Red Sea, Arabian Gulf

1. INTRODUCTION

The Arabian Peninsula surrounded by the Red Sea from the west, Arabian Gulf from the east and Arabian Sea and Indian Ocean from the south. Recent foraminifera for five of the studied area around the Arabian Peninsula have been treated recently by some authors: from Egypt, Saudi Arabia, SA, Yemen, UAE, and Qatar (Anan, 1984; Youssef, 2015; Al-Wosabi et al., 2012; El Deeb, 1992; Al-Hitmi, 2000). The extreme evaporation rates in these arid to semi-arid regions of these marine basins result in high salinity of surface water masses with maximum values above 40% in the Red Sea (Egypt and SA), but 40-50% in shallow parts of the Arabian Gulf (UAE and Qatar). The water temperatures can fluctuate between 40°C in summer and 15°C in winter. The geographic distribution of this species is shown on figure (1).

Figure 1: The different localities of *C. pseudoparisensis* around the Arabian Penisula (Red Sea: Egypt and SA, Arabian Sea: Yemen and Arabian Gulf: UAE and Qatar).

2. MATERIAL OF STUDY

The Arabian Peninsula is surrounding by more one marine seas (Red Sea, Arabian Sea and Arabian Gulf) and represents a tropical and classical region for investigations in foraminifera taxonomy. It is currently under intensive study to understand its role in both modern and palaeoenvironmental global ocean/climate system, e. g., (Said, 1949; El-Nakhal, 1980; Anan, 1984; El Deeb, 1992; Cherif et al., 1997; Al-Hitmi, 2000; Al-Wosabi et al., 2012; Youssef, 2015). The benthic foraminifera assemblages were dominated by species belonging to suborders Textulariina, Miliolina, Lagenina, Rotaliina and rare golobigerids. Among these assemblages, this study foucused on the geography and paleontology of the diagnostic agglutinated foraminiferal species *Clavulina pseudoparisensis* (Anan, 1984).

3. SYSTEMATIC PALEONTOLOGY

The taxonomy used here is that of Loeblich & Tappan (1988).

Order Foraminiferida Eichwald, 1830

Suborder Textulariina Delage & Hérouard, 1896

Superfamily Lituolacea De Blainville, 1825

Family Ataxophragmiidae Schwager, 1877

Subfamily Valvulininae Berthelin, 1880

Genus *Clavulina* d'Orbigny, 1826

Type species *Clavulina parisiensis* d'Orbigny, 1826

Clavulina pseudoparisensis Anan, 1984 - (Plate 1, figures 1-4)

1984 *Clavulina pseudoparisensis* Anan, p. 239, pl. 1, figs. 6, 7.●{illustrated specimen}

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1992 *Clavulina pseudoparisensis* Anan - El Deeb, p. 193, pl. 1, fig. 8.

2000 *Clavulina angularis* d'Orbigny - Al-Hitmi, p. 169, pl. 1, fig. 1. ●

2012 *Martinottiella communis* d'Orbigny - Al-Wosabi et al, p. 34, pl. 1, fig. 1. ●

2015 *Clavulina tricarinata* d'Orbigny - Youssef, p. 244, fig. 12.1. ●

Remarks: The test of *Clavulina pseudoparisensis* has agglutinated, arenaceous with calcareous cement wall, triangular triserial early stage, and the early portion of the later uniserial stage is also triangular, but rounded in its later portion, aperture terminal with single tooth (Pl. 1, fig. 1). This species was originally described from the littoral coast of the Red Sea of Egypt, and later from Arabian Gulf of the UAE by (El Deeb, 1992). The figured specimens *Clavulina tricarinata* (pl. 1, fig. 2) of Youssef (2015) from the SA Red Sea is closely related to *C. pseudoparisensis*. The early triserial and later uniserial stages of the *Clavulina angularis* are triangular (Pl. 1, fig. 5). The test of the genus *Martinottiella* has early trochospiral coil with four to five chambers per whorl, later reduced to triserial, biserial, and a relatively elongate final uniserial stage. For that the figured specimen of Al-Wosabi et al (2012) is treated here to belong to *C. pseudoparisensis*. The Tertiary *C. parisiensis* (Pl. 1, fig. 6) shows a close resemblance to the *C. pseudoparisensis,* but differs in its rounded cross section along the uniserial stage. Anan (2020) proposed that *C. pseudoparisensis* may developed from the *C. parisiensis*. All the recorded species of this study are shown in Plate (1).

Plate 1

(scale bar 100 μm)

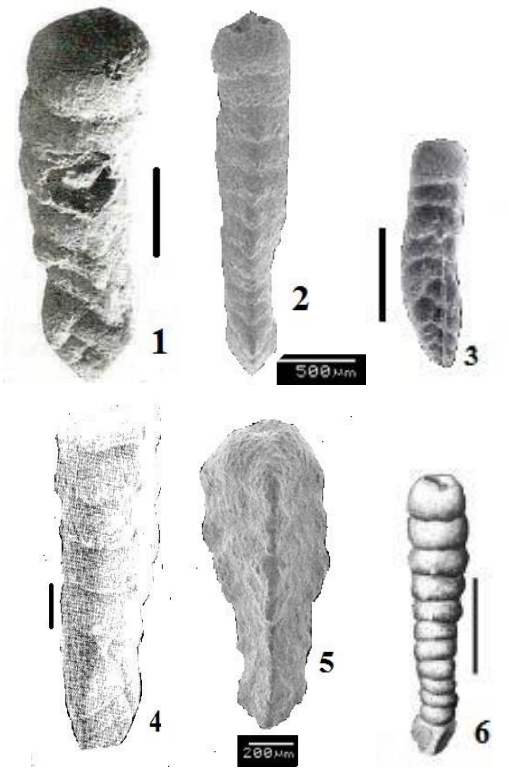

Figure 1-4: *Clavulina pseudoparisensis* Anan: **1**. (after Anan, 1984), **2**. *Clavulina tricarinata* (after Youssef, 2015), **3**. *Martinottiella communis* (after El-Wosabi et al., 2012), **4**. *Clavulina angularis* (after Al Hitmi, 2000), **5.** *Clavulina angularis* (after Youssef, 2015), **6.** *Clavulina parisiensis* (after Loeblich & Tappan, 1988).

4. Geographic Distribution

The agglutinated foraminiferal species *C. pseudoparisensis* was recorded in wide geographic distribution around the Arabian Peninsula, in the Red Sea (Egypt and SA), Arabian Sea (Yemen), and Arabian Gulf (Qatar and United Arab Emirates, UAE), which indicates an open marine environment between these localities (see Figure 1).

5. Environmental Setting

The coastal areas around the Arabian Peninsula are characterized by a relatively confined shallow shelf, which slopes gently to deeper water environments. Bottom sediments comprise sandy submarine beach. Anan (1984) noted that the greater abundance of the foraminiferal assemblage in the Egyptian Red Sea considered to be due to warmer nature of the water body. This warmer environment of the Red Sea, and also the other studied areas, favor precipitation of organic binding material for the sand grains of the arenaceous tests, which favor the forms thriving in shallow and warm environment. The existence of few planktic elements (in the Egyptian Red Sea) indicates the drifting of the sea water towards the coast. The presence of abnormal tests in the SA Red Sea suggests natural environmental stresses, e.g. changes in ecological parameters, extreme environmental conditions, or pollution (Youssef, 2015). These is a great variation in the percentages of the recorded species in the Arabian Gulf between Abu Dhabi coastal area and the study area of Qatar, which due to the coastal samples of Abu Dhabi, than Qatar samples which ranging in depth from the shore line to more than 20 fathoms (El Deeb, 1992; Al-Hitmi, 2000). On the other hand, Mohamed et al. (2013) not recorded this species in the foraminiferal assemblage of saline pool or evaporate sabkha in the Gulf of Suez (north of the Red Sea) with hypersaline basin (about 41-42‰), and it is within an arid climatic zone bordering a desert region and were evaporation greatly exceeds fresh water influx (Mohamed et al., 2013). Moreover, this species doesn't recorded in any marine coasts of the eastern part of the Mediterranean Sea or salt marsh in Tubli Bay, Bahrain (Said & Kamel, 1954; Anan, 1983; Samir & El-Din, 2001; Elshanawany et al., 2019; Kaminski et al, 2020).

6. Conclusions

The recorded *Clavulina pseudoparisensis* in five coastal areas around the Arabian Peninsula: the Red Sea of Egypt and Saudi Arabia, north Socotra of Yemen and the Arabian Gulf of UAE and Qatar, enables to present the following conclusions:

1. The agglutinated *C. pseudoparisensis* has wide geographic distribution in five localities around the Arabian Peninsula: two locations in the Red Sea, one from the Arabian Sea, and two locations in the Arabian Gulf.

2. There is no record of this species, so far, outside the study area, e.g. in any marine coast of the Mediterranean Sea, which means that this species is confined to the shallow warmer water, high salinity of surface water masses with maximum values above 40% in the Red Sea, but 40-50% in shallow parts of the Arabian Gulf.

3. Moreover, no record of this species in saline pool or evaporate sabkha, restricted basin, beside the west side of the Gulf of Suez (north of the Red Sea) with hypersaline basin, or salt marsh in Tubli Bay, Bahrain (north of Arabian Gulf).

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