

# Middle Miocene benthic foraminifera from the Al Khums area, northwestern Libya

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## ABSTRACT

The present study deals with the benthic foraminifera from three sections cropping out in the Al Khums area, northwestern Libya. Lithostratigraphically, these outcrops belong to the Al Khums Formation, which is locally subdivided into two informal members: An Naggazah and Ras Al Mannubiyah. Detailed investigation of the foraminiferal content led to the recognition of 27 species belonging to 16 genera and 13 families. The absence of index planktonic foraminifera does not enable the recognition of any planktonic biozone within the Al Khums Formation. The presence of the larger benthic foraminifera *Borelis melo melo* enables the assignment of a Middle Miocene age to this rock unit. The studied sections characterized by the common occurrence of benthic foraminiferal species living in a shallow neritic environment. This conclusion is corroborated by the co-occurrence of large oysters, corals and algae.

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## 1. Introduction

Benthic foraminifera are an important tool for detecting environmental changes, due to their great abundance in marine sediments, sensitivity to changes in their environment, short generation times and good preservation potential (e.g. Murray, 2006). They are widely used for paleoenvironmental interpretations (e.g. Cahuzac and Poignant, 2000; Filipescu et al., 2011; Pezelj et al., 2016).

Few studies have been published on the Miocene foraminifera of Libya. Significant papers are those by Berggren (1967), Barr and Weegar (1972), Van Hinte et al. (1978), Szczechura and Abd-Elshafy (1988), Sherif (1991), Abdulsamad and Barbieri (1999), Imam (1999), Hamad (2013), Abdulsamad and El Zanati (2013). The present study aims to document the benthic foraminiferal content of the studied rock unit, and to reconstruct the paleoenvironmental conditions that prevailed during the deposition of the Al Khums Formation. To carry out our goals, three sections cropping out in the Al Khums area, northwestern Libya, were studied (Fig. 1). Section Al Khums 1 was measured in the Wadi Kaam area, whereas Sections Al Khums 2 and 3 were measured to the west of Al Khums city.

## 2. Stratigraphic setting

Lithostratigraphically, the studied rock units are represented by the Al Khums Formation, which was locally subdivided by Salem and Spreng (1980) into two members: An Naggazah (at the base) and Ras Al Mannubiyah (at the top). The An Naggazah Member attains a thickness of about 7 m in Section 1, 9 m in Section 2 and about 4 m in Section 3 (Figs. 2–4). It is composed mainly of argillaceous limestone at the base followed upwards by white, massive and fossiliferous limestone with bivalves, gastropods, bryozoan fragments, foraminifera, ostracods and algae. The Ras Al Mannubiyah Member attains a thickness of about 3.5 m in Section 1 and about 10 m in Section 2 (Figs. 2 and 3). It is composed of white creamy limestone with rare foraminifera and ostracods. Regarding the age of Al Khums Formation, Mann (1975), Said (1978) and Srivistava (1979) assigned this rock unit as Middle Miocene (Langhian) on the basis of its stratigraphic position and paleontological evidences. On the contrary, Innocenti and Pertusati (1984) and El Waer (1992) assigned it as Late Miocene (Tortonian to Early Messinian) on the basis of the ostracod content. In the present study, the recorded foraminiferal content is very similar to that identified by Szczechura and Abd-Elshafy (1988) from the Middle Miocene of Egypt and Libya. Sherif (1991) and Hamad (2013) recorded similar foraminiferal faunas from Libya and assigned them also to the Middle Miocene. The presence of larger benthic foraminifera *Borelis melo melo* supports the Middle Miocene age to this rock unit (Imam,

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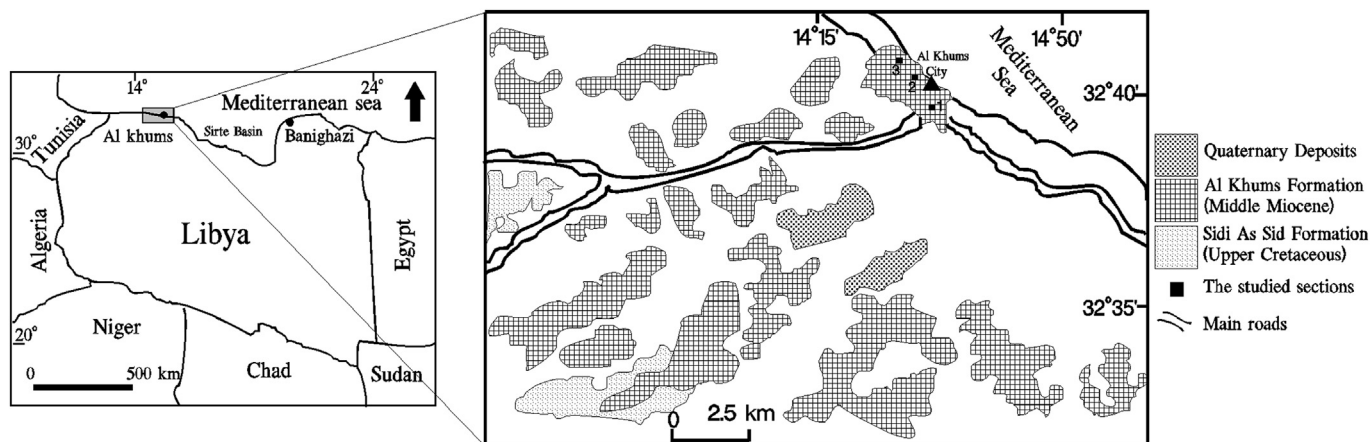


Fig. 1. Location and geologic maps of the study area.

2003; Hamad, 2013; Abdulsamad and El Zanati, 2013).

### 3. Material and methods

Fifty samples were collected, mostly carbonate rocks, from the above mentioned three sections cropping out in the Al Khums area. Approximately 100 g from each sample were soaked with a 5% H<sub>2</sub>O<sub>2</sub> solution, washed over a 63 μm mesh sieve and then dried and sieved into fractions greater than 250 μm, 125 μm and 63 μm, respectively. About 30 g of washed residue from every sample was examined under a binocular microscope at 50 magnification. Foraminiferal tests were picked and mounted on faunal slides. The identified foraminifera were photographed using Scanning Electron Microscope and illustrated in two plates.

To reconstruct the paleoecological conditions, the following quantitative data were used: 1- number of foraminiferal tests/g of dry sediment, 2- species richness, 3- relative abundance of agglutinated and calcareous foraminifera and 4- relative abundance of planktonic to benthic foraminifera.

### 4. Systematic paleontology

Detailed investigation of the foraminiferal content led to the recognition of 27 species belonging to 16 genera and 13 families. The samples were consisted of benthic foraminiferal species, whereas planktonic foraminifera are completely absent. Generic identifications of benthic foraminifera are based on the taxonomy of Loeblich and Tappan (1988). The stratigraphic distributions of the recorded species are shown in Figs. 2–4.

**Order: Foraminiferida Eichwald, 1830**  
**Suborder: Miliolina Delage and Herouard, 1896**  
**Superfamily: Miliolacea Ehrenberg, 1839**  
**Family: Spiroloculinidae Wiesner, 1920**  
**Genus: Spiroloculina d'Orbigny, 1826**  
***Spiroloculina communis* Cushman and Todd, 1944**  
 (Pl. 1, Fig. 1)

1944 *Spiroloculina communis* Cushman and Todd, p. 63, pl. 9, Figs. 4–5, 7–8.

1963 *Spiroloculina communis* Cushman and Todd - Souaya, pl. 58, Fig. 5.

1991 *Spiroloculina communis* Cushman and Todd - Sherif, pl. 2, Fig. 4.

**Occurrence and stratigraphic position:** This species was

recorded from the Miocene of Egypt (Souaya, 1963) and the Middle Miocene of Libya (Sherif, 1991). In the present study, it was rarely found in the Al Khums Formation.

**Family: Hauerinidae Schwager, 1876**  
**Subfamily: Hauerininae Schwager, 1876**  
**Genus: *Quinqueloculina* d'Orbigny, 1826**  
***Quinqueloculina laevigata* d'Orbigny, 1826**  
 (Pl. 1, Fig. 2)

1826 *Quinqueloculina laevigata* d'Orbigny, p. 301, no. 6.

1963 *Quinqueloculina laevigata* d'Orbigny - Souaya, p. 1, 55, Fig. 4a–c.

1991 *Quinqueloculina laevigata* d'Orbigny - Cimmerman and Langer, Figs. 8–11.

1991 *Quinqueloculina laevigata* d'Orbigny - Sherif, pl. 3, Fig. 11a, b.

**Occurrence and stratigraphic position:** This species was recorded from the Miocene of Egypt (Souaya, 1963; Ouda, 1998) and the Middle Miocene of Libya (Salem and Spreng, 1980; Sherif, 1991). In the present study, it rarely occurs in the Al Khums Formation.

***Quinqueloculina cuvieriana* d'Orbigny, 1839**  
 (Pl. 1, Fig. 3)

1838 *Quinqueloculina cuvieriana* d'Orbigny, p. 190, pl. 11, Figs. 19–21.

2013 *Quinqueloculina cuvieriana* d'Orbigny - Hewaidy et al., pl. 3, Fig. 1.

**Occurrence and stratigraphic position:** It was recorded from the Miocene of Egypt (Hewaidy et al., 2013). In the present study, it rarely occurs in the Al Khums Formation.

***Quinqueloculina seminulum* (Linne, 1758)**  
 (Pl. 1, Fig. 4)

1758 *Serpula seminulum* Linneaus, p. 786, pl. 2, fig. s.

1972 *Quinqueloculina seminulum* (Linne) - Luczkowska, pl. 10, Fig. 1.

2013 *Quinqueloculina seminulum* (Linne) - Hewaidy et al., pl. 3, Fig. 3.

**Occurrence and stratigraphic position:** It was recorded from the Miocene of Poland (Luczkowska, 1972) and Egypt (Hewaidy et al., 2013) and the Late Miocene of Turkey (Faranda et al., 2013). In the present study, it rarely occurs in the Al Khums Formation.

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