

Calcareous nannofossil and planktonic foraminifera biostratigraphy through the Middle to Late Eocene transition of Fayum area, Western Desert, Egypt



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ABSTRACT

The Eocene sequence exposed at Gebel Naalun (Fayum–Nile divide), Guta section-I (West of Birket Qarun near Guta Village) and Guta section-II (Northwest of Birket Qarun near Guta Village) is differentiated, from base to top, into two formations; Gehannam Formation (Middle–Late Eocene) and Birket Qarun Formation (Late Eocene), respectively.

Two calcareous nannofossil zones were recognized from the Eocene succession at Gebel Naalun; *Discoaster saipanensis* (NP17) and *Chiasmolithus oamaruensis* (NP18) zones as well as one planktonic foraminiferal zone; *Truncorotaloides (Acaranina) rohri* (P14) zone. However, at Guta section-I, two nannofossil zones were defined; *Discoaster saipanensis* (NP17) and *Chiasmolithus oamaruensis* (NP18) zones; the preservation of planktonic foraminiferal assemblage is too poor to enable us to recognize marker species as a result of many diagenetic processes. At Guta section-II, two nannofossil zones; *Chiasmolithus oamaruensis* (NP18) and *Isthmolithus recurvus* (NP19) and two planktonic foraminiferal zones; *T. pseudoampliapertura* zone and *G. semiinvoluta* zone are recorded.

Several authors found that the lowest occurrence of *Chiasmolithus oamaruensis* is a poor criterion for defining the base of NP18 Zone, which is confirmed here. The same criticism has been applied to the lowest occurrence of *Isthmolithus recurvus* which defines the NP18/NP19 zonal boundary. It is generally agreed that NP19 Zone falls in the Priabonian (Late Eocene).

As a result of the occurrence of the nannofossil marker species; *Isthmolithus recurvus* only in side views below and above the first appearance of *Chiasmolithus oamaruensis* at both Naalun and Guta section-I, this species is not reliable to define the NP18/NP19 zonal boundary. At Guta section-II, the Middle/Upper Eocene boundary can be delineated by the first appearance of *Globigerinatheka semiinvoluta* above the first occurrence of *Isthmolithus recurvus* in both plane and side views.

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1. Introduction

The Fayum depression is roughly triangular to circular in shape and occupies approximately 17,000 km². It is located in the northern part of the Western Desert of Egypt immediately to the west of the Nile Valley, about 95 km south–southwest of Cairo and 15 km north–west of Beni Suef. It lies between latitudes 28°60' and 29°50'N and longitudes 30°00' and 31°15'E (Fig. 1). Several geological, stratigraphical, sedimentological and paleontological studies were carried out in the Fayum depression.

A voluminous literature containing a great deal of new information has been gathered on the vertebrate fauna of

Fayum during the past thirty years. Surprisingly, calcareous plankton (planktonic foraminifera and calcareous nannofossils) and larger foraminifera, the most widely used biostratigraphic tools for age calibration, have seldom been studied, and then only in very localized sections (Strougo and Haggag, 1984; Haggag, 1990; Faris and Strougo, 1992; Haggag and Bolli, 1995, 1996; Bouhkary et al., 2003; Bouhkary and Kamal, 2003).

Saber (1998) studied in detail the stratigraphy and facies association of Eocene rocks; Gehannam Formation (Middle Eocene) and Birket Qarun Formation (Late Eocene) in the area between Fayum and Nile Valley (Gebel Naalun and Monqar El Lahun). He concluded that, the lower part of Gehannam Formation at Gebel Naalun was deposited mainly in subtidal lagoons under calm conditions with open circulation while its upper part was accumulated in shallow

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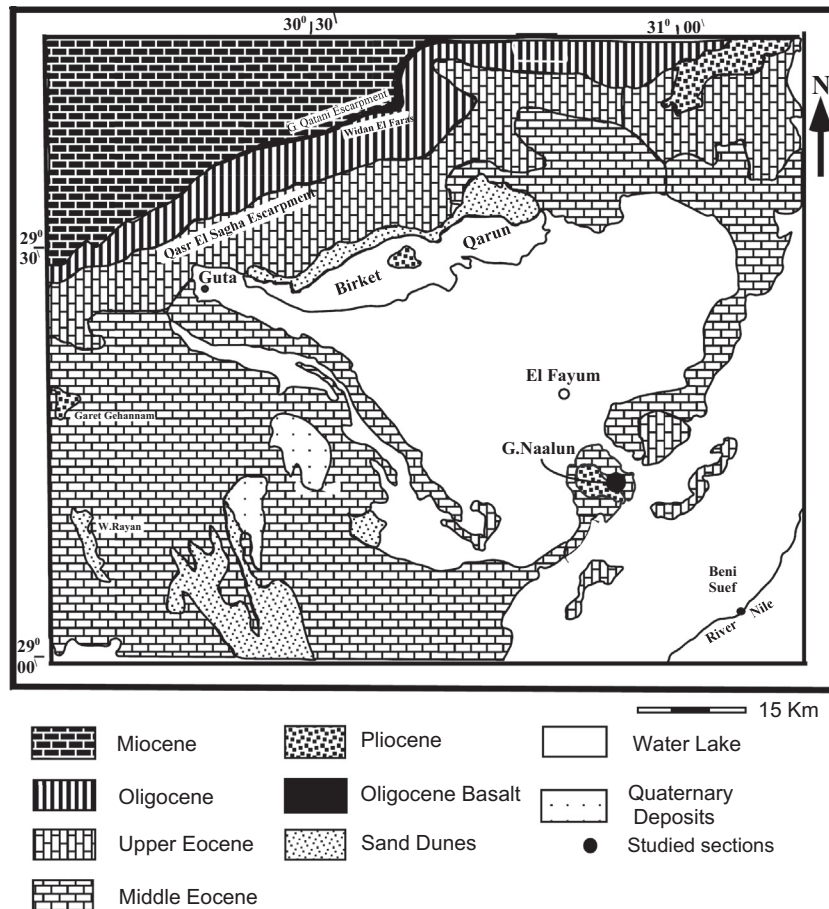


Fig. 1. Geological map of Fayum area (after Abdallah et al., 2003).

subtidal to intertidal environment with restricted circulation. Also, he mentioned that, Birket Qarun Formation was deposited in littoral environment with high energy conditions.

Strougo and Faris (2008) studied three sections from Fayum area; Gebel Naalun (Fayum-Beni Suef divide); Guta (northwest of Birket Qarun) and around the Wadi Sanur (southwest of Beni Suef). They concluded that, the marker species, *Isthmolithus recurvus*, could be used as a criterion to approximate the NP18/NP19–20 zonal boundary only if two undissociable conditions are fulfilled:

- (1) appearance above the first occurrence of *Chiasmolithus oamaruensis* (= base of Zone NP18) and,
- (2) occurrence with planktonic foraminiferal association corresponding to the *Globigerinatheka semiinvoluta* Zone.

Abd El-Azeam (2008) studied the planktonic foraminifera of the Gehannam Formation at Wadi Hitan and recognized only one planktonic foraminiferal zone; *Globigerinatheka semiinvoluta* Zone.

There is still uncertainty in the definition and recognition of global geological stage and age boundaries like the Bartonian–Priabonian boundary (Agnini et al., 2011).

Recently, Strougo et al. (2013) confirmed that the extinction of *Truncorotaloides* and *Morozovelloides* appears to be a crucial event at the middle Eocene–Late Eocene transition, and therefore, they advocate drawing the upper boundary of zone P14 at the top of this event and including the *T. pseudoampliapertura* zone at the base of P15 Zone. The latter zone could then be divided into two subzones: the *T. pseudoampliapertura* subzone (P15a) below, and the *G. semiinvoluta* subzone (P15b) above. As concerns the

calcareous nannofossils, it appears that the lowest occurrence of *Chiasmolithus oamaruensis*, the base of zone NP18 of standard schemes, correlates with the *Truncorotaloides rohri* Zone, not with the *Globigerinatheka semiinvoluta* Zone as indicated on some correlation charts (e.g., Berggren et al., 1995; Berggren and Pearson, 2005, 2006). At Wadi Hitan, the top of NP18 Zone could not be properly defined and appears to be situated higher than the interval studied.

Owing to many problems regarding the ranges of calcareous nannofossil marker taxa commonly used to construct standard zonal schemes, our chronostratigraphic interpretations are based mainly on planktonic foraminifera and calcareous nannofossil.

2. Location and materials

Three stratigraphic sections are measured, sampled and examined from Fayum province, Egypt (Fig. 1). The first section is Gebel Naalun at Southeast Fayum (Fayum–Nile divide) in the neighborhood of Dir Malak, Kalamshah Village (Lat. 29°12'N and Long. 31°54'E) and two sections west of Guta Village; Guta section-I at the west of Birket Qarun and Guta section-II at the northwestern tip of Birket Qarun (Lat. 29°26' to 29°25'N and Long. 30°23' to 30°25'E).

The samples for the present study were collected from the sedimentary sequence of the Eocene rocks in the studied sections. About 205 samples (79 samples from Gebel Naalun, 40 samples from Guta section-I and 86 samples from Guta section-II) were collected. The sample interval depends on the variations in lithology and/or bed thickness.

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