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Late Cenomanian oysters from Egypt and Jordan

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ABSTRACT

Late Cenomanian oysters occur in great numbers, wide distribution, usually as original shells, and can be used as guide fossils in northeastern Egypt and Jordan. Six genera including seven species of typical Tethyan palaeobiogeographic affinity have been recorded from two sections, Wadi Al-Atashieh in central Jordan and west Saint Anthony in north eastern Egypt. The oyster assemblages exhibit a similar stratigraphic trend in Egypt and Jordan. As a result, four oyster zones can be recognized in the upper Cenomanian succession i.e., *Ceratostreon flabellatum, Ilymatogyra africana, Costagyra olisiponensis*, and *Pycnodonte* (*Phygraea*) *vesicularis vesiculosa*. These zones are correlated with the equivalent ammonite zones. Extinction of some species of these oysters toward the Cenomanian/Turonian (C/T) boundary may be linked to the eustatic sea level rise.

1. Introduction

Cenomanian successions in Jordan are widely distributed and well exposed. They are characterized by sporadic planktonic micro- and macrofossil assemblages due to their deposition in comparatively shallow environments. Late Cenomanian oysters are highly diverse, abundant and well preserved, and are widely distributed in the Tethys Ocean (Dhondt et al., 1999; Dhondta and Jaillard, 2005). These taxa can be used as excellent guide fossils. Previous studies of this group concentrated on the taxonomy and many of them neglected to discuss its importance for the biostratigraphy of the eastern Tethys (e.g., Malchus, 1990; Aqrabawi, 1993; Ahmad and Al-Hammad, 2002; Zakhera and Kassab, 2002; Zakhera et al., 2002; Perrilliat et al., 2006; Berndt, 2002; Abdel-Gawad et al., 2004a,b, 2007; El-Qot, 2006; Mekawy, 2007; Hewaidy et al., 2012; Ayoub-Hannaa and Fürsich, 2011). The aim of this study is to demonstrate the biostratigraphic importance of Cenomanian oysters in Jordan and Egypt and to discuss their palaeobiogeographic affinities. Biostratigraphy of the oysters is correlated with that of the ammonites, which have been encountered in the same sections. Oysters and ammonites were collected from two outcrops; west of Saint Anthony at southern Galala, western Gulf of Suez, Egypt (co-ordinates: 28°57′53.5″N, 32°25′45″E) and at Wadi Al-Atashieh, south-eastern Dead Sea, Jordan (31°02′17″N, 35°34′55″E) (Fig. 1).

2. Geological setting

Cenomanian deposits are the products of the first major transgression that occurred during the Cretaceous period in the eastern Tethys. This major Cenomanian transgression covered large parts of the southern margins of the Tethys where predominantly shallow-water platform sediments were deposited during the Cenomanian and Turonian interval (Burdon and Quennell, 1959; Wetzel and Morton, 1959; Blanckenhorn, 1934; Powell, 1989) overlying Aptian–Albian fluvio-marine deposits. The Cretaceous succession at East Saint Anthony section has been classified, from base to top, into a number of formations (Ghorab, 1961; Awad and Abdallah, 1966; Abdallah and Eissa, 1970; Kuss, 1986): Malha (Aptian–Albian), Galala (Cenomanian), Abu Qada (early Turonian), Wata (Turonian), Matulla (Coniacian–Santonian), Gebel Thelmet (late Campanian), and Saint Anthony (Maastrichtian). The Cretaceous rocks are unconformably overlain by the Southern Galala Formation of Paleogene age. In Jordan, the Cretaceous succession has been subdivided into three lithostratigraphic units, which are the Kurnub Group (Berriasian–Albian),

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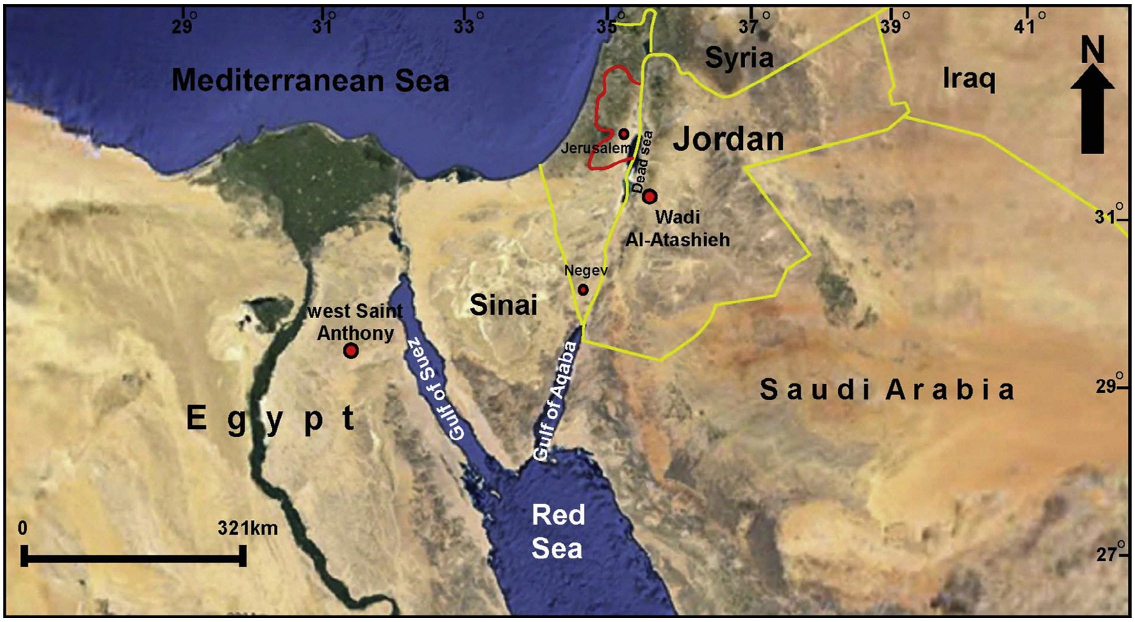

Fig. 1. Landsat image showing the location of the studied sections (source from Google Earth).

the Ajlun Group (Albian–Cenomanian to mid-Coniacian), and the Late Cretaceous–Eocene Belqa Group (Quennell, 1951; Burdon and Quennell, 1959; Powell, 1989; Powell and Moh'd, 2011; Bandel and Salameh, 2014). The groups are separated from each other by regional unconformities as was stated among others by Powell et al. (1996) and Powell and Moh'd (2011).

3. Lithostratigraphy

In Egypt, the Cenomanian is represented by the Galala Formation (Awad and Abdallah, 1966) which attains about 95 m at the west Saint Anthony section. The formation is well exposed and widely distributed forming mainly the foot of the escarpment of the Galala Plateau. The Galala Formation has been subdivided into three members named, from base to top, Abu Had, Mellaha Sandstone (Ghorab, 1961), and Ekma (Cherif et al., 1989) (Fig. 2).

The Abu Had Member is composed of shales intercalated with sandy marl and limestone yielding abundant macrofossils represented by bivalves, gastropods, echinoids and ammonites. Oysters occasionally form concentrations, generally of shallow-water origin. Starting with the lower boundary of the Galala Formation hemiasterid echinoids are very common, with the consistent occurrence of *Hemiaster cubicus* (Farouk, 2015).

The Mellaha Sandstone Member consists of friable sandstone representing a nearshore marine environment with an about 10-m-thick marl intercalation containing *Pycnodonte* (*Phygraea*) *vesicularis vesiculosa* in its middle.

The Ekma Member is composed mainly of argillaceous limestone interbedded with marl and shale bands. It is fossiliferous, especially toward the top, containing among others ammonites.

The Galala Formation unconformably overlies the fluvial cross-bedded sandstone of the Aptian–Albian Malha Formation. The contact is easily recognized in the field and characterized by a sharp, irregular, erosional surface with paleo-soils, roots, wood trunks and layers with iron oxides. Its upper contact with the Lower Turonian Abu Qada Formation (Ghorab, 1961) is also unconformable.

In Jordan, the Cenomanian–Turonian Ajlun Group is represents a shallow-marine platform setting subdivided into intra-platform basins (Kuss et al., 2003). The sediments of the Ajlun Group in Jordan have been deposited on a continental shelf with somewhat undulating surface. It was bordered by the open sea in the North and by land in the south and southeast. It can be classified into the Naur Limestone, Fuheis, Hummar Shuayb, and Wadi As Sir Limestone formations (Powell, 1989) (Fig. 3). Bandel and Salameh (2014) differentiated, near Amman, eight formations. From older to younger these are Rumeimin, Salihi, Suweilih, Naur (these four first formations have, in several studies, been united in the "Naur Limestone"), Fuheis, Hummar, Shuayb and Wadi Sir. Bandel and Salameh (2014), further subdivided these formations into 37 members, which can be recognized and studied in the area of Amman, especially around the Rumeimin area. Altogether they have traditionally been interpreted to compose the Ajlun Group that is dominated by limestones and marls and is overlain by chalks, flint-rich chalks and calcareous siltstone and marls of the Belqa Group (Wetzel and Morton, 1959).

The Naur Limestone Formation (Lower Cenomanian) represents the first transgressive phase of the Tethys during the Late Cretaceous, overlying alluvial plain deposits of the Kurnub Group (Powell, 1989). It consists mainly of bedded sandy limestone with few shale intercalations and changes to nodular limestone interbedded with shale and sandy limestone up-section. An Early Cenomanian age has been assigned to the Naur Limestone Formation by Powell (1989), Khalil (1992), and Shawabekeh (1998), while other authors assigned a Late Albian to Early Cenomanian age to the formation (e.g., Wetzel and Morton, 1959; Burdon and Quennell, 1959; Basha, 1978; Dilley, 1985; Ibrahim, 1993; Berndt, 2002; Schulze et al., 2005; Bandel and Salameh, 2014). Based on the biozonation with the aid of calcareous nannofossil as represented by Schulze et al. (2005), the Naur Limestone Formation lies in CC9 of Albian–Early Cenomanian age.

The Fuheis Formation (Upper Cenomanian), forming gentle slopes, consists of gray-green calcareous siltstone, beside nodular limestones rich in oysters which prefer shallow water. The Fuheis Formation is followed unconformably by the cliff-forming Karak Limestone, especially at Wadi Al-Atashieh. It consists of dolomitic limestone, highly bioturbated at the base, with a thickness ranging from 18 m in Wadi Mujib to 10 m in Wadi Al-Atashieh. *Neolobites vibrayeanus*, abundant *Ilymatogyra africana*