Geologia Croatica | 62/1 | 19–30 | 3 Figs. | 2 Tabs. | 2 Pls. | Zagreb 2009

Late Cenomanian ostracod faunas from the area south of Ain Sukhna, western side of the Gulf of Suez, Egypt

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Geologia Croatica

ABSTRACT

Ostracod faunas from an exposure of the Cenomanian Galala Formation in the area south of Ain Sukhna on the western side of the Gulf of Suez have yielded 11 species belonging to 10 genera. The recorded speciesare have been taxonomically described, discussed where required, and illustrated. The ostracod assemblage is characteristic for the late Cenomanian. It is composed of taxa of a typical marine shelf setting. The majority of the recorded species have a vastly extended geographic distribution in the areas along the southern shores of Tethys, indicating the absence of significant geographic barriers along this stretch during the late Cenomanian.

Keywords: Ostracods, late Cenomanian, Southern Tethys, Egypt

1. INTRODUCTION

The studied section is located on the western side of the Gulf of Suez, 5 km south of Ain Sukhna at latitude 29°33′17″ and longitude 32°20′24″ (Fig. 1). It consists of yellowish and grayish calcareous marls assigned to the Cenomanian Galala Formation (Fig. 2). It is underlain by a covered interval resting upon a ~70 m thick succession of varicoloured sandstones with minor clay, marl and limestone interbeds of the Permo-Triassic Qiseib Formation of ABDALLAH & ADINDANI (1963). It is overlain by ~100 m of intercalated limestones and dolomites assigned by KERDANY et al. (1973) to the Senonian, followed by Eocene limestones. A well-preserved ostracod fauna has been retrieved from the Galala Formation. The investigated section was previously studied for foraminifers (KERDANY et al., 1973) and ostracods (BOUKHARY et al., 1977). Re-investigation of the present section for ostracods yielded an additional faunal record which has not been documented in the previous study. The recorded fauna has been classified following updated taxonomy. Furthermore, it has been studied for biostratigraphic as well as palaeobiogeographic aspects.

The number of previous studies dealing with the Cenomanian ostracods of Egypt has been substantially increased and many publications are now available. Significant papers are those by BOLD (1964), COLIN & EL DAKKAK (1975), BOUKHARY et al. (1977), HATABA & AMMAR (1990), SHAHIN (1991), SHAHIN & KORA (1991), ORABI & ISMAIL (1993), SHAHIN et al. (1994), ISMAIL (1999), SZCZECHURA et al. (1991), ISMAIL & SOLIMAN (1997), ISMAIL (1999, 2001), MORSI & BAUER (2001) and BASSIOUNI (2002). Since Egypt was a part of the South Tethyan Palaeobiogeographic province during the Cenomanian, studies dealing with other areas in North Africa and the Middle East are equally important. The publications of BASSOULLET & DAMOTTE (1969), DAMOTTE & SAINT-MARC (1972), GROSDIDIER (1973), ROSENFELD & RAAB (1974), GERRY & ROSENFELD (1973), AL-ABDUL-RAZZAQ (1979), BEN YOUSSEF (1980), AL-ABDUL-RAZZAQ & GROSDIDIER (1981), BISMUTH et al., (1981a, b), AL-FURAIH (1983), GARGOURI-RAZGALLAH, 1983), BABINOT (1985), BABINOT & BASHA (1985),

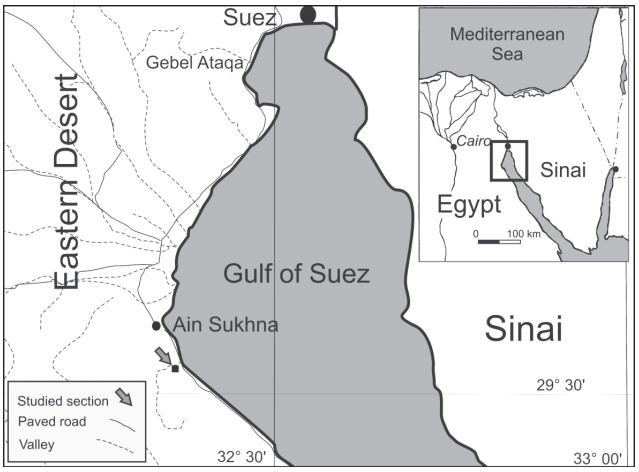


Figure 1: Location map of the studied section.

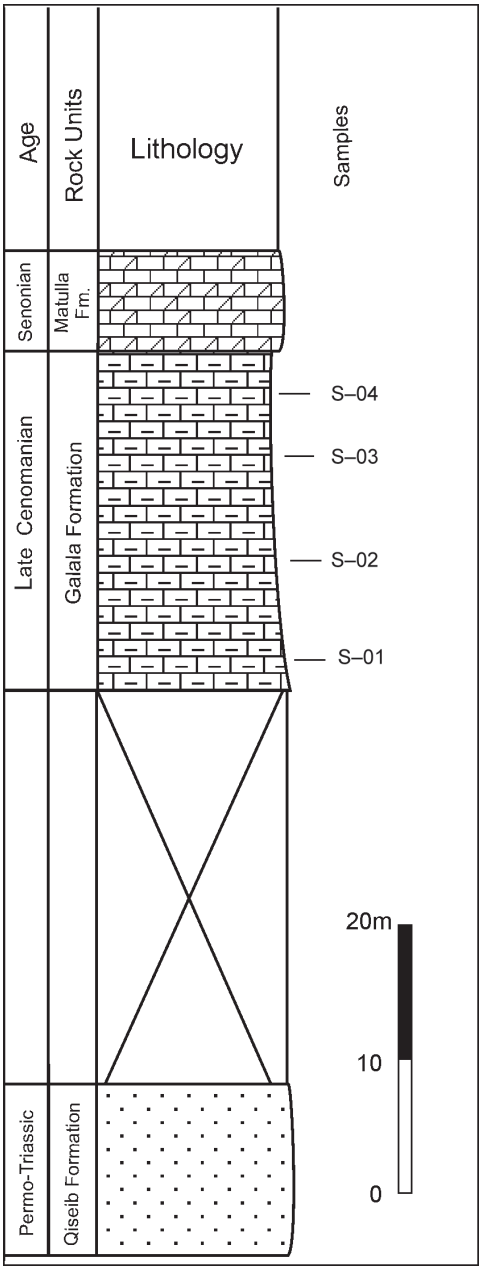


Figure 2: Stratigraphic log of the studied section.

Table 1: Stratigraphic distribution of ostracods in the studied section.

Age	Formation	Samples	*Paracypris dubertreti*	*Neocythere? mackenziei*	*Veeniacythereis streblolophata schista*	*Peloriops pustulata*	*Dolocytheridea atlastica*	*Metacytheropteron berbericum*	*Cythereis namousensis*	*Cytherella aegyptiensis*	*Eocytheropteron? cf. punctata*	*Peloriops aegyptiaca*	Gen. Indet. sp.
Late Cenomanian	Galala Fm.	S–04					•	•	•				
		S–03				•	•	•	•	•	•	•	•
		S–02	•	•	•	•	•	•	•	•	•		
		S–01	•	•	•	•	•	•	•				

DAMOTTE (1985, 1995), VIVIÉRE (1985), ATHERSUCH (1988, 1994), BABINOT & COLIN (1988), MAJORAN (1988, 1989, 1996), ANDREU-BOUSSUT (1991), ANDREU (1993), ABDALLAH et al. (1995), GEBHARDT (1999), COLIN et al. (2001), LUGER (2003) and SCHULZE et al. (2004) have also been used here.

2. SYSTEMATIC DESCRIPTIONS

The studied faunas yielded 11 ostracod species belonging to 10 genera (Table 1). The classification used here is that adopted in HORN et al. (2002). Morphological and taxonomic remarks have been given to previously known species wherever necessary. Reference numbers (AC–01 to AC–29) are given only to the illustrated specimens. They have been photographed using the *Cam Scan* SEM of Bremen University, Germany, and are permanently stored at the Geology Department, Faculty of Science, Ain Shams University (Cairo, Egypt).

Class Ostracoda LATRIELLE, 1806
Subclass Podocopa MÜLLER, 1894
Order Platycopida SARS, 1866
Suborder Platycopina SARS, 1866
Superfamily Cytherelloidea SARS, 1866
Family Cytherellidae SARS, 1866
Genus *Cytherella* JONES, 1849
Type species: *Cytherina ovata* ROEMER, 1840
***Cytherella aegyptiensis* COLIN & EL DAKKAK, 1975**
(Pl. 1, Figs. 1–2)

1974 *Cytherella* gr. *ovata* (ROEMER) – ROSENFELD & RAAB, p. 3, pl. 1, figs. 3–5
1975 *Cytherella aegyptiensis* n.sp. – COLIN & EL DAKKAK, p. 50, pl. 1, figs. 2–3
1977 *Cytherella ovata* (ROEMER) – BOUKHARY et al., p. 156, pl. 1, fig. 10a–b
1991 *Cytherella* cf. *eosulcata* COLIN – SHAHIN, p. 133, pl. 1, figs. 3–4
1991 *Cytherella aegyptiensis* COLIN & EL DAKKAK – SZCZECHURA et al., p. 12, pl. 1, figs. 1–6

1994 *Cytherella ahmadiensis* AL-ABDUL-RAZZAQ – SHAHIN et al., p. 36, pl. 1, figs. 1–2

2001 *Cytherella aegyptiensis* COLIN & EL DAKKAK – MORSI & BAUER, p. 383, pl. 1, figs. 1–2

Material: 11 specimens.

Dimensions: Length: 0.92–0.96 mm; height: 0.59–0.61 mm; width: 0.51–0.53 mm.

Stratigraphic and geographic distribution: This species is known from the Cenomanian of Egypt (COLIN & EL DAKKAK, 1975; BOUKHARY et al., 1977; SHAHIN et al., 1994; MORSI & BAUER, 2001; SZCZECHURA et al., 1991), Lower Cenomanian of Jordan (BABINOT & BASHA, 1985) and the Cenomanian–Turonian of Israel (ROSENFELD & RAAB, 1974). In the studied section, it occurs in the upper Cenomanian, samples S–02 and S–03.

Order Podocopida MÜLLER, 1894
Suborder Cypridocopina JONES, 1901
Superfamily Cypridoidea BAIRD, 1845
Family Candonidae KAUFMANN, 1900
Genus *Paracypris* SARS, 1923
Type species: *Paracypris polita* SARS, 1866
***Paracypris dubertreti* DAMOTTE & SAINT-MARC, 1972**
(Pl. 1, Figs. 3–4)

1972 *Paracypris dubertreti* n.sp. – DAMOTTE & SAINT-MARC, p. 276, pl. 1, fig.1

1974 *Paracypris acutocaudata* n.sp. ROSENFELD *in* ROSENFELD & RAAB, p. 8, pl. 1, figs. 22–24

1977 *Paracypris acutocaudata* ROSENFELD – BOUKHARY et al., p. 157, pl. 1, figs. 8a–c, 9a–c

1984 *Paracypris acutocaudata* ROSENFELD – ROSENFELD & RAAB, p. 116

1985 *Paracypris dubertreti* DAMOTTE & SAINT-MARC – VIVIERE, p.149, pl. 3, figs. 6–7

1989 *Paracypris dubertreti*? DAMOTTE & SAINT-MARC – MAJORAN, p.10, pl. 2, figs. 10–12

1994 *Paracypris acutocaudata* ROSENFELD – SHAHIN et al., p. 41, pl. 1, fig. 23

1999 *Paracypris acuta* (CORNUEL) – ISMAIL, p. 309, pl. 3, figs. 14–15

1999 *Paracypris acutocaudata* ROSENFELD – ISMAIL, p. 310, pl. 3, figs. 16–17

2001 *Paracypris dubertreti* DAMOTTE & SAINT-MARC – MORSI & BAUER, p. 385, pl. 2, figs. 4–5

2001 *Paracypris dubertreti* DAMOTTE & SAINT-MARC – HEWAIDY & MORSI, p. 239, pl. 2, fig. 6.

2002 *Paracypris dubertreti* DAMOTTE & SAINT-MARC – BASSIOUNI, p. 19, pl. 2, figs. 5–9

Material: 3 specimens.

Dimensions: Length: 0.72–0.74 mm; height: 0.26–0.27 mm.

Stratigraphic and geographic distribution: This species was first described from the middle and upper Cenomanian of Lebanon (DAMOTTE & SAINT-MARC, 1972), Aptian to upper Cenomanian of Israel (ROSENFELD & RAAB, 1974, 1984), Cenomanian of Algeria (MAJORAN, 1989) and Jordan (SCHULZE et al., 2004), Cenomanian–Lower Turonian of Algeria (VIVIÉRE, 1985) and Aptian–Albian and Cenomanian of Egypt (BOUKHARY et al., 1977; SHAHIN et al., 1994; ISMAIL, 1999, MORSI & BAUER, 2001; HEWAIDY & MORSI, 2001; BASSIOUNI, 2002). Here, it occurs in the Upper Cenomanian, samples S–01 and S–02.

Superfamily Cytheroidea BAIRD, 1850
Family Cytherideidae SARS, 1925
Subfamily Cytherideinae SARS, 1925
Genus *Dolocytheridea* TRIEBEL, 1938
Type species: *Cytherina hilseana* ROEMER, 1841
***Dolocytheridea atlasica* BASSOULLET & DAMOTTE, 1969**
(Pl. 1, Figs. 5–8)

1969 *Dolocytheridea atlasica* n.sp. BASSOULLET & DAMOTTE, p. 139, pl. 2, figs. 9a–d

1973 *Dolocytheridea* cf. *atlasica* BASSOULLET & DAMOTTE – GROSDIDIER, pl. 3, fig. 22

1974 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – ROSENFELD & RAAB, p. 11, pl. 2, figs. 12–13

1975 *Dolocytheridea* (*Puracytheridea?*) *atlasica* BASSOULLET & DAMOTTE – COLIN & EL DAKKAK, p. 57, pl. 2, fig. 3

1977 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – BOUKHARY et al., p. 157, pl. 1, fig. 11

1980 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – BEN YOUSSEF, p. 91, pl. 5, figs. 12–13; pl. 6, fig. 19

?1981a *Parakrithe* sp. – BISMUTH et al., p. 230, fig. 6

?1983 *Schuleridea* sp. – GARGOURI-RAZGALLAH, p. 185, pl. 31, fig. 10

1985 *Dolocytheridea* aff. *atlasica* BASSOULLET & DAMOTTE – VIVIÉRE, p. 154, pl. 4, figs. 1–2

?1989 '*Dolocytheridea*' *polymorphica* n.sp. – MAJORAN, p. 11, pl. 3, figs. 10–13

1991 *Dolocytheridea*? sp. 4 – ANDREU-BOUSSUT, p. 508, pl. 16, figs. 1–3

1991 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – SZCZECHURA et al., p. 16, pl. 3, figs. 1–10

?1991 *Dolocytheridea*? *atlasica* BASSOULLET & DAMOTTE – SZCZECHURA et al., pl. 3, fig. 11

1994 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – SHAHIN et al., p. 47, pl. 2, figs. 14–15

2001 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – COLIN et al., p. 94, pl. 1, figs. 7–8

2001 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – ISMAIL, fig. 12: 4–6.

2001 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – MORSI & BAUER, p. 387, pl. 2, fig. 14.

2002 *Dolocytheridea atlasica* BASSOULLET & DAMOTTE – BASSIOUNI, p. 25, pl. 4, figs. 12–16

Material: 44 specimens.

Dimensions: Length: 0.68–0.76 mm; height: 0.37–0.43 mm; width: 0.37–0.40 mm.

Remarks: The descriptions and illustrations of the present species in the above mentioned citations show variations in the degree of angularity at the posteroventral corner, which are considered conspecific. These variations are observed in the present material and have been also noted by MAJORAN (1989) and BASSIOUNI (2002), and discussed by BASSIOUNI (op. cit.). As BASSIOUNI remarked, variations in the size of the present species are also present in the different areas. The size range of our material is comparable with that recorded by COLIN & EL DAKKAK (1975) and BASSIOUNI (2002) and relatively larger than in the other records listed in the synonymy.

Stratigraphic and geographic distribution: *Dolocytheridea atlasica* is widely known from the lower and upper Cenomanian of Algeria (BASSOULLET & DAMOTTE, 1969; VIVIÉRE, 1985; MAJORAN, 1989), lower and upper Cenomanian of Israel (ROSENFELD & RAAB, 1974), Cenomanian of Morocco (ANDREU-BOUSSUT, 1991; ANDREU, 1993), Tunisia (BEN YOUSSEF, 1980; BISMUTH et al., 1981a; GARGOURI-RAZGALLAH, 1983) and Jordan (BABINOT & BASHA, 1985; SCHULZE et al., 2004) and upper Albian to Cenomanian of Oman (BABINOT & BOULARDILLON DE GRISSAC, 1989; COLIN et al., 2001) and Iran (GROSDIDIER, 1973). It was also recorded in the upper Albian–Cenomanian of Iraq (RICHE & PRISTAT, 1980) and the Cenomanian of Libya and Somalia (COLIN et al, 2001). In Egypt, it is recorded from the (?) late Albian–Turonian (SHAHIN et al., 1994; COLIN & EL DAKKAK, 1975; BOUKHARY et al., 1977; SZCZECHURA, et al., 1991; ISMAIL, 2001; MORSI & BAUER, 2001; BASSIOUNI, 2002). In the present study, this species occurs in the upper Cenomanian, samples S–01, S–02, S–03 and S–04.

Family Cytheruridae MÜLLER, 1894
Genus *Eocytheropteron* Alexander, 1933
Type species: *Cytheropteron bilobatum* ALEXANDER, 1929
Eocytheropteron? cf. *punctata* (BASSIOUNI, 2002)
(Pl. 1, Figs. 9–12)

1977 *Aversovalva* sp. BOUKHARY et al., p. 158, pl. 1, fig. 5a–b

cf. 2002 *Majungaella hevyonensis punctata* n.sp. BASSIOUNI, p. 61, pl. 13, figs. 6–10

Material: 5 specimens.

Dimensions: Length: 0.43–0.45 mm; height: 0.25–0.26 mm; width: 0.26 mm.

Remarks: The present species is assigned to the genus *Eocytheropteron* ALEXANDER, 1933 as it resembles other known species belonging to this genus in having similar lateral and dorsal outlines, a posteriodorsal caudal process as well as a ventrolateral extension overreaching the ventral margin. However, this assignment is made questionable since no open valves have been found and the internal features could not hence be investigated. The species to which our material has been conferred was erected by BASSIOUNI (2002) as a new subspecies of *Neocythere*? *hevyonensis* ROSENFELD & RAAB, 1974, from the early Cenomanian of Egypt, being both assigned to the genus *Majungaella* GRÉKOFF, 1963. The assignment of *Eocytheropteron*? *punctata* to this genus is questionable since no open valves were described for this species and as *Majungaella* is known more for the southern Gondwana. The present material deviates from *E.*? *punctata* in having a broader, less protruding posterior caudal process. *Eocytheropteron retroversicardinatum* AL-ABDULRAZZAQ, 1980, from the early Cenomanian of Kuwait is punctate like the present specimens and *Eocytheropteron*? *punctata*, but has a different lateral outline and its posterior caudal process is more ventrally situated.

Stratigraphic and geographic distribution: The present species was previously recorded in the Lower and Upper Cenomanian of Egypt (BOUKHARY et al., 1977; BASSIOUNI, 2002). In the present area, it is observed in the upper Cenomanian, samples S–02 and S–03.

Genus *Metacytheropteron* OERTLI, 1957
Type species: *Metacytheropteron elegans* OERTLI, 1957
Metacytheropteron berbericum (BASSOULLET & DAMOTTE, 1969)
(Pl. 1, Figs. 16–20)

1969 *Cytheropteron berbericus* n.sp. BASSOULLET & DAMOTTE, p. 137, pl. 2, fig. 7a–d

1973 *Metacytheropteron parnesi* SOHN – GROSDIDIER, p. 150, pl. 6, fig. 54a–d

1974 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – ROSENFELD & RAAB, p. 12, pl. 2, figs. 26–28; pl. 5, figs. 2–4

1975 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – COLIN & EL DAKKAK, p. 58, pl. 2, figs. 8–11

1977 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – BOUKHARY et al., p. 158, pl. 1, figs. 2a–b, 3a–c

1978 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – BABINOT et. al., p. 21, pl. 4, fig. 10

1980 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – BEN YOUSSEF, p. 89, pl. 6, fig. 21

1981a *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – BISMUTH et al., p. 225, pl. 8, figs. 7–8

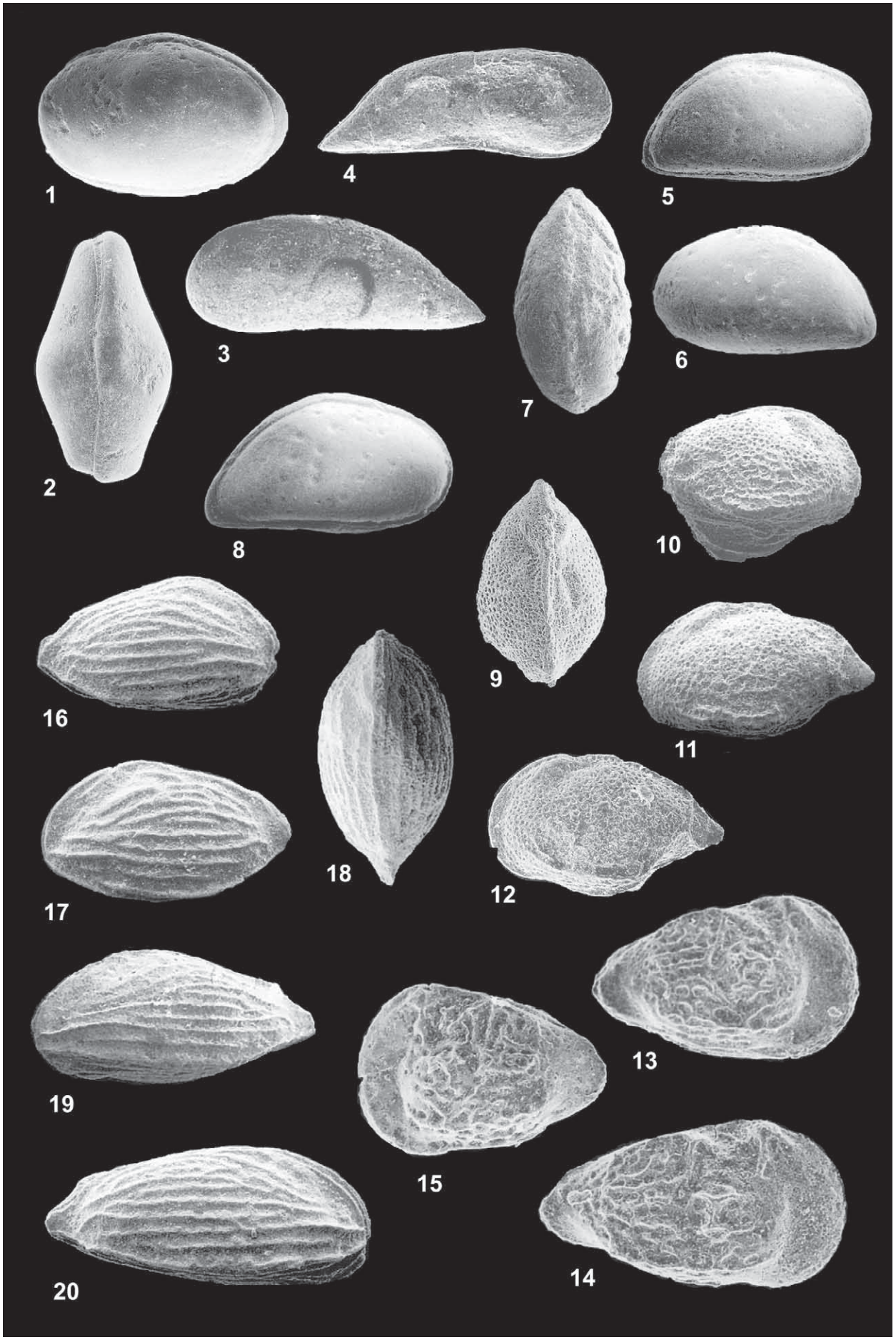
1983 *Metacytheropteron pleura* n.sp. AL-FURAIH, p. 2, pl. 1, figs. 1–2

1983 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – GARGOUI-RAZGALLAH, p. 150, pl. 27, figs. 2–5

Plate 1

1–2 *Cytherella aegyptiensis* COLIN & EL DAKKAK, 1975. Galala Formation, sample 02, 1, AC–01, L 0.92 mm, LVC; 2, AC–02, W 0.53 mm, DVC.
3–4 *Paracypris dubertreti* DAMOTTE & SAINT-MARC, 1972. Galala Formation, sample 02, 3, AC–03, L 0.72 mm, LVC; 4, AC–04, L 0.74 mm, RVC.
5–8 *Dolocytheridea atlasica* BASSOULET & DAMOTTE, 1969. Galala Formation, sample 03, 5, AC–05, L 0.76 mm, RVC; 6, AC–06, L 0.72 mm, LVC; 7, AC–07, W 0.37 mm, DVC; 8, AC–08, L 0.68 mm, RVC.
9–12 *Eocytheropteron*? cf. *punctata* (BASSIOUNI, 2002). Galala Formation, sample 02, 9, AC–09, W 0.26 mm, DVC; 10, AC–10, L 0.43 mm, RVC; 11, AC–11, L 0.43 mm, LVC; 12, AC–12, L 0.45 mm, LVC.
13–15 *Neocythere*? *mackenziei* (MAJORAN, 1989). Galala Formation, sample 02, 13, 15, females: 13, AC–13, L 0.48 mm, RVC; 15, AC–15, L 0.46 mm, LVC; 14, male, AC–14, L 0.49 mm, RVC.
16–20 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE, 1969). Galala Formation, sample 02, 16–19, females: 16, AC–16, L 0.48 mm, RVC; 17, AC–17, L 0.51 mm, LVC; 18, AC–18, W 0.27 mm, DVC; 19, AC–19, L 0.51 mm, LVC; 20, male, AC–20, L 0.61 mm, RVC.

Abbreviations:
RVC: right view carapace, LVC: left view carapace, DVC: dorsal view carapace, L: length, W: width.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1985 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – VIVIÉRE, p. 251, pl. 26, figs. 9–10

1988 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – ATHERSUCH, p. 7201, pl. 1, figs. 12–13

1989 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – MAJORAN, p. 14, pl. 6, figs. 1–2

1991 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – SHAHIN & KORA., p. 683, fig. 9:20

1991 *Metacytheropteron* cf. *berbericus* (BASSOULLET & DAMOTTE) – SZCZECHURA et al., p. 23, pl. 4, fig.15; pl. 10, fig. 1

1991 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – SHAHIN, p. 142, pl. 3, figs. 5–6

1991 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – SHAHIN & KORA, p. 682, fig. 9:20

1994 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – ATHERSUCH, p. 263, pl. 12.1, figs. 12–13

1994 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – SHAHIN et al., p. 51, pl. 3, figs. 2–3

1995 *Metacytheropteron berbericus* (BASSOULLET & DAMOTTE) – ABDALLAH et al., p. 531, fig. 20:12

1997 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – ISMAIL & SOLIMAN, p. 174, pl. 3, figs. 8–9

1999 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – ISMAIL, p. 309, pl. 3, fig. 13

2001 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – ISMAIL, fig. 12:11–12

2001 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – MORSI & BAUER, p. 390, pl. 3, figs. 14–15

2002 *Metacytheropteron berbericum* (BASSOULLET & DAMOTTE) – BASSIOUNI, p. 46, pl. 10, figs. 4–5

Material: 29 specimens.

Dimensions: Length, 0.48–0.51 mm; height, 0.25–0.28 mm; width 0.27 mm (females);

Length, 0.61 mm; height, 0.26 mm (male).

Stratigraphic and geographic distribution: This species has a wide distribution in North Africa and the Middle East. In Algeria, where it was first described, it was recorded throughout the Cenomanian (BASSOULLET & DAMOTTE, 1969; VIVIÉRE, 1985; MAJORAN, 1989). It was also found in the upper Albian–Cenomanian of Tunisia (BEN YOUSSEF, 1980; BISMUTH et al., 1981a; GARGOURI-RAZGALLAH 1983; ABDALLAH et al., 1995), Cenomanian of Israel (ROSENFELD & RAAB, 1974; MAJORAN, 1989), Jordan (BABINOT & BASHA, 1985; SCHULZE et al., 2004), Saudi Arabia (AL-FURAIH, 1983), Oman (ATHERSUCH, 1988, 1994; BABINOT & BOULARDILLON DE GRISSAC, 1989) and Iran (GROSDIDIER, 1973). From southern Europe, it was recorded in the upper Cenomanian of the western Portugese basin (BABINOT, et al., 1978). In Egypt, it is similarly known from the (?)Albian–Cenomanian (COLIN & EL DAKKAK, 1975; BOUKHARY et al., 1977; SHAHIN, 1991; SHAHIN & KORA, 1991; SZCZECHURA, et al. 1991; SHAHIN et al., 1994; ISMAIL & SOLIMAN, 1997; ISMAIL, 1999, 2001; MORSI & BAUER, 2001; BASSIOUNI, 2002). In the present material, *Metacytheropteron berbericum* comes from the Upper Cenomanian, samples S–01, S–02, S–03 and S–04.

Family Progonocytheridae MERTENS, 1956
Genus *Neocythere* MERTENS, 1956
Type species: *Neocythere vanveenae* MERTENS, 1956
Neocythere? *mackenziei* (MAJORAN, 1989)
(Pl. 1, Figs. 13–15)

1989 '*Eucythere' mackenziei* n.sp. MAJORAN, p. 13, pl. 5, figs. 1–5

2002 ?*Eucythere mackenziei* MAJORAN – BASSIOUNI, p. 31, pl. 15, figs. 3–4

Material: 4 specimens.

Dimensions: Length: 0.46–0.48 mm; height: 0.29–0.33 mm (females);

Length: 0.49 mm; height: 0.26 mm (males).

Remarks: MAJORAN (1989) who erected and described this species, and BASSIOUNI (2002), both assigned it the present species tentatively to the genus *Eucythere*. They both realized from the external features that this species does not really belong to *Eucythere* as it possesses eye tubercles and a different surface sculpture; they mentioned that it possibly represents a new genus. The use of *Eucythere* was only based on outline similarity as they did not find well-preserved open valves to investigate the internal features. The material found by MAJORAN was mostly represented by sediment-filled open valves with poorly preserved hinges, apparently merodont/entomodont, and BASSIOUNI merely recorded a single carapace. No open valves were discovered in the present study. We agree that this species most probably belongs to a new genus that is more likely, as mentioned by BASSIOUNI (2002), related to the Progonocytheridae. Therefore, we prefer to assign the present species tentatively to the progonocytherid genus *Neocythere*, which was also mentioned by MAJORAN as being comparable with the present species, than to *Eucythere,* although it also different. *Neocythere* deviates from the present species in having a more regularly ornamented surface and an ovoid rather than triangular lateral outline. However, the tentative assignment to *Neocythere* has been made as we could not find a better match and an exact generic assignment must wait until well-preserved open valves enabling access to the internal features are discovered.

Stratigraphic and geographic distribution: The present species was first recorded from the Upper Cenomanian of Algeria (MAJORAN, 1989). In Egypt, it was recorded from the Lower Cenomanian of north Sinai (BASSIOUNI, 2002). This species is recorded here in the Upper Cenomanian, samples S–01 and S–02.

Family Trachyleberididae SYLVESTER-BRADLEY, 1948
Subfamily Trachyleberidinae SYLVESTER-BRADLEY, 1948
Genus *Cythereis* JONES, 1849
Type species: *Cytherina ornatissima* REUSS, 1846
Cythereis namousensis BASSOULLET & DAMOTTE, 1969
(Pl. 2, Figs. 1–5)

1969 *Cythereis namousensis* n.sp. BASSOULLET & DAMOTTE, p. 134, pl. 1, fig. 3a–d

1974 *Cythereis namousensis* BASSOULLET & DAMOTTE – ROSENFELD & RAAB, p. 17, pl. 3, figs. 17–18

1977 *Cythereis namousensis* BASSOULLET & DAMOTTE – BOUKHARY et al., p. 158, pl. 1, fig. 5a–d

1980 *Cythereis namousensis* BASSOULLET & DAMOTTE – BEN YOUSSEF, p. 78, pl. 6, figs. 5–8

1981a *Cythereis namousensis* BASSOULLET & DAMOTTE – BISMUTH et al., p. 232, pl. 8, figs. 9–10

1983 *Cythereis namousensis* BASSOULLET & DAMOTTE – GARGOURI-RAZGALLAH, p. 154, pl. 29, fig. 1

1989 *Cythereis namousensis* BASSOULLET & DAMOTTE – MAJORAN, p. 21, pl. 10, figs. 13–16

1991 *Cythereis namousensis* BASSOULLET & DAMOTTE – SHAHIN, p. 145, pl. 3, fig. 12

1994 *Cythereis namousensis* BASSOULLET & DAMOTTE – SHAHIN et al., p. 56, pl. 3, figs. 21–22

1995 *Cythereis namousensis* BASSOULLET & DAMOTTE – ABDALLAH et al., p. 531, fig. 20:10

2001 *Cythereis namousensis* BASSOULLET & DAMOTTE – ISMAIL, fig. 13:9–10

2001 *Cythereis namousensis* BASSOULLET & DAMOTTE – MORSI & BAUER, p. 392, pl. 4, figs. 10–11

2002 *Cythereis namousensis* BASSOULLET & DAMOTTE – BASSIOUNI, p. 70, pl. 15, figs. 13–16

Material: 15 specimens.

Dimensions: Length: 0.65–0.67 mm; height: 0.37–0.38 mm; width: 0.34 mm (females);

Length: 0.69 mm; height: 0.36 mm; width: 0.31 mm (male).

Stratigraphic and geographic distribution: The present species is common in the Cenomanian rocks in Algeria (BASSOULLET & DAMOTTE, 1969; MAJORAN, 1989), Israel (ROSENFELD & RAAB, 1974; MAJORAN, 1989), Tunisia (BEN YOUSSEF, 1980; BISMUTH et al., 1981a; GARGOURI-RAZGALLAH, 1983; ABDALLAH et al., 1995), Jordan (SCHULZE et al., 2004), and Egypt (BOUKHARY et al., 1977; SHAHIN et al., 1994; SHAHIN, 1991; ISMAIL, 2001; MORSI & BAUER, 2001; BASSIOUNI 2002). Here, it comes from the Upper Cenomanian, samples S–01, S–02, S–03 and S–04.

Genus *Peloriops* AL-ABDUL-RAZZAQ, 1979
Type species: *Cythereis ziregensis* BASSOULLET & DAMOTTE, 1969
Peloriops aegyptiaca MORSI & BAUER, 2001
(Pl. 2, Fig. 7)

2001 *Peloriops aegyptiaca* n.sp. MORSI & BAUER, p. 394, pl. 5, figs. 4–5, 8

Material: A single specimen.

Dimensions: Length: 0.46 mm; height: 0.25 mm.

Stratigraphic and geographic distribution: This species was first described from the Upper Cenomanian of Egypt (MORSI & BAUER, 2001). In the present section, it is also present in the Upper Cenomanian, sample S–03.

Peloriops pustulata (ROSENFELD, 1974)
(Pl. 2, Figs. 8–10)

1974 *Planileberis pustulata* n.sp. ROSENFELD *in* ROSENFELD & RAAB, p. 19, pl. 3, figs. 2–5; pl. 6, figs. 1–4

1977 *Planileberis pustulata* ROSENFELD – BOUKHARY et al., p. 159, pl. 1, figs. 1a–d

1979 *Peloriops ulosa* n.sp. AL-ABDUL-RAZZAQ, p. 51, pl. 1, figs. 4–5, 11, 15; pl. 2, fig.3

1981a *Cythereis ziregensis* BASSOULLET & DAMOTTE–BISMUTH et al., p. 234, pl. 8, figs. 9–12

1988 *Peloriops ulosa* AL-ABDUL-RAZZAQ–ATHERSUCH, p. 1203, pl. 4, fig. 10–11

pars 1989 *Peloriops ziregensis*? (BASSOULLET & DAMOTTE) – MAJORAN, p. 24, pl. 15, figs. 4–13; non pl. 15, figs. 1–3

1991 *Peloriops* sp. SZCZECHURA *et al*., p. 25, pl. 8, fig. 8

1994 *Peloriops ulosa* AL-ABDUL-RAZZAQ – ATHERSUCH 1994, p. 263, pl. 12.2, figs. 2, 4

1994 *Planileberis pustulata* ROSENFELD – SHAHIN et al., p. 57, pl. 3, figs. 29–31

2001 *Peloriops pustulata* (ROSENFELD) – MORSI & BAUER, p. 394, pl. 5, figs. 6–7, 9

2002 *Peloriops pustulata* (ROSENFELD) – BASSIOUNI, p. 88, pl. 21, figs. 9–13

Material: 10 specimens.

Dimensions: Length: 0.66–0.71 mm; height: 0.37–0.38 mm; width: 0.24–0.26 mm.

Stratigraphic and geographic distribution: This species was first described from the Cenomanian of Israel (ROSENFELD & RAAB, 1974). It is also known from the Cenomanian of Algeria (MAJORAN, 1989), Tunisia (BISMUTH et al., 1981a), Kuwait (AL-ABDUL-RAZZAQ, 1979), Oman (ATHERSUCH, 1988, 1994) and Egypt (BOUKHARY et al., 1977; SHAHIN et al., 1991; SZCZECHURA et al., 1991; MORSI & BAUER, 2001; BASSIOUNI, 2002). In the present material, it is recorded in the Upper Cenomanian, samples S–01, S–02 and S–03.

Genus *Veeniacythereis* GRÜNDEL, 1973
Type species: *Cythereis imparia* GRÜNDEL, 1968
Veeniacythereis streblolophata schista AL-ABDUL-RAZZAQ & GROSDIDIER, 1981
(Pl. 2, Figs. 11–15)

1973 *Cythereis* IR C 4, GROSDIDIER, pl. 8, figs. 66a–d

pars 1975 *Veeniacythereis jezzineensis* (BISCHOFF) – COLIN & EL-DAKKAK, p. 56, pl. 2, fig. 1; non pl. 1, figs. 11–12; non pl. 2, fig. 2

1981 *Veeniacythereis streblolophata schista* n.sp. AL-ABDUL-RAZZAQ & GROSDIDIER, 185, pl. 2, figs. 1–5

pars 1981a *Veeniacythereis streblolophata* AL-ABDUL-RAZZAQ – BISMUTH et al., p. 233, pl. 10, figs. 5–7, non figs. 3–4

1983 *Veeniacythereis streblolophata schista* AL-ABDUL-RAZZAQ & GROSDIDIER–GARGOURI-RAZGALLAH, p. 55, pl. 29, figs. 2–6

pars 1985 *Veeniacythereis* gr. *jezzineensis* (BISCHOF) – VIVIÉRE, p. 185, pl. 11, fig. 5; non pl. 11, figs. 6–11

1988 *Veeniacythereis streblolophata schista* AL-ABDUL-RAZZAQ & GROSDIDIER – ATHERSUCH, pl. 3, figs. 1–2

1991 *Veeniacythereis* ex. gr. *streblolophata* AL-ABDUL-RAZZAQ & GROSDIDIER – SZCZECHURA et al., p. 29, pl. 7, figs. 1–3, 5–8

1991 *Veeniacythereis jezzinensis* (BISCHOFF) – SHAHIN, p. 144, pl. 3, figs. 8–9

1994 *Veeniacythereis streblolophata schista* AL-ABDUL-RAZZAQ & GROSDIDIER – ATHERSUCH, pl. 12.3, figs. 4–5

1994 *Veeniacythereis streblolophata schista* AL-ABDUL-RAZZAQ & GROSDIDIER – SHAHIN et al., p. 60, pl. 4, figs. 14–15

1997 *Veeniacythereis jezzinensis* (BISCHOFF) – ISMAIL & SOLIMAN, p. 182, pl. 3, figs. 14–15

1997 *Cythereis* cf. *canteriolata* (CRANE) – ISMAIL & SOLIMAN, p. 178, pl. 3, figs. 19–20

1997 *Cythereis gapensis* (ALEXANDER) – ISMAIL & SOLIMAN, p. 180, pl. 3, figs. 21–22

2001 *Veeniacythereis streblolophata schista* AL-ABDUL-RAZZAQ & GROSDIDIER – MORSI & BAUER, p. 396, pl. 5, figs. 13–15

2002 *Veeniacythereis streblolophata schista* AL-ABDUL-RAZZAQ & GROSDIDIER – BASSIOUNI, p. 81, pl. 18, figs. 13–16; pl. 19, fig. 12

Material: 19 specimens.

Dimensions: Length: 0.70 mm; height: 0.42 mm; width, 0.37 mm (females);

Length: 0.73–0.75 mm; height: 0.35–0.42 mm (males).

Stratigraphic and geographic distribution: The present subspecies was previously found in the Arabian Gulf region from the Albian–Lower Cenomanian of Iran (GROSDIDIER, 1973), Cenomanian of Oman (ATHERSUCH, 1988, 1994) and Upper Cenomanian of Kuwait (AL-ABDULRAZZAQ & GROSDIDIER, 1981). It was also reported from the Cenomanian of Jordan (SCHULZE et al., 2004). In North Africa, it was recorded in the Cenomanian of Tunisia (BISMUTH et al., 1981a; GARGHOURI-RAZGALLAH, 1983), Lower Cenomanian of Algeria, (VIVIÉRE, 1985) and (?) Albian–Cenomanian of Egypt (COLIN & EL DAKKAK, 1975; SHAHIN, 1991; SZCZECHURA et al., 1991; SHAHIN et al., 1994; ISMAIL & SOLIMAN, 1997; MORSI & BAUER, 2001; BASSIOUNI, 2002). In the present section, it is retrieved from in the Upper Cenomanian, samples S–01 and S–02.

Gen. Indet. sp.
(Pl. 2, Fig. 6)

Material: A single specimen.

Dimensions: Length: 0.42 mm; height: 0.21 mm.

Remark: This species is represented only by a single carapace recalling the trachleberidids, hence it is assigned to the family Trachyleberididae. It resembles *Praephacorhabdotus*? *jirensis* from the Cenomanian of Morocco (ANDREU-BOUSSUT, 1991). However, the present specimen is relatively smaller in size and has a shorter and thicker ventral rib occupying the mid-ventral part of the lateral surface; in *Praephacorhabdotus*? *jirensis* this rib is longer, thinner and extends farther anteriorly to join the anterior marginal rib at the anteroventral corner.

Stratigraphic and geographic distribution: Upper Cenomanian, sample S–03.

3. BIOSTRATIGRAPHIC IMPLICATIONS

Cenomanian ostracod biostratigraphy in North African and the Middle East areas was discussed by ROSENFELD & RAAB (1974), BISMUTH et al. (1981a), ATHERSUCH (1988, 1994), HATABA & AMMAR (1990), SZCZECHURA et al. (1991), SHAHIN (1991), SHAHIN & KORA (1991), SHAHIN et al. (1994), DAMOTTE (1995), ISMAIL (2001), MORSI & BAUER (2001) and BASSIOUNI (2002). Depending on previous documentations, the species constituting the assemblage found in the present section are dominated by typical Cenomanian taxa consisting of *Cytherella aegyptiensis*, *Neocythere*? *mackenzei*, *Eocytheropteron*? cf. *punctata*, *Cythereis namousensis*, *Peloriops aegyptiaca*, *Peloriops pustulata* and *Veeniacythereis streblolophata schista*. Fewer taxa having longer ranges are represented by *Dolocytheridea atlasica* and *Metacytheropteron berbericum*, which are widespread in the Cenomanian, but also have records in the Albian in Tunisia (BEN YOUSSEF, 1980; BISMUTH et al., 1981a) Iran (GROSDIDIER, 1973) and questionably Egypt (SZCZECHURA et al., 1991), as well as *Paracypris dubertreti*, which is also known from the Aptian/Albian of Israel (ROSENFELD & RAAB, 1984) and Egypt (HEWAIDY & MORSI, 2001; BASSIOUNI, 2002) and the early Turonian of Algeria (VIVÉRE, 1985). In terms of biostratigraphic zonation, many local ostracod zonal schemes were proposed for different areas by ROSENFELD & RAAB (1974) in Israel, BISMUTH et al. (1981a) in Tunisia, ATHERSUCH (1988, 1994) in the Arabian Gulf area, and HATTABA & AMMAR (1990), SHAHIN et al. (1994), and ISMAIL (2001) in Egypt. In the present section, many of the recorded species were partly utilized in the zonal schemes proposed by ROSENFELD & RAAB (1974) and ISMAIL (2001), where *Dolocytheridea atlasica*, *Metacytheropteron berbericum*, *Cythereis namousensis* and *Peloriops pustulata* were used among the species characteristic for the *Metacytheropteron berbericum* Acme Zone of ROSENFELD & RAAB and the *Cythereis algeriana–Metacytheropteron berbericum* Zone of ISMAIL, both assigned to the late Cenomanian. Moreover, *Peloriops aegyptiaca*, which is also found among the recorded fauna,

Plate 2

1–5 *Cythereis namousensis* BASSOULLET & DAMOTTE, 1969. Galala Formation, sample 03, 1, 4–5 females:1, AC–21, L 0.65 mm, RVC; 4, AC–24, W 0.34 mm, DVC; 5, AC–25, L 0.67 mm, LVC; 2–3, males: 2, AC–22, W 0.69 mm, RVC; 3, AC–23, W 0.31 mm, DVC.

6 Gen. Indet. sp. Galala Formation, sample 02, AC–26, L 0.42 mm, RVC.

7 *Peloriops aegyptiaca* MORSI & BAUER, 2001. Galala Formation, sample 03, AC–27, L 0.46 mm, RVC.

8–10 *Peloriops pustulata* (ROSENFELD & RAAB, 1974). Galala Formation, sample 03, 8, AC–28, W 0.24 mm, DVC; 9, AC–29, L 0.71 mm, LVC; 10, AC–30, L 0.66 mm, RVC.

11–15 *Veeniacythereis streblolophata schista* AL-ABDULRAZZAQ & GROSDIDIER, 1981. Galala Formation, sample 02, 11, 13 females: 11, AC–31, L 0.70 mm, RVC; 13, AC–33, W 0.37 mm, DVC; 12, 14–15, males: 12, AC–32, L 0.75 mm, RVC; 14, AC–34, L 0.73 mm, RVC; 15, AC–35, L 0.75 mm, RVC.

Abbreviations:
RVC: right view carapace, LVC: left view carapace, DVC: dorsal view carapace, L: length, W: width.

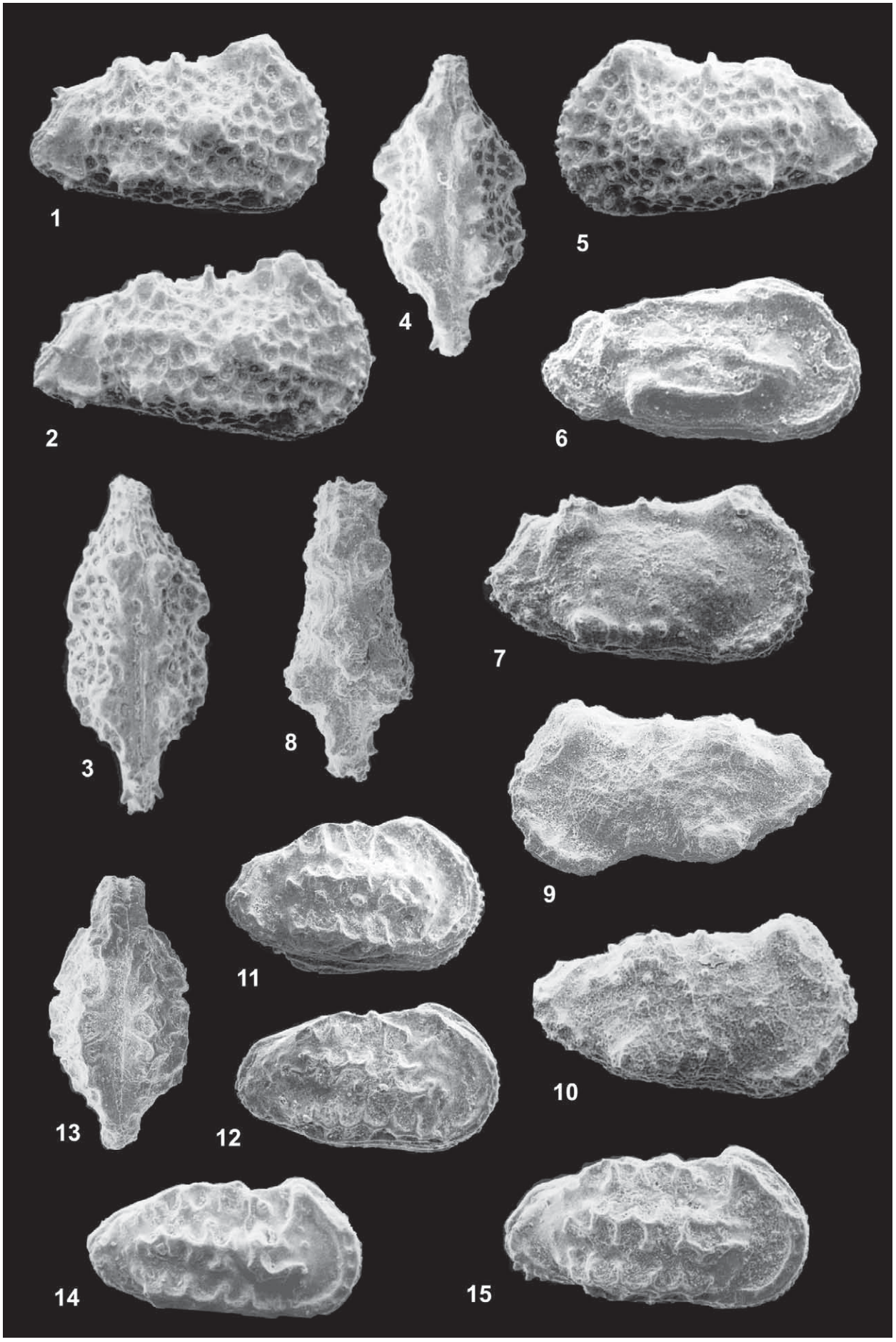
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Table 2: Geographic distribution of the recorded ostracod fauna in different countries.

	Cytherella aegyptiensis	*Paracypris dubertreti*	*Dolocytheridea altasica*	*Eocytheropteron? cf. punctata*	*Neocythere? mackenzie*	*Metacytheropteron berbericum*	*Cythereis namousensis*	*Peloriops aegyptiaca*	*Peloriops pustulata*	*Veeniacythereis streblolophata schista*
West Africa						•				
Morocco	•	•	•			•				
Algeria		•	•		•	•	•		•	
Tunisia			•			•	•		•	•
Libya			•							
Egypt	•	•	•	•	•	•	•	•	•	•
Israel	•	•	•			•	•		•	
Jordan	•	•	•			•	•		•	•
Libanon		•					•			
Kuwait						•			•	•
Oman			•			•			•	•
Iraq			•							
Iran			•			•				•
Somalia			•							
South Europe						•				

was described from the Upper Cenomanian of Sinai in Egypt (MORSI & BAUER, 2001), together with a similar assemblage. Therefore, the recorded association could be utilized to indicate a late Cenomanian age for the studied section.

4. PALAEOBIOGEOGRAPHIC IMPLICATIONS

The most comprehensive synthesis of ostracod palaeobiogeographic aspects in the Tethyan region was previously made by BABINOT (1985), BABINOT & COLIN (1988), ANDREU (1993), GEBHARDT (1999), and LUGER (2003). Supporting contributions were also given by BABINOT et al. (1978), DAMOTTE (1985, 1995), VIVIÉRE (1985), ATHERSUCH (1988), BABINOT & BOULARDION DE GRISSAC (1989); MAJORAN (1989), COLIN et al. (2001) and MORSI & BAUER (2001). During the Cenomanian, the separation between the northern and southern margins of Tethys became total and two well-differentiated bioprovinces were individualized: a northern bioprovince comprising West Europe, and a southern bioprovince in North Africa and the Middle East (BABINOT, 1985; BABINOT & COLIN, 1988), in the midst of which Egypt was situated. The south Tethyan bioprovince was named 'bioprovince of *Veeniacythereis jezzineensis* and *Metacytheropteron berbericum*' or the Afro–Arabian north-Gondwanian bioprovince, and has been extended to incorporate the northern part of East Africa (BABINOT & COLIN, 1988; COLIN et al., 1991). At the generic level, this bioprovince was characteristically inhabited by representatives of *Dolocytheridea*, *Glenocythere*, *Matacytheropteron*, *Nigeroloxoconcha*, *Peloriops* and *Veeniacythereis,* together with cosmopolitan genera such as *Cytherella*, *Bairdia*, *Bythocypris*, *Bythoceratina* and *Cythereis*. At the species level, palaeogeographic control on ostracod faunal distribution is also emphasized by a large number of species documented in a large number of publications (e.g. AL-ABDUL-RAZZAQ & GROSDIDIER, 1981; DAMOTTE, 1985; BABINOT & BOULARDION DE GRISSAC, 1989; MAJORAN, 1989; ANDREU-BOUSSUT, 1991; ANDREU, 1993; GEBHARDT, 1999; COLIN et al., 2001; MORSI & BAUER, 2001; BASSIOUNI, 2002; LUGER, 2003). In the present

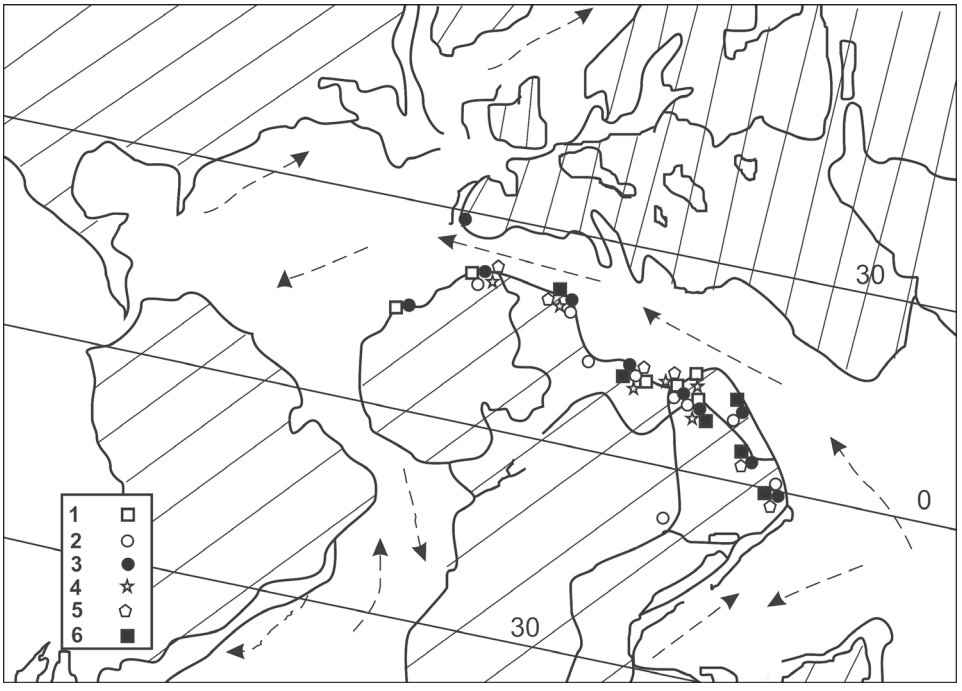

Figure 3: Palaeobiogeography of selected South Tethyan marine ostracod species (map modified after BARRON et al., 1981; oceanic circulation after HAQ, 1984). (1) *Paracypris dubertreti* (2) *Dolocytheridea atlasica* (3) *Metacytheropteron berbericum* (4) *Cythereis namousensis* (5) *Peloriops pustulata* (6) *Veeniacythereis streblolophata schista.*

study, the recorded ostracod fauna is composed of taxa of a typical marine shelf setting. Most of the taxa are typical south Tethyan forms and are already known from different regions in this province, from Morocco in the west to the Arabian Gulf region in the east. Of the species discovered, *Cytherella aegyptiensis*, *Paracypris dubertreti*, *Dolocytheridea atlasica*, *Metacytheropteron berbericum*, *Cythereis namousensis*, *Peloriops pustulata*, and *Veeniacythereis streblolophata schista* show a wide distribution with records in Morocco, Algeria, Tunisia, Egypt, Jordan, Israel, Lebanon, Kuwait, Oman and Iran (see Tab. 2 and Fig. 3). *Dolocytheridea atlasica* was additionally cited to have records in Libya, Somalia (COLIN et al., 2001), and Iraq (RICHE & PRISTAT, 1980). The palaeogeographic distribution of *Neocythere*? *mackenziei* is still not very well-known as it has so far only been recorded only in Algeria (MAJORAN, 1989) and Egypt (BASSIOUNI, 2002; present study). The relationship with the Northern Tethys is weakly pronounced and only *Metacytheropteron berbericum* has a record in Southern Europe from the western Portugese basin (BABINOT et al., 1978). BABINOT & COLIN (1988) suggested that the depth of Tethys and also the unfavourable currents could be the reasons for the eliminated ostracod faunal exchanges between Northern and Southern Tethys.

ACKNOWLEDGEMENT

The authors are grateful to Prof. Michael SCHUDACK (Free University of Berlin, Germany) and Dr. Jean-Paul COLIN (Cestas, France) for their critical review and suggestions that enhanced the quality of the manuscript. Special thanks are due to Prof. Hans-Joachim KUSS (University of Bremen, Germany) for his help in usage of the SEM for photographing the ostracod material in his department. For technical assistance, thanks are also due to Dr. Hartmut MAI (University of Bremen).

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Manuscript received January 2, 2008
Revised manuscript accepted May 5, 2008