

ON CENOMANIAN OSTRACODA FROM CENTRAL TUNISIA

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Abstract: Here is presented a study of Cenomanian *Ostracoda* from Tunisia occurring in two different environments. In the Djebel Semmama area, a shelf environment exists, and in the Kalaat Senan area a distal environment is present. In the Cenomanian of the Kalaat Senan area, no distinctive bathyal genus is recognized in this distal setting. Except for two species, the vertical distribution of the most significant ostracodes is generally the same in both environments, so the ostracods can be used as biostratigraphic markers in the two types of environment.

Key words: Central Tunisia, Cenomanian, *Ostracoda*.

Introduction

In Tunisia, much is known about Cenomanian ostracodes in a shelf environment and marine shallow water conditions, specially in the Djebel Semmama area, northern Central Tunisia (Bismuth et al. 1981a, b). But only one publication deals with Cenomanian ostracodes living in deeper environment (Bismuth et al. 1995). This publication concerns the sections outcropping in the Kalaat Senan area, north-western part of Central Tunisia, and presents a general survey of Cenomanian basin facies ostracodes.

So, it will be interesting to compare the ostracodes association occurring in those two environments; and to confirm if ostracodes are good biostratigraphical markers, as I think, or if they can only be used as paleoenvironmental markers.

Djebel Semmama Mts.

General features

The Djebel Semmama mountain range is located in Central Tunisia, in the atlasics folds area, ten kilometers North of Kasserine (Fig. 1). This Djebel is about one thousand three hundred meters high. The south end of this anticline is cut by collapsed transverse valley which separates the Djebel Semmama from the Djebel Chambi, and this truncature allows us to see all the different levels from Aptian white sandstone to the Campanian carbonates.

The first sequence, or Selloum sequence, is Upper Albian and Vraconian, with clays in the first levels and carbonates in the upper part, showing a transgressive to regressive evolution. The second one, or Ben Younes sequence, is Cenomanian, and shows the same evolution. This sequence is the most transgressive one. These two sequences constitute the Fadhene Formation.

Above it, is the Turonian Semmama sequence, with marls at the bottom and carbonates in the upper part. This sequence is slightly regressive compared to the Ben Younes one.

Ostracodes

In Djebel Semmama, five biozones were established in the Cenomanian (Bismuth et al. 1981b). The upper part of the "Dicrorygma" aff. GA 22 Zone, biozone beginning in the Upper Vraconian, is Cenomanian in age.

The Lower Cenomanian (upper part of "Dicrorygma" aff. GA22 Zone, Ostracode B3 Zone and Veeniacythereis streblolophata schista Zone) is characterized by the appearance of *Peloriops ziregensis*, *Monoceratina trituberculata*, *Amphicytherura distincta*, *Cytherella sulcata* in the first levels. *Bythoceratina*

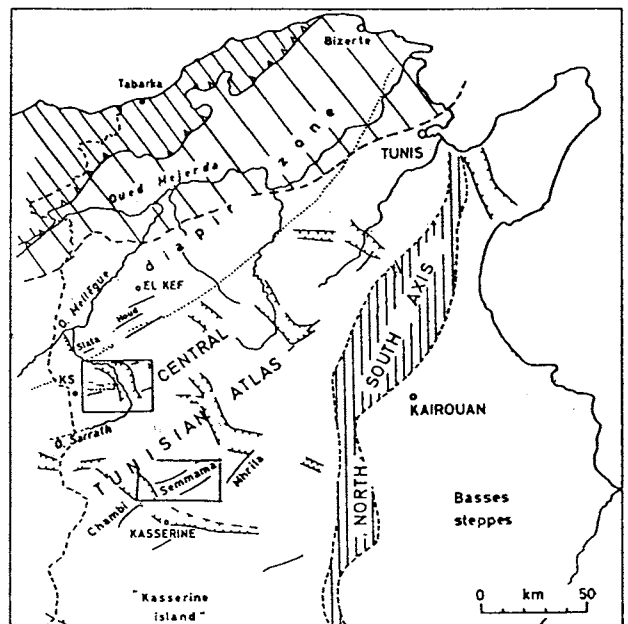


Fig. 1. The Kalaat Senan (KS) region and the Djebel Semmama within the geographical and structural context of Tunisia. After Bismuth et al. 1995, figure 1, modified.

tamarae, *Veeniacythereis streblolophata schista*, *Spinoleberis kasserinensis kasserinensis*, *Cythereis* cf. *aaramtaensis aaramtaensis* and *Brachycythere* cf. *sapucariensis* occur in the second part of the Lower Cenomanian. *Centrocythere tunetana* disappears below the top of the Lower Cenomanian and *Eocytheropteron glintzboeckeli* above the limit of the Lower and Middle Cenomanian.

The Middle Cenomanian (Protobuntonia *semmamaensis* Zone) is principally characterized by the appearance of *Veeniacythereis streblolophata streblolophata*, but *Protobuntonia semmamaensis* is also present in the upper part of the Lower Cenomanian. *Cythereis algeriana*, *Spinoleberis kasserinensis truncata*, *Neocythere?* cf. *bisulcata* only appear in the second part of this substage. Some of the Lower Cenomanian species are also present in the Middle Cenomanian, mainly: *Peloriops ziregensis*, *Amphicytherura distincta*, *Cytherella sulcata*, *Spinoleberis kasserinensis kasserinensis*, *Brachycythere* cf. *sapucariensis* ...

The Upper Cenomanian (*Cythereis algeriana* Zone and *Veeniacythereis maghrebensis* Zone) is characterized by the appearance of *Cythereis namousensis* in the lower part and of *Veeniacythereis maghrebensis* in the upper part. *Peloriops ziregensis* disappears in the lower part of this substage and above *Monoceratina trituberculata*, *Cytherella sulcata*, *Brachycythere* cf. *sapucariensis*, *Neocythere* cf. *bisulcata*. In the upper part of the Upper Cenomanian, *Amphicytherura distincta* and *Cythereis algeriana* disappear below the Cenomanian-Turonian boundary. No Cenomanian ostracodes are still present in the Lower Turonian, which is characterized by the appearance of *Cythereis mahjoubi*, *Cythereis mdaouerensis* and *Oertliella tarfayensis* (synonym of *Reticulicosta vitiliginosa*); *Reticulicosta vitiliginosa* is the only one present in the basal Turonian formation from the Kalaat Senan area.

The vertical extension of the main Cenomanian species is shown on Fig. 3.

The Kalaat Senan area

General features

The studied area (Fig. 1) is situated in the Kalaat es Senan sheet (scale 1:50,000), West of the quaternary Tajerouine-Kalaa Khasba Basin, about 2 or 3 km to the West of the Bir Solaa well (Lehotský et al. 1978).

The Cenomanian strata outcrop in the thalwegs of Smara, Bou Touil and Hammadja wadis. Though many faults break the normal succession, thanks to some marker beds, good and reliable correlations between the partial sections led to the construction of a composite section showing all of the Cenomanian (Fig. 2 and Robaszynski et al. 1993a).

The area concerned is located between a carbonate platform southwards (South of Kasserine) and a basin to the North (El Kef area). In this transitional zone, events that affected both, or successively, the carbonate platform and the basin are recorded and can be detected by the analysis of the facies and microfacies which characterize the two types of environment.

Obviously, the basin has left its mark stronger than the platform did, judging by the predominant marly facies of the Cenomanian series; and this is the very character of the Fadhene Formation. In spite of the rather monotonous nature of the sedimentation, several lithological units are recognized:

Fadhene Formation:

- from SMA 78 up to 99.5: 20 m or so, of marl and limestone beds, often channelled, including three or four layers with phosphatized nodules and fossils;
- between SMA 99.5 and SMC 167: about 400 m of marls including some decimetric beds of marly limestones; at around the top, occur centimetric beds of biocalcirudites and of distal sandy tempestites;
- from SMC 167 (= KD 25) up to SM 114: thickness about 200 m, marls including several limestone beds and layers of biocalcirudites and tempestites as well.

Bahloul Formation:

- top of the Cenomanian: from SM 114 up to SM 137: approximately 23 m thick; laminated black limestones admitting non laminated and more marly intercalations and beds made of abundant *Calcisphaerulido*.

The lithological units attest modifications of the marine environment, itself closely controlled by the sea level variations. Four full eustatic sequences and two partial ones (sensu Vail) have been put forward within the Cenomanian of the Kalaat Senan area (in Robaszynski & al. 1993a and b). The three earliest ones convey the transgressive pulsations occurring during the uppermost Albian and Lower Cenomanian (SMA 78 up to SMC 52.5). The fourth sequence corresponds to a vigorous sedimentary record (SMC 52.5 up to KD 136.5) with a thick lowstand wedge (SMC 52.5 - SMC 167). In the fifth one, many limestone beds occur, including abundant *Calcisphaerulidae*. The sixth and last sequence begins with the shelf margin wedge, rich in *Calcisphaerulidae*, and the laminated black limestones by which the Bahloul Formation starts.

Collection and identification of a lot of ammonites led to the subdivision into ten zones, allowing the precise recognition of the three classic Cenomanian subdivisions (Amedro in Robaszynski et al. 1993a) with the help of the following criteria:

- base of the Lower Cenomanian: simultaneous appearance of both genera *Mantelliceras* and *Hypoturritites*.
- base of the Middle Cenomanian: defined by the appearance of *Cunningtoniceras* which occurs slightly below that of the genus *Acanthoceras*.
- base of the Upper Cenomanian: marked by the extinction of the genus *Acanthoceras*; the Upper Cenomanian is characterized by the expansion of the genus *Eucalycoceras*.
- base of the Lower Turonian: close to the appearance of *Pseudaspidoceras flexuosum* (in the studied area, the species *Watinoceras devonense* has not yet been found; according to recent opinions, its appearance should indicate the very base of the Turonian).

The planctonic *Foraminifera* are studied in two publications: Robaszynski et al. (1993a, b); their stratigraphical distributions are compared with those of the ammonites.

Ostracodes

In most of the samples, ostracodes are quite frequent but not always well preserved. Except rare separate valves, they were closed, making examination of their internal characters difficult. Specimens of *Cytherella*, common or abundant throughout the sections, were often found together with the more or less

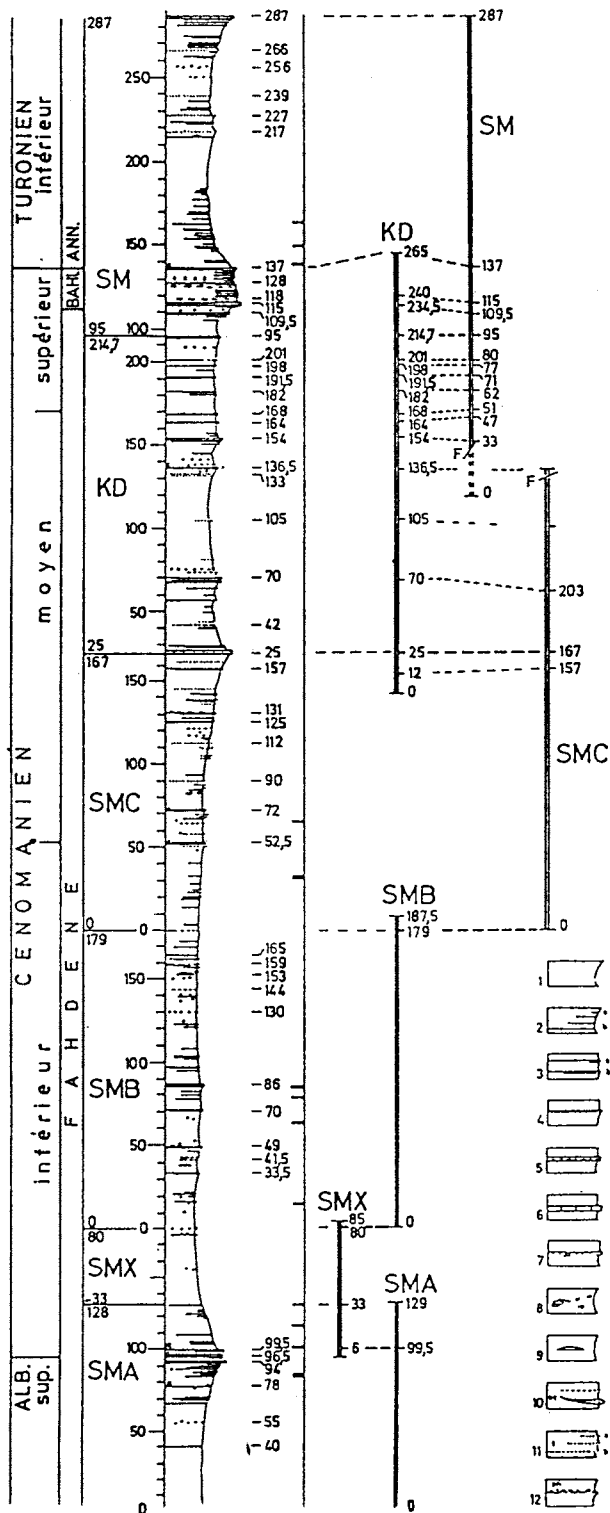


Fig. 2. Composite lithological succession of the Cenomanian of the Kalaat Senan area from six partial sections. In each one, the studied samples are indicated by a number which represents the vertical distance to the base quoted 0. After Bismuth et al. (1995). Legend of the lithological symbols used: 1 - marls; 2a - thin calcareous marl; 2b - thick calcareous marl; 3a - calcareous marls; 3b - *idem* more calcareous; 4, 5 - successively more calcareous marls; 6 - limestone; 7 - borings; 8 - calcareous septarian nodules; 9 - pseudo-bioherm; 10 - channelled biocalcarenites and biocalcirudites; 11 - tempestites, a) thin, b) thick (5-10 cm); 12 - phosphate nodules.

rare *Bairdia*. The study of these ubiquitous forms has not been undertaken at a specific level.

Examination of the numerous samples (about 310 samples) collected from the uppermost Albian up to the Lower Turonian, in this well exposed series about 900 m thick and with a marly predominant lithology, gave rise to the identification of twenty six species of ostracodes, all of them previously mentioned in North African countries. However, the occurrence in Tunisia of six species is here pointed out for the first time, namely: *Algeriana reymonti*, *Monoceratina? hodnaensis*, *Cythereis afroreticulata*, *Cythereis punctatafoveolata*, *Phlyctocythere citreum* and *Pontocyprilla maghrebensis*. Those species are all illustrated in Bismuth et al. (1995).

Though the water depth in this area during mid-Cretaceous time is supposed to be 300 to 800 m (Robaszynski et al. 1993a) no true distinctive species of a bathyal environment has been recorded; indeed, all the species found are known to occur in the carbonate platform or the outer shelf. The occurrence, among others, of ostracodes with prominent eyes tubercles makes one question the allochthony of this material. Transported macrofossils (Rudists, Echinoderms, Lamellibranchs) and numerous tempestites were already pointed out (Robaszynski et al. 1993a) and interpreted as originating from the platform. But the eventuality cannot be set aside of a greater tolerance towards water depth conditions. We can add, that in certain genera as *Cytherella*, *Cythereis*, larval forms are present together with adults ones, this indicates that these forms lived where they are fossilised.

In this distal environment, the vertical distribution of the most significant ostracodes presents no contradiction at all to the distribution already known in the shelf setting (Fig. 3). So, *Eocytheropteron peroni* disappears below the Albian-Cenomanian boundary as in the Djebel Semmama area. The extinction of *Veniacythereis streblolophata schista* occurs at the very top of the Lower Cenomanian. *Eocytheropteron glintzboeckeli*, already present in the Upper Albian, persists for some seventy meters at the base of the Middle Cenomanian. *Algeriana cenomanica* is limited to the Lower Cenomanian whilst *Amphicytherura distincta* is present in nearly the whole Cenomanian disappearing just below the Bahloul Formation (in the uppermost Cenomanian). *Cythereis punctatafoveolata* is characteristic of Middle Cenomanian. *Maghrebeis tuberculata* and *Cythereis afroreticulata* occur in all the Middle and Upper Cenomanian without reaching, however, the Bahloul Formation. Typical Upper Cenomanian ostracodes, such as *Veniacythereis maghrebensis*, are extremely rare.

One of the main differences observed between the vertical extension here and in shallow water setting concerns *Cythereis fahrioni bigrandis*. In all the previously studied Tunisian sections, this species was confined to the Upper Albian and Lower Cenomanian, while in the Kalaat area it occurs in the Lower, Middle and Upper Cenomanian (no indication of remained forms can be observed).

No characteristic Cenomanian ostracodes survive in the Turonian; most of them, became extinct before the Bahloul Formation settlement. Occurrence of *Reticulina gr. vitiliginosa* is typical of the Lower Turonian.

Ostracodes - systematics

In the systematics below, the information concerns the most significant species. For each one, I only give the original citation and some, but not all, other mentions. For illustrations of

Stages	V r a c o n i a n	C E N O M A N I A N			T u r o n i a n
		lower	middle	upper	
Ostracoda					
<i>Nigeroloxoconcha</i> aff. GA 22	---	-----	-----	---	
<i>Eocytheropteron peroni</i>	---	-----	-----	-----	
<i>Metacytheropteron berbericus</i>	---	-----	-----	-----	
<i>Centrocythere tunetana</i>	---	-----	-----	-----	
<i>Parexophthalmocythere rhombusa</i>	---	-----	-----	-----	
<i>Eocytheropteron glintzboeckeli</i>	---	-----	-----	-----	
<i>Peloriops ziregensis</i>	---	-----	-----	-----	
<i>Monoceratina? trituberculata</i>	---	-----	-----	-----	
<i>Amphicytherura distincta</i>	---	-----	-----	-----	
<i>Cytherella sulcata</i>	---	-----	-----	-----	
<i>Paracypris dubertreti</i>	---	-----	-----	-----	
<i>Algeriana cenomanica</i>	---	-----	-----	-----	
<i>Pontocyprilla maghrebensis</i>	---	-----	-----	-----	
<i>Monoceratina? hodnaensis</i>	---	-----	-----	-----	
<i>Algeriana reymenti</i>	---	-----	-----	-----	
<i>Cythereis fahrioni bigrandis</i>	---	-----	-----	-----	
<i>Veeniacythereis str. schista</i>	---	-----	-----	-----	
<i>Bythoceratina tamarae</i>	---	-----	-----	-----	
<i>Spinoleberis kas. kasserinensis</i>	---	-----	-----	-----	
<i>Cythereis</i> cf. <i>aar. aaramtaensis</i>	---	-----	-----	-----	
<i>Brachycythere sapucariensis</i>	---	-----	-----	-----	
<i>Amphicytherura</i> aff. <i>berbiguierensis</i>	---	-----	-----	-----	
<i>Protobuntonia semmamaensis</i>	---	-----	-----	-----	
<i>Maghrebeis tuberculata</i>	---	-----	-----	-----	
<i>Veeniacythereis str. streblolophata</i>	---	-----	-----	-----	
<i>Cythereis</i> cf. <i>namousensis</i>	---	-----	-----	-----	
<i>Spinoleberis kas. truncata</i>	---	-----	-----	-----	
<i>Cythereis punctatafoveolata</i>	---	-----	-----	-----	
<i>Cytherella</i> sp.1	---	-----	-----	-----	
<i>Cythereis algeriana</i>	---	-----	-----	-----	
<i>Neocythere? cf. bisulcata</i>	---	-----	-----	-----	
<i>Cythereis afroreticulata</i>	---	-----	-----	-----	
<i>Paracypris mdaouerensis</i>	---	-----	-----	-----	
<i>Phlyctocythere citreum</i>	---	-----	-----	-----	
<i>Veeniacythereis maghrebensis</i>	---	-----	-----	-----	
<i>Spinoleberis yotvataensis</i>	---	-----	-----	-----	
<i>Reticulicosta</i> gr. <i>vitiliginosa</i>	---	-----	-----	-----	

Fig. 3. Distribution of the main *Ostracoda* species in the Cenomanian from Kalaat Senan area (—) and from the Djebel Semmama (- - -).

the species, the publications from Bismuth et al. (1981a, b, 1995), Majoran (1989), can be consulted. The genera are successively presented in alphabetical order.

Genus *Algeriana* Majoran 1989

Algeriana cenomanica Majoran 1989

- 1959 Ostracode F3. Glintzboeckel & Magne, p. 64, pl. 3, fig. 30.
- 1981b *Cythereis* cf. *aaramtaensis aaramtaensis* Bischoff. Bismuth & al., p. 230, pl. 9, fig. 13-15.
- 1989 *Algeriana cenomanica* n. sp. Majoran, p. 18, pl. 9, fig. 1-12.

Stratigraphic and geographical distribution: This species was described from the Algerian Cenomanian.

In the Kalaat Senan area, *Algeriana cenomanica* is recorded in the Lower Cenomanian.

Algeriana reymenti Majoran 1989

- 1989 *Algeriana reymèni* n. sp. Majoran, p. 18, pl. 8, fig. 1-14

Stratigraphic and geographical distribution: This species was described from the Algerian Cenomanian.

In Kalaat Senan area, it occurs in Lower Cenomanian (SMB 54 to SMC 135). It is the only mention in Tunisia.

Genus *Amphicytherura* Butler & Jones 1957

Amphicytherura distincta Gerry & Rosenfeld 1973

- 1973 *Amphicytherura distincta* n. sp. Gerry & Rosenfeld, p. 99, pl. 2, fig. 7-40.
- 1981b *Amphicytherura distincta* Gerry & Rosenfeld. Bismuth & al., p. 228, pl. 7, fig. 16-18.
- 1989 *Amphicytherura distincta* Gerry & Rosenfeld. Majoran, p. 12, pl. 4, fig. 6-9.

Stratigraphic and geographical distribution: This species was described from the Cenomanian of Israel. It occurs in the Cenomanian of Algeria, and in all the Cenomanian of Tunisia, the Djebel Semmama and Kalaat Senan area.

Amphicytherura aff. *berbiguierensis* Colin 1974

- aff. 1973 *Amphicytherura berbiguierensis* n. sp. - Colin, p. 38, pl. 10, fig. 11-13.
1981b *Amphicytherura* aff. *berbiguierensis* Colin. Bismuth & al., p. 229, pl. 8, fig. 3.

Stratigraphic and geographical distribution: The form, allowed with queries to Colin's species, occurs in the Lower (not basal), Middle and Upper (not the top) Cenomanian of the Djebel Semmama.

Genus *Brachycythere* Alexander 1933

Brachycythere sapucariensis Krommelbein, sensu Bismuth & al. 1981

- 1981b *Brachycythere* cf. *sapucariensis* Krömmelbein. Bismuth & al., p. 228, pl. 6, fig. 13-16.

Stratigraphic and geographical distribution: *Brachycythere* cf. *sapucariensis* was found in Tunisia in the Lower to Upper Cenomanian levels of the Djebel Semmama and only in the upper part of the Lower Cenomanian of the Kalaat Senan area.

Genus *Bythoceratina* Hornibrook 1952

Bythoceratina tamarae Rosenfeld 1974

- 1959 Ostracode D9. Glintzboeckel & Magne, p. 62, pl. 2, fig. 2.
1974 *Bythoceratina tamarae* n. sp. Rosenfeld & Raab, p. 10, pl. 2, fig. 3-5, pl. 4, fig. 7-8.
1981b *Bythoceratina tamarae* Rosenfeld. Bismuth & al. p. 224, pl. 8, fig. 4-6.

Stratigraphic and geographical distribution: *Bythoceratina tamarae* was described from Upper Cenomanian of Israel. This species is also present in the Lower Cenomanian of the Djebel Semmama and from the upper part of Lower Cenomanian up to the Middle Cenomanian of the Kalaat Senan area, and also in Algeria.

Centrocythere Mertens 1956

Centrocythere tunetana Bismuth & Donze 1981

- 1959 Ostracode B8. Glintzboeckel & Magne, p. 62, pl. 2, fig. 19.
1981a *Centrocythere tunetana* n. sp. Bismuth & Donze, in Bismuth & al. p. 57, pl. 2, fig. 10-11
1981b *Centrocythere tunetana* Bismuth & Donze. Bismuth & al., p. 227, pl. 8, fig. 13-14.
1989 *Centrocythere tunetana* Bismuth & Donze. Majoran, p. 11, pl. 4, fig. 1-5.

Stratigraphic and geographical distribution: Described from the Vraconian and Lower Cenomanian of Tunisia (Djebel Semmama), *Centrocythere tunetana* occurs also from the Upper Albian to the Middle Cenomanian in the Kalaat Senan area.

Genus *Cythereis* Jones 1849

Cythereis cf. *aaramtaensis aaramtaensis* Bischoff 1963

- aff. 1963 *Cythereis aaramtaensis aaramtaensis* n. sp. Bischoff, p. 28, pl. 11, fig. 79-83.
1981b *Cythereis* cf. *aaramtaensis aaramtaensis* Bischoff. Bismuth & al., p. 230, pl. 9, fig. 13-15.

Stratigraphic and geographical distribution: The form, attributed with some queries to Bischoff's species, occurs in the lower (not basal) and Lower Cenomanian of the Djebel Semmama.

Cythereis afroreticulata Majoran 1989

- 1989 *Cythereis afroreticulata* n. sp. Majoran, p. 22, pl. 13, fig. 1-..

Stratigraphic and geographical distribution: This species described from the Cenomanian of Algeria, is here pointed out for the first time in Tunisia. In the Kalaat Senan area, it occurs in the Middle and Upper Cenomanian.

Cythereis algeriana Bassoullet & Damotte 1969

- 1969 *Cythereis algeriana* n. sp. Bassoullet & Damotte, p. 132, pl. 1, fig. 1 a-d.
1981b *Cythereis algeriana* Bassoullet & Damotte. Bismuth & al. p. 230, pl. 10, fig. 15.

Stratigraphic and geographical distribution: This species was described in the Upper Cenomanian from Western Algeria. It occurs in the upper part of the Middle Cenomanian and in the Upper Cenomanian from the Djebel Semmama.

Cythereis fahrioni bigrandis Majoran 1989

- 1981b *Cythereis* cf. *fahrioni* Bischoff. Bismuth et al. 231, pl. 9, fig. 6-8.
1989 *Cythereis fahrioni bigrandis* n. subsp. Majoran, p. 20, pl. 11, fig. 1-13.

Stratigraphic and geographical distribution: *Cythereis fahrioni bigrandis* was described from Lower Cenomanian of Algeria; it was cited from Upper Albian and Cenomanian of Algeria and from Albian of Lebanon. In Tunisia, it occurs in the Upper Albian and Cenomanian from the Djebel Semmama, and from the Lower up to the Upper Cenomanian from Kalaat Senan area.

Cythereis cf. *namousensis* Bassoullet & Damotte 1969

- 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, fig. 17-18.
1981b *Cythereis namousensis* Bassoullet & Damotte. Bismuth & al., p. 232, pl. 9, fig. 9-10.
1989 *Cythereis namousensis* Bassoullet & Damotte. Majoran, p. 21, pl. 10, fig. 13-16.

Stratigraphic and geographical distribution: Initially described from the Upper Cenomanian of Western Algeria, this species is present in Cenomanian of Algeria and Israel. In Tunisia, it occurs in the lower part of the Upper Cenomanian from the Djebel Semmama and scarcely in the Middle Cenomanian from the Kalaat Senan area.

Cythereis punctatafoveolata Majoran 1989

- 1989 *Cythereis? punctatafoveolata* n. sp. Majoran, p. 21, pl. 12, fig. 5-13.

Stratigraphic and geographical distribution: This species was described from the Cenomanian of Algeria.

In Tunisia, it occurs in the Middle Cenomanian of the Kalaat Senan area.

Genus *Cytherella* Jones 1849

Cytherella sulcata Rosenfeld 1974

1974 *Cytherella sulcata* Rosenfeld. Rosenfeld & Raab, p. 5, pl. 1, fig. 6-8, pl. 4, fig. 1-2.

1981b *Cytherella sulcata* Rosenfeld. Bismuth & al., p. 223, pl. 1, fig. 6, fig. 3-4.

Stratigraphic and geographical distribution: This species is known in the Cenomanian from Israel, Kuwait, Iran and in Central Tunisia (Djebel Semmama).

Cytherella sp. 1 Viviere 1985

1986 *Cytherella* sp. 1. Viviere, p. 137, pl. 1, fig. 5-6.

Stratigraphic and geographical distribution: *Cytherella* sp. 1 was described from Upper Cenomanian of Eastern Algeria.

In Tunisia, it occurs in the Middle and Upper Cenomanian from the Kalaat Senan area.

Genus *Eocytheropteron* Alexander 1933

Eocytheropteron glintzboeckeli Donze & Le Fevre 1981

1981a *Eocytheropteron glintzboeckeli* n. sp. Donze & Le Fevre in Bismuth & al., p. 58, pl. 1, fig. 13-16.

1981b *Eocytheropteron glintzboeckeli* Donze & Le Fevre. Bismuth & al., p. 226, pl. 9, fig. 1-3.

1989 *Eocytheropteron glintzboeckeli* Donze & Le Fevre. Majoran, p. 15, pl. 6, fig. 11-13.

Stratigraphic and geographical distribution: This species was described from the uppermost Vraconian and Cenomanian of Tunisia (Djebel Semmama) and it is also present from the upper part of the Upper Albian to the Middle Cenomanian from the Kalaat Senan area. It occurs in the Upper Albian and Cenomanian of Algeria.

Eocytheropteron peroni Le Fevre & Saint Marc 1981

1981a *Eocytheropteron peroni* n. sp. Le Fevre & Saint Marc in Bismuth & al., p. 58, pl. 1, fig. 10-12.

1981b *Eocytheropteron peroni* Le Fevre & Saint Marc, Bismuth & al., p. 226, pl. 9, fig. 1-3.

Stratigraphic and geographical distribution: This species was described from Upper Albian (Vraconian) of the Djebel Semmama, and is also present in the Upper Albian from Kalaat Senan area.

Genus *Maghrebeis* Majoran 1987

Maghrebeis tuberculata Majoran 1987

1985 *Eucytherura? totaliana* n. sp. - Viviere, p. 245, pl. 25, fig. 8-11.

1987 *Maghrebeis tuberculata* n. gen n. sp. Majoran, p. 29.

1989 *Maghrebeis tuberculata* Majoran. Majoran, p. 23, pl. 14, fig. 1-3.

Stratigraphic and geographical distribution: Described from the Cenomanian of Algeria, *Maghrebeis tuberculata* occurs from the upper part of the Lower Cenomanian to the Upper Cenomanian from the Kalaat Senan area.

Genus *Metacytheropteron* Oertli 1957

Metacytheropteron berbericus (Bassoullet & Damotte 1969)

1959 Ostracode M 1. Glintzboeckel & Magne, p. 64, pl. 3, fig. 22.

1969 *Cytheropteron berbericus* n. sp. Bassoullet & Damotte, p. 137, pl. 2, fig. 7 a-d.

1981b *Metacytheropteron berbericus* (Bassoullet & Damotte). Bismuth & al., p. 225, pl. 8, fig. 7-8.

Stratigraphic and geographical distribution: This species was described in the Upper Cenomanian from Western Algeria. It is also known in the Cenomanian from Iran and Israel. In Tunisia, in the Djebel Semmama, *Metacytheropteron berbericus* is present in the Vraconian to Upper Cenomanian.

Genus *Monoceratina* Roth 1928

Monoceratina? hodnaensis Majoran 1989

1985 *Pedicythere* sp. 2. Viviere, p. 248, pl. 25, fig. 15.

1989 *Monoceratina? hodnaensis* n. sp. Majoran, p. 13, pl. 5, fig. 10-12.

Stratigraphic and geographical distribution: Described from the Cenomanian of Algeria, it scarcely occurs in the Lower Cenomanian from the Kalaat Senan area.

Monoceratina? trituberculata Rosenfeld 1974

1974 *Monoceratina? trituberculata* Rosenfeld. Rosenfeld & Raab, p. 11, pl. 2, fig. 10-11, pl. 4, fig. 6.

1981b *Monoceratina? trituberculata* Rosenfeld. Bismuth & al., p. 224, pl. 7, fig. 14-15, pl. 8, fig. 1-2.

Stratigraphic and geographical distribution: This species was described in the Upper Cenomanian from Israel. In Tunisia, Djebel Semmama, it occurs in the whole Cenomanian (scarcely in the Upper Cenomanian).

Genus *Neocythere* Mertens 1956

Neocythere? cf. bisulcata Rosenfeld 1974

1974 *Neocythere? bisulcata* Rosenfeld. Rosenfeld & Raab, p. 14, pl. 2, fig. 35-38, pl. 5, fig. 5.

1981b *Neocythere? cf. bisulcata* Rosenfeld. Bismuth & al., p. 227, pl. 7, fig. 7-8.

Geographical and stratigraphic distribution: This species was described in the Upper Cenomanian from Israel. In the Djebel Semmama, Tunisia, it is present in the upper part of the Lower Cenomanian and in the lower part of the Middle Cenomanian.

Genus *Nigeroloxoconcha* Reyment 1963

Nigeroloxoconcha aff. GA 22 (Grosdidier 1979)

1979 "*Dicrorygma*" GA 22. Grosdidier, pl. 9, fig. 46 a-d.

1981b "*Dicrorygma*" GA 22 Grosdidier. Bismuth & al., p. 236, pl. 7, fig. 11-13.

1985 *Nigeroloxoconcha* aff. GA 22 (Grosdidier). Viviere, p. 239, pl. 23, fig. 1-4.

Stratigraphic and geographical distribution: *Nigeroloxoconcha* GA 22 is present in the Turonian of West Africa (Gabon); Viviere found it from the Vraconian to Upper Cenomanian of Eastern Algeria. In Tunisia, it occurs in the Vraconian

to Upper Cenomanian of the Djebel Semmama, and in the Middle Cenomanian from the Kalaat Senan area.

Genus *Paracypris* Sars 1866

Paracypris dubertreti Damotte & Saint-Marc 1972

- 1972 *Paracypris dubertreti* n. sp. Damotte & Saint-Marc, p. 276, pl. 1, fig. 1.
 1974 *Paracypris acutocaudata* n. sp. Rosenfeld & Raab, p. 8, pl. 1, fig. 22-24.
 1989 *Paracypris dubertreti* Damotte & Saint-Marc. Majoran, p. 10, pl. 2, fig. 10-12.

Stratigraphic and geographical distribution: *Paracypris dubertreti* was described from the Middle Cenomanian of Libanon. It occurs in the Upper Cenomanian of Israel, as well as in the Cenomanian and Lower Turonian of Algeria.

In Tunisia, it is present in the Lower and Middle Cenomanian from the Kalaat Senan area.

Paracypris mdaouerensis Bassoullet & Damotte 1969

- 1969 *Paracypris mdaouerensis* n. sp. Bassoullet & Damotte, p. 140, pl. 2, fig. 10.
 1974 *Paracypris mdaouerensis* Bassoullet & Damotte. Rosenfeld & Raab, p. 7, pl. 1, fig. 29-31.

Stratigraphic and geographical distribution: *Paracypris mdaouerensis* was described from the Lower Turonian of Western Algeria. It occurs in the Cenomanian to Coniacian of Eastern Algeria, and in the Cenomanian and Lower Turonian of Israel.

In Tunisia, it is present in the Middle to Upper Cenomanian from the Kalaat Senan area.

Genus *Parexophthalmocythere* Oertli 1959

Parexophthalmocythere rhombusa Viviere 1985

- 1959 Ostracode E8. Glintzboeckel & Magne, pl. 3, fig. 32.
 1981b Ostracode E8 Glintzboeckel & Magne. Bismuth & al. p. 237.
 1985 *Parexophthalmocythere rhombusa* n. sp. Viviere, p. 170, pl. 7, fig. 9-12.
 1989? *Parexophthalmocythere* sp. Majoran, p. 17, pl. 7, fig. 9-12.

Stratigraphic and geographical distribution: Viviere described this form from the Lower Cenomanian of Eastern Algeria. In Tunisia, it is known in the Vraconian, Lower Cenomanian from the Djebel Semmama and from the Upper Albian to Upper Cenomanian of the Kalaat Senan area.

Genus *Peloriops* Al-Abdul-Razzaq 1979

Peloriops ziregensis (Bassoullet & Damotte 1969)

- 1959 Ostracode E3. Glintzboeckel & Magne, p. 62, pl. 2, fig. 20.
 1969 *Cythereis ziregensis* n. sp. Bassoullet & Damotte, p. 135, pl. 1, fig. 4 a-d.
 1974 *Planileberis ziregensis* (Bassoullet & Damotte). Rosenfeld & Raab, p. 19, pl. 3, fig. 1.
 1981b *Peloriops ziregensis* (Bassoullet & Damotte). Bismuth & al., p. 234, pl. 8, fig. 9-12.
 1989 *Peloriops ziregensis?* (Bassoullet & Damotte). Majoran, p. 24, pl. 14, fig. 4-13, pl. 15, fig. 1-3.

Stratigraphic and geographical distribution: This species was originally described from the Upper Cenomanian of West-

ern Algeria. *Peloriops ziregensis* has, since, been cited in many regions of the South Tethyan realm: Israel, Kuwait, Tunisia, Algeria.

In Tunisia, it occurs in the Middle Cenomanian from the Djebel Semmama and in the Lower and Middle Cenomanian from the Kalaat Senan area.

Genus *Phlyctocythere* Keij 1958

Phlyctocythere citreum Viviere 1985

- 1985 *Phlyctocythere citreum* n. sp. Viviere, p. 236, pl. 22, fig. 9-12.

Stratigraphic and geographical distribution: This species was described from the upper part of the Lower Cenomanian to the Turonian of Eastern Algeria.

In Tunisia, it occurs in the upper part of Middle Cenomanian from Kalaat Senan area.

Genus *Pontocyprilla* Mandelstam in Ljubimova 1955

Pontocyprilla maghrebensis Majoran 1989

- 1985 *Pontocyprilla* sp. 1. Viviere, p. 146, pl. 3, fig. 1.
 1989 *Pontocyprilla maghrebensis* n. sp. Majoran, 10, pl. 3, fig. 1-3.

Stratigraphic and geographical distribution: *Pontocyprilla maghrebensis* was described from Lower Cenomanian of Algeria. In Tunisia, it occurs from the Lower Cenomanian to the lower part of the Upper Cenomanian in the Kalaat Senan area.

Genus *Protobuntonia* Grekoff 1954

Protobuntonia semmamaensis Bismuth & Le Fevre 1981

- 1981a *Protobuntonia semmamaensis* Bismuth & Le Fevre. Bismuth & al., p. 62, pl. 1, fig. 1-4.
 1981b *Protobuntonia semmamaensis* Bismuth & Le Fevre. Bismuth & al., p. 228, pl. 11, fig. 1-3.

Stratigraphic and geographical distribution: This species was described in the Middle Cenomanian from the Djebel Semmama, Tunisia. It also occurs in the upper part of the Lower Cenomanian of the same region.

Genus *Reticulicosta* Gruendel 1974

Reticulicosta gr. *vitiliginosa* (Apostolescu 1961)

- 1959 Ostracode B4. Glintzboeckel & Magne, p. 66, pl. 4, fig. 34.
 1961 *Cythereis vitiliginosa* n. sp. Apostolescu, p. 822, pl. XIV, fig. 279-284.
 1963 *Cythereis vitiliginosa reticulata* n. subsp. Apostolescu, p. 822, pl. V, fig. 129-132, pl. VI, fig. 133-134.
 1978 *Oertiella tarfayensis* n. sp. Reymont, p. 26, pl. 1, fig. 1-14, pl. 2, fig. 1-3.
 1981b *Oertiella?* aff. *tarfayensis* Reymont. Bismuth & al., p. 234, pl. 10, fig. 12-14.

Stratigraphic and geographical distribution: *Reticulicosta vitiliginosa* was described from the Senonian of West Africa (Gambia). Reymont described *Oertiella tarfayensis* in the Upper Cretaceous (uppermost Cenomanian-Turonian) of Morocco, but this species is considered as a junior synonym of Apostolescu's species (Viviere 1985). In Tunisia this form is present in the Turonian from the Djebel Semmama and Kalaat Senan area.

Genus *Spinoleberis* Deroo 1966*Spinoleberis kasserinensis kasserinensis* Bismuth & Saint-Marc 1981

- 1981a *Spinoleberis kasserinensis kasserinensis* Bismuth & Saint-Marc. Bismuth & al., p. 66, pl. 1, fig. 5-8.
 1981b *Spinoleberis kasserinensis kasserinensis* Bismuth & Saint-Marc. Bismuth & al., p. 235, pl. 11, fig. 13-15.

Stratigraphic and geographical distribution: This subspecies was described in the Lower Cenomanian from Djebel Semmama, Tunisia and is still present in lower part of the Middle Cenomanian.

Spinoleberis kasserinensis truncata Bismuth & Saint-Marc 1981

- 1981a *Spinoleberis kasserinensis truncata* Bismuth & Saint-Marc. Bismuth & al., p. 67, pl. 1, fig. 9.
 1981b *Spinoleberis kasserinensis truncata* Bismuth & Saint-Marc. Bismuth & al. p. 235, pl. 11, fig. 16.

Stratigraphic and geographical distribution: This subspecies was described in the Upper Cenomanian of the Djebel Semmama, Tunisia, and is also present from the middle part of the Middle Cenomanian up to the Upper Cenomanian.

Spinoleberis yotvataensis Rosenfeld 1974

- 1968 *Cythereis* EmJs 1333. Grékoff, pl. 1, fig. 10a-b.
 1974 *Spinoleberis yotvataensis* n. sp. Rosenfeld & Raab, p. 21, pl. 3, fig. 8-11, pl. 5, fig. 11.
 1981b *Spinoleberis yotvataensis* Rosenfeld. Bismuth & al., p. 235, pl. 11, fig. 4-11.
 1989 *Spinoleberis yotvataensis* Rosenfeld. Majoran, p. 27, pl. 16, fig. 10-12.

Stratigraphic and geographical distribution: This species was described from the Lower Turonian of Israel. *Spinoleberis yotvataensis* occurs in the Turonian-Coniacian from Algeria.

In Tunisia, this species is present in the Middle Turonian from the Djebel Semmama, and the Lower Turonian from the Kalaat Senan area.

Genus *Veeniacythereis* Gruendel 1974*Veeniacythereis* cf. *maghrebensis* (Bassoullet & Damotte 1969)

- 1959 Ostracode C1. Glintzboeckel & Magne, p. 64, pl. 3, fig. 33.
 1969 *Cythereis maghrebensis* n. sp. Bassoullet & Damotte, p. 133, pl. 1, fig. 2a-c.
 1974 *Veeniacythereis jezziniensis* (Bischoff). Rosenfeld & Raab, p. 21, pl. 3, only fig. 10.
 1981b *Veeniacythereis maghrebensis* (Bassoullet & Damotte). Bismuth & al., p. 232, pl. 10, fig. 1-2.

Stratigraphic and geographical distribution: Initially this species was described from the Upper Cenomanian of Western Algeria. In Tunisia, it is restricted to the upper part of the Upper Cenomanian from the Djebel Semmama and is only present in one level of the Upper Cenomanian from the Kalaat Senan area.

Veeniacythereis streblophata streblophata (Al-Abdul-Razzaq & Grosdidier 1981)

- 1959 Ostracode C2. Glintzboeckel & Magné, p. 66, pl. 3, fig. 27.
 1981 *Cythereis streblophata streblophata* n. sp. Al-Abdul-Razzaq & Grosdidier, p. 183, pl. 1, fig. 7-10, pl. 2, fig. 6-8.

- 1981b *Veeniacythereis streblophata streblophata* (Al-Abdul-Razzaq). Bismuth & al., p. 233, pl. 10, fig. 5-7.

Stratigraphic and geographical distribution: This subspecies was described in the "upper part Cenomanian" (citation of the stratigraphic range indicated by the authors, p. 183) from Kuwait, but the same authors write, page 185: "*Cythereis streblophata streblophata* is characteristic of the lower Ahmadi Limestone Member of Lower Cenomanian age in Kuwait".

In Tunisia, Djebel Semmama, this subspecies is scarcely present in the lower part of the Upper Cenomanian.

Veeniacythereis streblophata schista (Al-Abdul-Razzaq & Grosdidier 1981)

- 1959 Ostracode C3. Glintzboeckel & Magne, p. 64, pl. 3, fig. 27.
 1981 *Cythereis streblophata schista* n. sp. Al-Abdul-Razzaq & Grosdidier, p. 185, pl. 2, fig. 1-5.
 1981b *Veeniacythereis streblophata* (Al-Abdul-Razzaq). Bismuth & al., p. 233, pl. 10, fig. 5-7.
 ?1989 "*Veeniacythereis*" *subrectangulata* Majoran. Majoran p. 23, pl. 13, fig. 12-16.

Stratigraphic and geographical distribution: This species is described from the Upper Cenomanian of Kuwait. In Tunisia *Veeniacythereis streblophata schista* occurs in the Lower Cenomanian from the Djebel Semmama, and scarcely in the lower and basal Middle Cenomanian from the Kalaat Senan area.

Conclusion

The vertical distribution of the most significant ostracodes in a distal environment is generally in accordance with what is already known from the shelf setting. One of the main differences observed concerns *Cythereis fahrioni bigrandis*: in all the Tunisian sections previously studied, this species was confined to the Upper Albian and Lower Cenomanian, while in the Kalaat Senan area, it also occurs in the Middle and Upper Cenomanian.

The ostracodes can be used as stratigraphical markers in the two studied types of environmental setting: distal and platform environments. However in the distal context, ostracodes are no more the privileged tool they are in platform environments.

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