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Albian benthic ostracods from the boreholes Vst-8 and Agt-2 (Vértes Foreland, NW-Hungary)

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(with 3 figures, 1 table and 2 plates)

The benthic ostracod faunas from the Albian succession of the Vértessomló Siltstone in the boreholes Vst-8 and Agt-2 were examined and compared. In the present study 10 species belonging to 8 genera were identified. The aim of the study was to give a picture of the palaeo-environment during the Albian age in this region of the Tethys using the ostracods. The dominance of platycopids in benthic assemblages of both boreholes indicates low-oxygenated bottom water conditions. Moreover, the low diversity, the presence of mainly deeper marine environment favouring podocopid forms and the absence or weakly developed eye spot bearing ostracods indicate a normal marine, shallow bathyal depositional environment. However, differences in the faunal composition of the two boreholes could be observed which can be explained with the different palaeogeographical position of the studied sequences during the Albian.

Introduction

Only a few studies have been made on ostracods from the Cretaceous sections of Hungary. These include the taxonomy and the palaeoecological interpretations of the Albian (ZALÁNYI 1959) and Cenomanian (MONOSTORI 2000) faunas from the Transdanubian Central Range. The Albian ostracod assemblages from the Vértessomló Siltstone have not been published yet. The goal of this work is the detailed systematical descriptions of the Albian benthic faunas from the boreholes Vértessomló Vst-8 and Agostyán Agt-2. The planktonic ostracod fauna of these boreholes was published in 2013 by CSÉFÁN & TÓTH. Further aim is to detect the depositional environment of these sequences because ostracods, living in every aquatic environment, are very useful in the palaeo-environmental reconstructions. Different assemblages occur in marine settings characterized by different water depth, substrate, temperature, salinity, water energy and oxygen content.

Geological setting

The studied boreholes are located in the Vértes Foreland, in the eastern zone of the Transdanubian Central Range, north-western Hungary (Fig. 1). The studied Vértessomló Siltstone Formation was deposited during the Early Cretaceous in a semi-enclosed basin. This grey silty and marly sequence interfingers with a platform carbonate, called Környe Limestone Formation to the southwest and with the Lábatlan Sandstone Formation to the northeast (CSÁSZÁR 2002). The succession reaches its maximum thickness (410 m) in the borehole Agt-2 (JÁMBOR et al. 1973) (Fig. 2). The age of the Vértessomló Siltstone Formation is Lower to Middle Albian based on mainly foraminiferal studies (BODROGI 1992; CSÁSZÁR 1998, 2002; FÜLÖP 1975; GÖRÖG 1993, 1996). In the borehole Vst-8 only the lower Albian part is represented (GÖRÖG 1996).

Material and methods

There were 114 samples examined: 23 from the borehole Vst-8 and 91 from the borehole Agt-2, respectively. The Vértessomló Siltstone mainly consists of silty marls, argillaceous marls and marly limestone layers. The ostracods were extracted with hydrogen-peroxide from the silty samples, and with cold acetolysis, modified after LETHIERS & CRASQUIN-SOLEAU (1988) from the more calcareous samples. For the identification and the illustration of the ostracods the photos were made by scanning electron microscope. For the palaeoecological interpretations semi-quantitative analyses of the faunas were used.

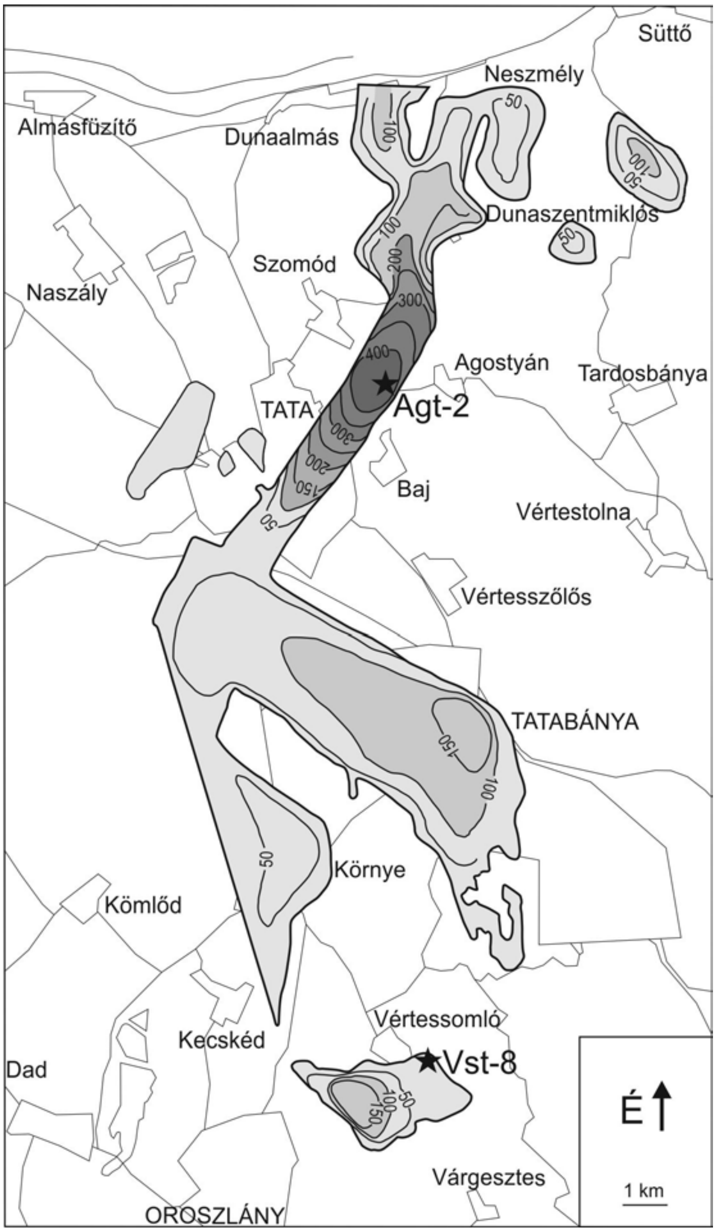

Fig. 1. Geographical locations of the boreholes Vst-8 and Agt-2 and recent extent and thickness distribution of the Vértessomló Siltstone Formation (after CSÁSZÁR, 2002).

Fig. 2. Lithostratigraphical sections of the boreholes Vst-8 and Agt-2.

Systematic part

Classification of the ostracods follows that of HORNE et al. (2002). The specimens are deposited in the Department of Palaeontology of Eötvös University (Budapest, Hungary).
The number of specimens per sample can be found in Table 1. (right valve/left valve, carapace).
Abbreviations: L=length and H=height.

Phylum Arthropoda SIEBOLD & STANNIUS, 1845
Subphylum Crustacea PENNANT, 1777
Class Ostracoda LATREILLE, 1806
Subclass Podocopa MÜLLER, 1894
Order Platycopida SARS, 1866
Superfamily Cytherelloidea SARS, 1866
Family Cytherellidae SARS, 1866
Genus *Cytherella* JONES, 1849
Type species: *Cytherina ovata* ROEMER, 1841

Cytherella gr. *ovata* (ROEMER, 1841)
Pl. 1. Figs 1—4.

1841. *Cytherina ovata* n. sp. – ROEMER, p. 104, pl. 16. figs 21. a-b.
1845. *Cytherina ovata* – REUSS, p. 16, pl. 5. fig. 35.
1854. *Cytherella ovata* ROEMER – BOSQUET, pp. 45-48, pl. 8, fig 1.
1956. *Cytherella ovata* (ROEMER) – DEROO, p. 1508, pl. 1, figs 4—6.
1958. *Cytherella ovata* (ROEMER 1841) – OERTLI, p. 1502, pl. 1, figs 10—29.
1959. *Cytherella ovata* (ROEMER) – ZALÁNYI, pp. 522—524, pl. 4, fig. 4., text-fig. 63.
1964. *Cytherella ovata* (ROEMER, 1841) – BAYNOVA & TALEV, p. 20. pl. 1. figs 4—6.
1965. *Cytherella ovata* (ROEMER, 1840) – KAYE, pp. 385—386, pl. 50, fig. 10.
1965. *Cytherella ovata* (ROEMER, 1840) – KAYE & Barker, pp. 385—386, pl. 50, fig. 10.
1966. *Cytherella ovata* (ROEMER, 1841) – GRÜNDEL, p. 12, pl. 1, fig. 2.
1966. *Cytherella ovata* (ROEMER, 1841) – HERRIG, pp. 718—728, text-figs 11—19, pl. 2, figs 1—7, pl. 44. figs 6—8.
1971. *Cytherella ovata* (ROEMER, 1841) – DAMOTTE, pp. 55—56, pl. 1, figs 2—7.
1971. *Cytherella* cf. *ovata* (ROEMER) – KEEN & SIDDIQUI, p. 61, pl. 1, figs 1, 9.
1974. *Cytherella ovata* (ROEMER, 1840) – DAMOTTE & FREYTEt, pp. 202—203, pl. 1, fig. 1.
1974. *Cytherella* gr. *C. ovata* (ROEMER, 1841) – ROSENFELD & RAAB, pp. 3—4, pl. 1, figs 3—5.
1976. *Cytherella „ovata"* (ROEMER, 1840) – BREMAN, pp. 82—83, pl. 1, fig. 1, pl. 2, fig. 1e.
1976. *Cytherella ovata* (ROEMER) – JAIN, pp. 202—203, figs 3. C—D.
1977. *Cytherella* gr. *ovata* (ROEMER, 1841) – CHAROLLAIS et al., pl. 1, fig. 1.
1978. *Cytherella ovata* (ROEMER, 1841) – NEALE, pl. 1, figs 1—2.
1978. *Cytherella ovata* (ROEMER) – SWAIN, pp. 251—252, pl. 1, figs 2—5.
1979. *Cytherella ovata* (ROEMER, 1840) – DAMOTTE, p. 276, pl. 6/1, fig. 1.
1982. *Cytherella* ex gr. *ovata* (ROEMER, 1840) – WEAVER, pp. 12—14, pl. 1, figs 1—5, pl. 2, fig. 20; figs 7—8.
1985. *Cytherella* gr. *C. ovata* (ROEMER, 1840) – AINSWORTH, p. 27, fig. 9/16.
1985. *Cytherella ovata* (Roemer, 1841) – BABINOT et al., pl. 48, fig. 1, pl. 55, figs 1—2.
1985. *Cytherella* gr. *ovata* (ROEMER, 1841) – VIVIERE, p. 135, pl. 1, fig. 1.
1988. *Cytherella ovata* (ROEMER) – JARVIS et al., fig. 15/a.
1990. *Cytherella* cf. *ovata* (ROEMER, 1841) – MAJORAN, pl. 1, figs 1—12.
1991. *Cytherella* gr. *ovata* (ROEMER, 1840) – SHAHIN, p. 133, pl. 1, fig 5.
1992. *Cytherella ovata* (ROEMER, 1841) – WITTE et al., pp. 46—47, pl. 1, figs 8—10.
1993. *Cytherella ovata* (ROEMER, 1841) – BABINOT & GROSHENY, p. 101, pl. 1, figs 1—4.
2000. *Cytherella ovata* (ROEMER, 1841) – MONOSTORI, pp. 6—7, pl. 1, figs 1—6.
2000. *Cytherella* cf. *ovata* (ROEMER, 1840) – MORSI, p. 50, pl. 1, figs 1—2.
2002. *Cytherella* cf. *ovata* (ROEMER, 1841) – EL-NADY, p. 597, pl. 1, figs 10—11.
2006. *Cytherella* aff. *ovata* (ROEMER, 1841) – ANDREU & BILOTTE, p. 58, pl. 1, figs 1—5.
2007. *Cytherella* ex gr. *ovata* (ROEMER, 1841) – BABINOT et al., p. 41, pl. 1, figs 1—3.
2008. *Cytherella ovata* (ROEMER, 1841) – EL NADY et al., p. 542, pl. 1, fig. 6.
2009. *Cytherella* cf. *ovata* (ROEMER, 1841) – SCHUDACK & Schudack, fig. 10/15.
2010. *Cytherella ovata* (ROEMER, 1841) – ALLAMEH et al., pl. 1, fig. 6.

Dimensions: L: 0.57—0.89 mm
H: 0.37—0.59 mm
L/H: 1.4—1.8

Remarks. Characteristic features are the following: carapace oval in lateral view; anterior margin evenly rounded; dorsal margin arched and gently sloping from mid-length; posterior margin asymmetrically rounded; ventral margin straight to convex and right valve overlaps the left one. According to DAMOTTE (1971) the holotype of this variable species is unfortunately lost and does not have a detailed description and illustration. Furthermore, the carapace is characterless because the valve surface smooth, the intra-specific variability of the shape and the size is great. Due to these facts, the species level classification of the extinct species belonging to the genus *Cytherella* is difficult.

Occurrences and stratigraphic ranges. England: Aptian-Turonian (KAYE & BARKER 1965; NEALE 1978, JARVIS et al. 1988), Ireland: Aptian-Maastrichtian (KEEN & SIDDIQUI 1971; AINSWORTH 1985), France: Aptian-Campanian (DEROO 1956; OERTLI 1958; DAMOTTE 1971; DAMOTTE & FREYTET 1974; DAMOTTE 1979; BABINOT et al. 1985; BABINOT & GROSHENY 1993; ANDREU & BILOTTE 2006; BABINOT et al. 2007), Netherlands: Cenomanian (WITTE et al. 1992), Switzerland: Albian (CHAROLLAIS et al. 1977), Hungary: Albian-Cenomanian (ZALÁNYI 1959; MONOSTORI 2000; this paper), Spain: Albian-Turonian (BREMAN 1976; SWAIN 1978; SCHUDACK & SCHUDACK 2009), Algeria: Cenomanian (Majoran 1990), Egypt: Cenomanian-Maastrichtian (MORSI 2000; EL-NADY 2002; EL-NADY et al. 2008.), Israel: Cenomanian-Turonian (ROSENFELD & RAAB 1974), Iran: Turonian-Santonian (ALLAMEH et al. 2010), India: Albian (JAIN 1976).

Cytherella parallela (REUSS, 1846)
Pl. 1. Figs 5—6.

1845. *Cytherina parallela* – REUSS, p. 16, pl. 5, fig. 33.
1958. *Cytherella* cf. *parallela* (REUSS, 1846) – OERTLI, pp. 1501—1502, pl. 1, figs 1—9.
1966. *Cytherella parallela* (REUSS, 1846) – GRUENDEL, p. 12, pl. 1, fig. 4.
1966. *Cytherella parallela* (REUSS, 1845) – HERRIG, pp. 728—736, text-fig. 20—24, pl. 3, figs 1, 2, 4.
1971. *Cytherella* cf. *parallela* (REUSS, 1846) – DAMOTTE, p. 56, pl. 1, fig. 8.
1974. *Cytherella* cf. *C. parallela* (REUSS) – ROSENFELD & RAAB, p. 3, pl. 1, figs 1—2.
1976. *Cytherella* cf. *C. parallela* (REUSS, 1845) – BREMAN, pp. 84—85, pl. 2, fig. 2a.
1976. *Cytherella* cf. *parallela* (REUSS) – JAIN, p. 203, figs 3. E—F.
1977. *Cytherella* gr. *parallela* (REUSS, 1846) – CHAROLLAIS et al., pl. a, fig 2.
1978. *Cytherella parallela* (REUSS) – SWAIN, p. 251, pl. 1, fig. 1.
1979. *Cytherella* cf. *parallela* (REUSS, 1845) – DAMOTTE, pp. 276—277, pl. 6/1, fig. 2.
1985. *Cytherella parallela* (REUSS, 1846) – BABINOT et al., pl. 48, fig. 2, pl. 55, fig. 10.
1991. *Cytherella* cf. *parallela* (REUSS, 1845) – SHAHIN, p. 134, pl. 1, figs 6—7.
1993. *Cytherella* cf. *parallela* (REUSS, 1845) – BABINOT & Grosheny, p. 101, pl. 1, figs 5—7.
1997. *Cytherella parallela* (REUSS) – ISMAIL & SOLIMAN, pl. 2, figs 4—5.
2000. *Cytherella parallela* (REUSS, 1845) – MONOSTORI, pp. 7—8, pl. 1, figs 7—8, pl. 2, figs 1—2.
2002. *Cytherella parallela* (REUSS, 1846) – EL-NADY, p. 597, pl. 1, fig. 12.
2006. *Cytherella* aff. *parallela* (REUSS, 1846) – ANDREU & Bilotte, p. 60, pl. 1, figs 6—8.
2007. *Cytherella* cf. *parallela* (REUSS, 1846) – BABINOT et al., p. 41, pl. 1, fig. 4.

Dimensions: L: 0.61—0.88 mm
H: 0.31—0.51 mm
L/H: 1.6—2.1

Remarks. Characteristic features are the following: Carapace sub-rectangular in lateral view. Right valve overlaps left. Surface smooth. The studied specimens are the most similar in details to those described by OERTLI (1958), BREMAN (1976), BABINOT et al. (1985, 2007), BABINOT & GROSHENY (1993), MONOSTORI (2000) and ANDREU & BILOTTE (2006).

Occurrences and stratigraphic ranges. England: Albian (DAMOTTE 1971), France: Aptian-Turonian (OERTLI 1958; DAMOTTE 1971; DAMOTTE 1979; BABINOT et al. 1985; BABINOT & GROSHENY 1993; ANDREU & BILOTTE 2006), Switzerland: Albian (CHAROLLAIS et al. 1977), Germany: Cenomanian (DAMOTTE 1971), Hungary: Albian-Cenomanian (MONOSTORI 2000; this paper), Egyipt: Cenomanian-Coniacianan (ISMAIL & SOLIMAN 1997; EL-NADY 2002), Israel: Cenomanian-Turonian (ROSENFELD & RAAB 1974), India: Albian (JAIN 1976).

Order Podocopida SARS, 1866
Superfamily Bairdioidea SARS, 1866
Family Bairdiidae SARS, 1888
Genus *Bairdia* MCCOY, 1844
Type species: *Bairdia curta* MCCOY, 1844

Bairdia sp.
Pl. 1. Fig. 7.

Dimensions: L: 1.17 mm
H: 0.77 mm
L/H: 1.5

Remarks. Dorsal margin trapezoidal. Posterior end pointed. Ventral margin convex. The single specimen is poorly preserved.

Occurrences and stratigraphic ranges. Lower Albian (this paper).

Superfamily Cytheroidea BAIRD, 1850
Family Cytheridae BAIRD, 1850
Subfamily Protocytherinae LIUBIMOVA, 1955
Genus *Protocythere* TRIEBEL, 1938
Type species: *Cytherina triplicata* ROEMER, 1841

Protocythere albae DAMOTTE & GROSDIDIER, 1963
Pl. 1. Figs. 11—12.

1963. *Protocythere albae* n. sp. – DAMOTTE & GROSDIDIER, pp. 54—55, pl. 1, fig. 3.
1966. *Protocythere albae* DAMOTTE & GROSDIDIER,

1963 – GRÜNDEL, pp. 25—26, pl. 4, figs 9—10, text-fig. b/a-b.
1971. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – BERTRAM & KEMPER, pl. 2, figs 3—4.
1971. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – DAMOTTE, p. 89, pl. 5, fig. 15.
1971. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – KEEN & SIDDIQUI, p. 64, pl. 2, figs 4, 8.
? 1971. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – RISCH, pp 59—60, pl. 8, figs 1—4.
1977. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – CHAROLLAIS et al., pl. 2, figs 8—9.
1978. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – WIEL, pl. 2, fig. 7.
1979. *Protocythere (Protocythere) albae* DAMOTTE & GROSDIDIER, 1963 – DAMOTTE, p. 285, pl. 6/2, fig. 21.
1985. *Protocythere (Protocythere) albae* DAMOTTE & GROSDIDIER, 1963 – BABINOT et al., pl. 53. figs 15—16, pl. 54, fig. 1.
1989. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – ELSTNER & KEMPER, pl. 2, figs 7—8.
1991. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963 – KEMPER, pl. 3, figs 4—5.

Dimensions: L: 0.94—1.00 mm
H: 0.50—0.55 mm
L/H: 1.8

Remarks. *Protocythere* with three subparallel ridges. Dorsal ridge arched and extends over the dorsal margin. Anterior side of the median and ventral ridges are weakly connected, which is more characteristic on the right valve. Left valve overlaps right on the anterodorsal, anteroventral and posterodorsal sides. The specimens resemble the most to those described by GRÜNDEL (1966), BERTRAM & KEMPER (1971), ELSTNER & KEMPER (1989) and apart from the posterior spines to the specimen of WIEL (1978). Differs from the otherwise similar form *Protocythere derooi* OERTLI in the morphology of the ribs and in carapace size (sensu OERTLI, 1958, p. 1509-1510 pl. 6, figs 129-143).
Occurrences and stratigraphic ranges. England: Albian (DAMOTTE 1971), Ireland: Cenomanian (KEEN & SIDDIQUI 1971), France: Albian (DAMOTTE & GROSDIDIER 1963; GRÜNDEL 1966; BABINOT et al. 1985; DAMOTTE 1971, 1979; WIEL 1978), Switzerland: Albian (CHAROLLAIS et al. 1977), Germany: Albian (GRÜNDEL 1966; BERTRAM & KEMPER 1971; ELSTNER & KEMPER 1989; KEMPER 1991), Hungary: Lower Albian (this paper).

Protocythere galileensis ROSENFELD & RAAB, 1984
Pl. 1. Fig. 13.

1984. *Protocythere galileensis* n. sp. – ROSENFELD & RAAB, pp. 101–102, pl. 4, figs 4—6.
1996. *Protocythere galileensis* ROSENFELD & RAAB, 1984 – ZGHAL et al. , p. 79, pl. 1, figs 27—28.

Dimensions: L: 0.86 mm
H: 0.44 mm
L/H: 2

Remarks. *Protocythere* with straight dorsal and ventral margin and three straight ridges. Median and ventral ridges joined together on the anterior side, forming a rotated U shape. Differs from the holotype in the less prominent dorsal ridge.
Occurrences and stratigraphic ranges. Tunisia: Albian (ZGHAL et al. 1996), Israel: Aptian-Albian (ROSENFELD & RAAB 1984). Hungary: Lower Albian (this paper).

Family Cytherideidae SARS, 1925
Subfamily Schulerideinae MANDELSTAM, 1959
Genus *Schuleridea* SWARTZ & SWAIN, 1946
Type species: *Schuleridea acuminata* SWARTZ & SWAIN, 1946

Schuleridea rhomboidalis NEALE, 1960
Pl. 1. Figs 8—10.

1960. *Schuleridea rhomboidalis* n. sp. – NEALE, p. 210, pl. 2, figs 1, 2, 5, 7, 8.
1978. *Schuleridea rhomboidalis* NEALE, 1960 – NEALE, pl. 7, fig. 14, pl. 8, figs 1—2.
1980. *Schuleridea rhomboidalis* NEALE, 1960 – DAMOTTE & Rey, p. 23, pl. 1, figs 25—26.
1985. *Schuleridea rhomboidalis* NEALE, 1960 – BABINOT et al., pl. 46, fig. 7.
1991. *Schuleridea* cf. *S. rhomboidalis* NEALE, 1960 – SWAIN & CHUANLI, p. 75—76, pl. 2, figs 18—19.

Dimensions: L: 0.65—1.02 mm
H: 0.31—0.61 mm
L/H: 1.3—1.9

Remarks. Right valve trapezoidal in lateral view. Left valve is more rounded and entirely overlaps the right one. Eye tubercle almost always visible. Differs from the holotype in the less rounded left valve with more prominent posterodorsal angle. The specimens resemble the most to those described by NEALE (1978) and BABINOT et al. (1985). Strong sexual dimorphism with more elongated males can be recognized.
Occurrences and stratigraphic ranges. England: Hauterivian-Barremian (NEALE 1960, 1978), France: Barremian (BABINOT et al. 1985), Portugal: Hauterivian (DAMOTTE & REY 1980), western North Atlantic Ocean: Albian or Cenomanian (SWAIN & CHUANLI 1991). Hungary: Lower Albian-Middle Albian (this paper).

Family Trachyleberididae SYLVESTER-BRADLEY, 1948
Subfamily Trachyleberidinae SYLVESTER-

BRADLEY, 1948
Genus *Rehacythereis* GRUENDEL, 1973
Type species: *Cythereis luermannae* TRIEBEL, 1940

Rehacythereis bartensteini (OERTLI, 1958)
Pl. 2. Figs 1—3.

1958. *Cythereis bartensteini* n. sp. – OERTLI, pp. 1513—1514, pl. 8, figs 171—179, pl. 9, figs 197—198.
1971. *Cythereis bartensteini* OERTLI, 1958 – RISCH, p. 60, pl. 8, figs 11—14.
1985. *Rehacythereis bartensteini* (OERTLI, 1958) – BABINOT et al., pl. 49, fig. 5.
1993. *Rehacythereis bartensteini* (OERTLI, 1958) – ANDREU et al., p. 110, pl. 5, fig. 8.
2007. *Rehacythereis bartensteini* (OERTLI) – BABINOT et al., pl. 6, figs 16-17.
2007. *Rehacythereis* aff. *bartensteini* (OERTLI) – BABINOT et al., pl. 6, fig. 15
2007. *Rehacythereis* cf. *bartensteini* (OERTLI, 1958) – BABINOT et at. p. 56.

Dimensions: L: 0.66—0.84 mm
H: 0.39—0.46 mm
L/H: 1.5—2.0

Remarks. *Rehacythereis* with well-developed and small tubercles on the anteromarginal ridge and with a distinct sub-central tubercle. Secondary ornamentation is punctation and weak reticulation. Sexual dimorphism is present with more elongated males. Differs from the holotype and from the very similar specimens described by BABINOT et al. (1985) in the less developed reticulation. The eye tubercle is less pronounced as well. The weaker ornamentation could be caused by the preservation of the carapaces and/or the poorer environmental conditions that persisted in the deeper parts of the ocean.

Occurrences and stratigraphic ranges. France: Aptian-Albian (OERTLI 1958; BABINOT et al. 1985; BABINOT et al. 2007), Northern Limestone Alps: Albian (RISCH 1971), Morocco: Albian (ANDREU et al. 1993), Hungary: Lower Albian-Middle Albian (this paper).

Rehacythereis luermannae (TRIEBEL, 1940)
Pl. 2. Figs 4—6.

1940. *Cythereis lürmannae* n. sp. – TRIEBEL, pp. 201—204, pl. 6, figs 63—66.
1964. *Cythereis lurmannae* TRIEBEL, 1940 – KAYE, pp. 66—67, pl. 8, figs 11—15.
1966. *Cythereis luermannae* TRIEBEL, 1940 – GRÜNDEL, p. 36, pl. 6, fig. 23.
1971. *Cythereis luermannae* TRIEBEL, 1940 – BERTRAM & Kemper, p. 38, pl. 1, figs 1, 2, 5, 6.
1971. *Cythereis luermannae* TRIEBEL, 1940 – DAMOTTE, p. 66, pl. 2, fig. 13.
1972. *Cythereis* aff. *lürmannae* TRIEBEL, 1940 – DONZE & PORTHAULT, pp. 364—367, pl. 3, figs 8—10.
1977. *Cythereis (Rehacythereis?) luermannae* TRIEBEL, 1940 – DAMOTTE, pl. 1, fig. 4.
1978. *Cythereis luermannae* TRIEBEL, 1940 – WIEL, pl. 1, figs 7—8.
1979. *Cythereis luermannae* TRIEBEL, 1940 – DAMOTTE, pp. 281-282, pl. 6/2, fig. 12.
1982. *Rehacythereis luermannae bemerodensis* (KEMPER, 1971) – WEAVER, p. 80, pl. 12, figs 1—2.
1982. *Rehacythereis luermannae luermannae* (TRIEBEL, 1940) – WEAVER, p. 79, pl. 11, figs 20—21.
1985. *Cythereis (Rehacythereis) luermannae* TRIEBEL, 1940 – BABINOT et al., pl. 52, figs 1—3.
1989. *Cythereis luermannae* TRIEBEL, 1940 – FRIEG & KEMPER, pl. 18, figs 1—9.
1992. *Rehacythereis luermannae* (TRIEBEL, 1940) – WITTE et al., pp. 74—75, pl. 7, figs 2, 4, 5.
1996. *Rehacythereis luermannae* (TRIEBEL, 1940) – HERNGREEN et al., pl. 9, fig. 17.
2011. *Cythereis (Rehacythereis)* cf. *luermannae hannoverana* BERTRAM & KEMPER, 1981 – SAUVAGNAT & WEIDMANN, p. 171, pl. 1, figs 7—8.

Dimensions: L: 0.68—0.90 mm
H: 0.38—0.45 mm
L/H: 1.8—2.0

Remarks. *Rehacythereis* with weaker ornamentation than that of the holotype. Sub-central tubercle and marginal ridges are visible on most specimens. Secondary ornamentation is punctation and weak reticulation. The presence of reduced and varied ornamentation on this form may be due to the life style in a stress environment and therefore may be an ecophenotypic variation.

Occurrences and stratigraphic ranges. England: Albian-Cenomanian (GRÜNDEL 1966; DAMOTTE 1971, 1979; WEAVER 1982), France: Albian-Cenomanian (GRÜNDEL 1966; DAMOTTE 1971, 1977, 1979; BABINOT et al. 1985), Netherlands: Albian-Cenomanian (WITTE et al. 1992; HERNGREEN et al. 1996), Switzerland: Cenomanian (SAUVAGNAT & WEIDMANN 2011), Germany: Albian-Cenomanian (GRÜNDEL 1966; BERTRAM & KEMPER 1971; DAMOTTE 1971, 1979; WEAVER 1982; FRIEG & KEMPER 1989), Poland: Albian-Cenomanian (GRÜNDEL 1966), Canada: Albian (WITTE et al. 1992). Hungary: Lower Albian (this paper).

Genus Cythereis JONES, 1849
Type species: *Cytherina ciliata* REUSS, 1846

Cythereis ex gr. *fahrioni* (BISCHOFF, 1963)
Pl. 2. Fig. 7.

Dimensions: L: 1.17 mm
H: 0.57 mm
L/H: 2.0

Remarks. Large *Cythereis* with distinct reticulated valve surface. The carapace strongly resembles *C. fahrioni* (BISCHOFF, 1963, pp. 31—33, pl. 12, figs 90—93, pl. 13, fig. 94) from the Middle Albian of Lebanon but the median ridge and sub-central tubercle are virtually missing. Only one moderately preserved specimen occurs in the material so it can be classified only to the group *C. fahrioni* with certainty.

Occurrences and stratigraphic ranges. Lower Albian (this paper).

Superfamily Pontocypridoidea MÜLLER, 1894
Family Pontocyprididae MÜLLER, 1894
Genus *Pontocyprella* MANDELSTAM in LIUBIMOVA, 1955
Type species: *Bairdia harrisiana* JONES, 1849

Pontocyprella harrisiana (JONES, 1849)
Pl. 2. Fig. 8.

1849. *Bairdia harrisiana* n. sp. – JONES, p. 25—26, pl. 6, fig. 17a—f.
1962. *Pontocyprella harrisiana* (JONES) – NEALE, pl. 6, figs 12—13.
1964. *Pontocyprella harrisiana* (JONES, 1849) – BAYNOVA & TALEV, P. 24, PL. 2, FIGS 6—7.
1965. *Pontocyprella harrisiana* (JONES, 1849) – BAYNOVA, pl. 1, figs 10—11.
1966. *Pontocyprella harrisiana* (JONES, 1849) – GRÜNDEL, p. 17, pl. 2, fig. 9.
1966. *Pontocyprella harrisiana* (JONES, 1849) – HERRIG, pp. 788—789, text-fig. 58, pl. 14, figs 2a, b.
1982. *Pontocyprella harrisiana* (JONES, 1849) – WEAVER, pp. 29—30, pl. 4, figs 17—20.
1992. *Pontocyprella harrisiana* (JONES, 1849) – WITTE et al., p. 52, pl. 2, fig. 14.
1997. *Pontocyprella harrisiana* (JONES, 1849) – SLIPPER, pl. 6, figs 4—5.
2000. *Pontocyprella* n. sp. aff. *P. harrisiana* (JONES, 1849) – MONOSTORI, pp. 15—16, pl. 8, fig. 7, pl. 9, figs 1—3.
2007. *Pontocyprella harrisiana* (JONES, 1849) – BABINOT et al., p. 47, pl. 3, figs 11—12.
2007. *Pontocyprella harrisiana* (JONES, 1849) – VAZIRI et al., p. 133, pl. 3, fig. k.
2009. *Pontocyprella harrisiana* (JONES) – VAZIRI, pl. 6, figs e—f.
2011. *Pontocyprella* cf. *harrisiana* (JONES, 1849) – BABINOT & COLIN, p. 753, pl. 8, fig. 9.

Dimensions: L: 0.59—1.17 mm
H: 0.27—0.77 mm
L/H: 1.7—2.4

Remarks. *Pontocyprella* with elongated, smooth carapace. Anterior margin asymmetrically rounded. Anterodorsal margin straight and slopes from middle length. Posterodorsal margin convex. Posterior margin pointed. Ventral margin concave. The specimens resemble the most to those described by BAYNOVA & TALEV (1964), WITTE et al. (1992), SLIPPER (1997), MONOSTORI (2000) and BABINOT et al. (2007).

Occurrences and stratigraphic ranges. England: Albian-Turonian (JONES 1849; GRÜNDEL 1966; NEALE 1973; WEAVER 1982; SLIPPER 1997; VAZIRI 2009), France: Barremian-Aptian (BABINOT et al. 2007; BABINOT & COLIN 2011) Netherlands: Cenomanian (WITTE et al. 1992), Germany: Albian-Cenomanian (GRÜNDEL 1966; WEAVER 1982), Poland: Albian-Cenomanian (GRÜNDEL 1966), Hungary: Albian-Cenomanian (MONOSTORI 2000, this paper), Morocco: Valanginian (BABINOT & COLIN 2011), Iran: Albian-Cenomanian (VAZIRI et al. 2007).

Superfamily Cypridoidea BAIRD, 1845
Family Candonidae KAUFMANN, 1900
Subfamily Paracypridinae SARS, 1923
Genus *Paracypris* SARS, 1866
Type species: *Paracypris polita* SARS, 1866

Paracypris jonesi BONNEMA, 1941
Pl. 2. Fig. 9.

1941. *Paracypris jonesi* n. sp. – BONNEMA, p. 115, pl. 3, figs 24—28.
1958. *Paracypris jonesi* BONNEMA, 1940 – OERTLI, p. 1503, pl. 2, figs 30—38.
1965. *Paracypris jonesi* BONNEMA – LIUBIMOVA, p. 26—27, pl. 2, figs 8—9.
1975. *Paracypris jonesi* BONNEMA – JAIN, p. 207, figs 1. U—V.
1985. *Paracypris* cf. *jonesi* BONNEMA, 1941 – BABINOT et al., pl. 48, fig. 3.
2005. *Paracypris jonesi* BONNEMA, 1941 – SHAHIN, p. 756, pl. 1, fig. 20.
2008. *Paracypris* aff. *jonesi* BONNEMA, 1941 – MORSI et al., pp. 165—166, pl. 1, fig. 17.

Dimensions: L: 0.76—0.91 mm
H: 0.31—0.36 mm
L/H: 2.5—2.7

Remarks. The specimens are identical in shape with the holotype figured and described by BONNEMA (1941).

Occurrences and stratigraphic ranges. France: Aptian-Albian (OERTLI 1958; BABINOT et al. 1985), Netherlands: Maastrichtian (BONNEMA 1941), Hungary: Lower Albian (this paper), Egypt: Maastrichtian-Eocene (SHAHIN 2005; MORSI et al. 2008), India: Coniacian-Maastrichtian (JAIN 1975a, 1975b).

Results

As a result of the studies 11 ostracod taxa were identified which includes 10 species and 8 genera. The most common ostracod genus was the platycopid *Cytherella* in both boreholes (Fig. 3). In the borehole Vst-8, the percentage of platycopids fluctuates around 50% between depths 135 m and 119 m. The percentage at depth 117 m is greatly reduced, then it reaches high values again from 115 m depth. In the borehole Agt-2, the percentage of platycopids from the bottom to 125 m depth is greater than 80%. In the samples above the values drop to 40-60 %. The second most frequent genus was the *Schuleridea* that is more common in the borehole Vst-8 than in the borehole Agt-2. The *Pontocyprella* appears in great abundance mainly in the lower parts of both boreholes. The ornamented trachyleberid ostracods, namely *Rehacythereis* and *Cythereis*, are few in numbers in the borehole Agt-2, but they occur in large amounts in the middle part, between depths 140 m and 123 m, of the borehole Vst-8. The ornamentation of the trachyleberids as well shows differences comparing the specimens of the two boreholes. The more ornamented forms occur in the borehole Vst-8. The genera *Bairdia*, and *Protocythere* and *Paracypris* are represented by only a few carapaces.

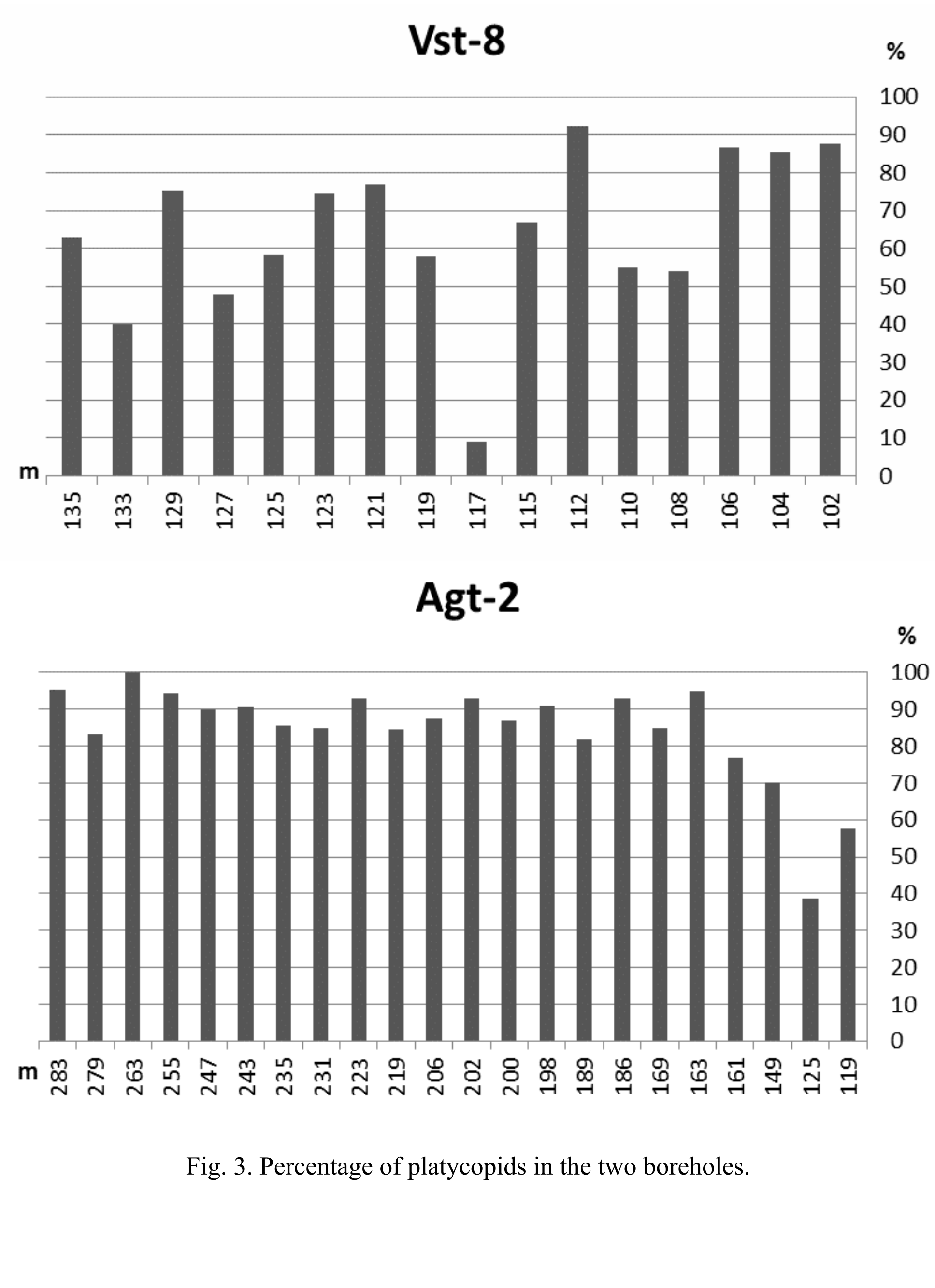

Fig. 3. Percentage of platycopids in the two boreholes.

Discussion

The palaeoecological interpretation of the benthic ostracod faunas from the boreholes Vst-8 and Agt-2 is to provide new data about the depositional environment of the Vértessomló Siltstone.

High proportion of platycopid *Cytherella*s in each sample of both boreholes likely indicates low oxygenated bottom water conditions in this subbasin of the Tethys according to previous studies of BOOMER & WHATLEY (1992) and WHATLEY et al. (1994) on Early Jurassic ostracod faunas. Following the calculations of WHATLEY et al. (2003) it was possible to estimate the oxygen content in the sea water using the "Platycopid signal", the percentage distribution of the platycopids. The samples containing more than 10 specimens were used in the analysis. The palaeo-oxygen level values in the borehole Vst-8 varied between 1.4 ml/l and 6.0 ml/l with an average of 3.1 ml/l, and were constant low in the borehole Agt-2 (between 1.0 ml/l and 2.0 ml/l).

The ratio of platycopids indicate higher oxygen levels than the estimation of SZINGER (2008) based on foraminifers, who could distinguish three intervals in the borehole Vst-8, that cannot be detected with the ostracods. However, some authors argue the usability of platycopids in the palaeo-oxygen level reconstruction, considering studies on recent ostracods living in the oxygen minimum zone (e.g. BRANDÃO & HORNE 2009). Nonetheless, it provided an opportunity to compare the results of this paper with the results of SZINGER (2008).

The genera *Cytherella* and *Pontocyprella* with smooth carapaces indicate normal marine environment with bathyal water depth, because they were dominant in open marine, terrigenous facies during the Cretaceous (e.g., BABINOT 1995). The trachyleberids and *Schuleridea* favoured the more calcareous platform environment in this periode, although they could have occurred in the shallow parts of the bathyal zone as well (BABINOT & COLIN 1983). *Bairdia*, *Protocythere* and *Paracypris* were all widespread considering their habitat. Whereas *Protocythere* was most common in the littoral zone, *Paracypris* was typical of deeper waters. The low diversity in the samples of both boreholes is also a supporting evidence of deeper water environment.

The amount of light is reduced toward the basin floor caused mainly by the sediment particles suspended in the water. The lower intensity of light may result in weaker or absent eye spots on the carapaces. Therefore the specimens living closer to the platform have distinct eye spots, while the forms occupying the basin have weaker or missing eye spots. This differences can be recognized on the trachyleberids and *Schuleridea*s of the studied ostracod faunas.

In conclusion, the depositional environment of the Vértessomló Siltstone was a shallow bathyal basin with normal marine and low oxygenated bottom water conditions during the Albian based on the ostracod assemblages of both boreholes.

Comparing the ostracod faunas of the two boreholes, the amount of specimens per samples are lower in the borehole Agt-2 due to the higher sediment input and to the stable low oxygenated bottom water conditions inside the basin. Whereas, the succession of the borehole Vst-8 was formed closer to the carbonate platform, the oxygen content fluctuated in this environment based on the composition changes of the fauna.

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Table 1. Distribution of ostracod taxa in the borehole Vst-8 and Agt-2.

m	*C. ovata*		*C. parallela*		*Bairdia*		*Protocythere*		*Schuleridea*		*R. bartensteini*		*R. luermannae*		*Cythereis*		*Pontocyprella*		*Paracypris*	
Agt2	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d
21																				
26	1/1		0/1							1										
34	1/0																	1		
38		1		1																
55	2/0	3		1																
59				1																
67		3																		
101										1										
107			1/0							2										
109		1								1		1								
117	1/1	2	1/0							2										
119	1/0	8		2						5										
125		1	0/1	3						4								4		
134										2										
138		1								2										
140	0/1	1		1						1		1								
143		1																		
145				1																
149	2/4	1								3										
151		1																		
155		1								1										
157	1/1	1								2								1		
159	2/2	1		1						1										
161	2/1	5		2						3										
163	2/3	9	1/0	4						1										
167	1/0	1		1						1										
169	6/6	1	1/2	1						3										
171		2								1										
173				1						1										
182	3/0		1/0							1										
184		1	1/0																	
186	6/3	2	1/1							1										
189	3/2	2	0/1	1						1										
196	2/0			2																
198	5/1	1		1						1										
200	5/3	8		4						3										
202	4/2	3	1/1	2					0/1											
204	2/4	1	1/0																	
206	7/7	1	2/2	2						2								1		
209	4/2			2						1										
213	1/0		3/1							2										
217		1		1																
219	2/3		2/3	1						1				1						
222																				
223	6/2	2	2/0	1						1										
227	1/1	1	0/1	1																
231	7/5	2	1/0	2						3										
235	6/3	1	1/0	1						1								1		
239	2/0	2	1/0	1				1												
243	5/3	3	2/2	4					1/0	1										
247	8/9	5	2/2	1					0/1	2										
251			1/0						0/1											
255	5/5	2	1/0	3																
263	8/6	11	1/0	1					1/0											
267	1/1	2		3						1										
271		1																		
275	3/0	1		1																
279	5/1		4/3	2					0/1	1				1						

m	*C. ovata*		*C. parallela*		*Bairdia*		*Protocythere*		*Schuleridea*		*R. bartensteini*		*R. luermannae*		*Cythereis*		*Pontocyprella*		*Paracypris*	
Agt2	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d	r/l	d
283	2/4	4	2/5	3										1						
287	2/1	1		1																
291														1			1/0			
295		1		1																
299	1/0	3	0/1	1										1				1		
303	0/1	2	0/1	3																
305		1																4		
307	0/1	1		1													0/1	1		
311	1/0	3	1/1											1				3		
315	1/0	2		1														1		
319	0/1	1		1														1		
323	1/0	3						1												
327		2	0/1	2						1										
329	0/1	2		1						2										1
331		3																1		
335		1																		
339	0/1			1										1						
343		2																		
345		1																		
347	1/1	2							1/0	1										
351	1/1	1																		
353	1/1	1		2																
359				1						1								1		
361				1					0/1											
363			0/1							1										
367	0/1		1/1																	
371	1/0	1		1																
373	2/0			1						1										1
375		2								2										
379	1/1	1	0/1															1		
383	1/0		0/1											1						
387	1/0																			
407		1						1												
Vst-8																				
102	0/1	8		10					0/2	1										
104	9/9	26	7/2	12					0/1	10										
106	12/6	18	2/5	9					1/0	8										
108	2/1	4	1/1	4					4/2	1								2		2
110			1/0	15					1/0	7								3		2
112	6/4	6	3/5	6					0/1	3										
115		8								3										1
117				1		1				4		2					1/0	3		
119	23/16	27	7/6	30					2/5	38		2						26		4
121	2/1	26	0/3	12						8								4		1
123	24/17	5	18/15	12						7		21						1		2
125		15		11						7		3						9		1
127		11		11						11		7						17		1
129	32/27	13	3/4	24						8		11						14		
133		3		1						5		2				1				
135	8/6	5	3/3	7					1/0	8		10								
137		2										1								2
140	24/18	18	11/10	20					0/1	6		29								2
142	1/0	2																		
149				1						2										
151	1/0	1	0/1	1						4								3		
153		1		1						5								1		
168	1/0	3		3						1										

Plate 1

Figs 1—4. *Cytherella* gr. *ovata* (ROEMER, 1841)
Fig. 1. Carapace in left view. Borehole Agt-2: 267 m
Fig. 2. Carapace in right view. Borehole Agt-2: 247 m
Fig. 3. Carapace in left view. Borehole Vst-8: 142 m
Fig. 4. Carapace in left view. Borehole Vst-8: 125 m

Figs 5—6. *Cytherella parallela* (REUSS, 1845)
Fig. 5. Carapace in left view. Borehole Agt-2: 169 m
Fig. 6. Carapace in left view. Borehole Agt-2: 243 m
Fig. 7. *Bairdia* sp. Right valve. Borehole Vst-8: 117 m

Figs 8—10. *Schuleridea rhomboidalis* NEALE, 1960
Fig. 8. Carapace in right view. Female. Borehole Vst-8: 110 m
Fig. 9. Carapace in right view. Male. Borehole Vst-8: 140 m
Fig. 10. Carapace in right view. Female. Borehole Agt-2: 235 m

Figs 11—12. *Protocythere albae* DAMOTTE & GROSDIDIER, 1963
Fig. 11. Carapace in right view. Borehole Agt-2: 407 m
Fig. 12. Carapace in left view. Borehole Agt-2: 323 m
Fig. 13. *Protocythere galileensis* ROSENFELD & RAAB, 1984. Carapace in right view. Borehole Agt-2: 239 m

Plate 1

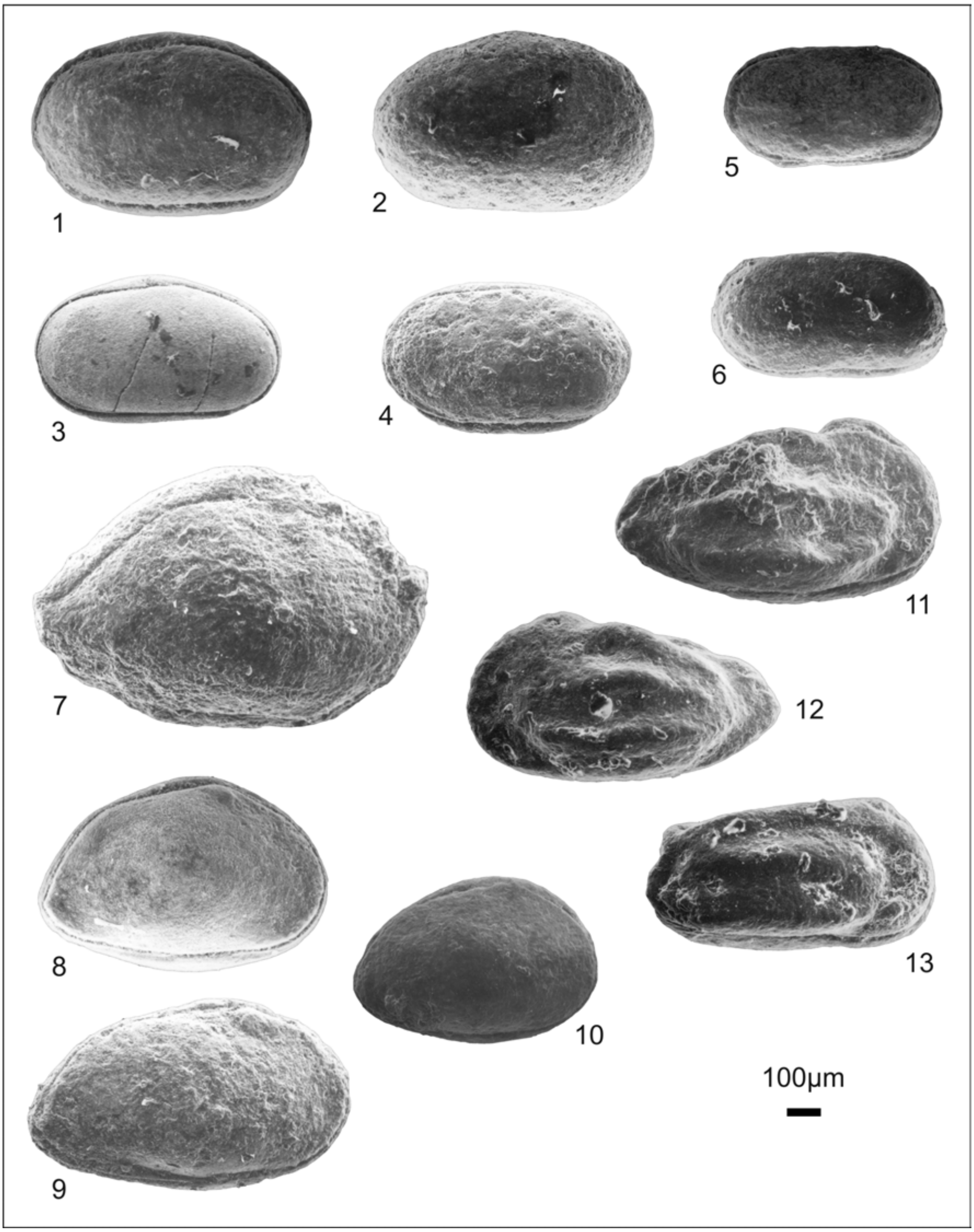

Plate 2

Figs 1—3. *Rehacythereis bartensteini* (OERTLI, 1958)
Fig. 1. Carapace in right view. Borehole Vst-8: 125 m
Fig. 2. Carapace in right view. Borehole Vst-8: 140 m
Fig. 3. Carapace in left view. Borehole Vst-8: 123 m

Figs 4—6. *Rehacythereis luermannae* (TRIEBEL, 1940)
Fig. 4. Carapace in left view. Borehole Agt-2: 311 m
Fig. 5. Carapace in right view. Borehole Agt-2: 291 m
Fig. 6. Carapace in left view. Borehole Agt-2: 339 m

Fig. 7. *Cythereis* ex gr. *fahrioni* (BISCHOFF, 1963). Carapace in right view. Borehole Vst-8 133 m

Fig. 8: *Pontocyprella harrisiana* (JONES, 1849). Carapace in right view. Borehole Agt-2: 319 m

Fig. 9. *Paracypris jonesi* BONNEMA, 1941. Carapace in right view. Borehole Vst-8: 110 m

Plate 2