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SHORT PALAEOECOLOGICAL NOTES ON THE MIDDLE SERRAVALLIAN-BASAL TORTONIAN OSTRACODS FROM THE TREMITI ISLANDS

BARBARA DALL'ANTONIA

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Riassunto. Viene discusso il significato paleoecologico dell'ostracofauna rinvenuta nell'intervallo Serravalliano medio-Tortoniano basale della successione delle Isole Tremiti. Questa è indicativa di un ambiente batiale per tutto l'intervallo investigato, ma modificazioni nella composizione delle associazioni suggeriscono che le condizioni al fondo subiscono alcuni cambiamenti. In particolare, nel Serravalliano medio gli ostracodi indicano l'esistenza di un ambiente a carattere termosferico profondo soggetto, probabilmente, a deboli influenze psicrosferiche. Nel Serravalliano terminale-Tortoniano basale registrano l'inizio di una graduale transizione verso condizioni tipiche della termosfera superiore.

La specie *Bradleya* (?) *saxolensis* Russo, 1966 viene discussa ed attribuita al genere *Agrenocythere* Benson, 1972.

Abstract. The palaecological significance of the ostracod faunas from the middle Serravallian-basal Tortonian of the Tremiti Islands is briefly discussed. The fauna is typical of the bathyal environment throughout the investigated interval. Compositional changes recorded in the assemblages, however, indicate that bottom-water conditions varied. Within the middle Serravallian, ostracods point to the existence of a lower thermospheric environment with possible feeble psychrospheric influences. In the latest Serravallian-basal Tortonian, the start of a gradual shift towards upper thermospheric conditions is recognizable.

The species *Bradleya* (?) *saxolensis* Russo, 1966 is herein redescribed and placed into the genus *Agrenocythere* Benson, 1972.

Introduction

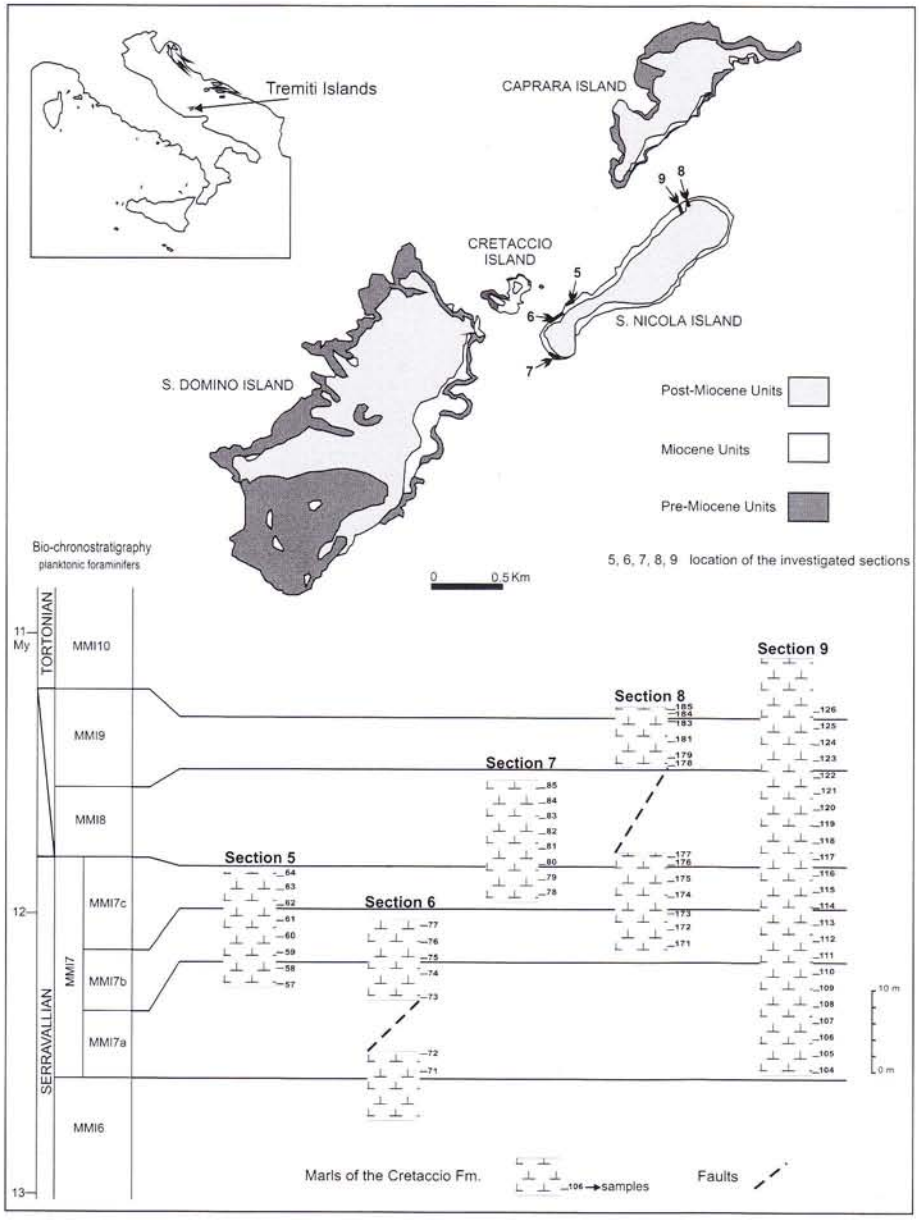
Deep-sea ostracods are a valuable tool for the diagnosis of the physical conditions of deep water-masses and have been often used to detect and investigate global and local palaeoceanographical changes (Benson & Sylvester-Bradley 1971; Benson 1973, 1975, 1976, 1978, 1990; Benson et al. 1984; Whatley & Coles 1991; Majoran & Dingle 2001). Some ostracod genera are particularly useful for recognizing past thermospheric and psychrospheric conditions. Among these is the genus *Agrenocythere* Benson, 1972, which is thought (Benson 1972, 1976) to be virtually restricted to the upper psychrosphere (oceanic waters beneath the permanent thermocline with temperature from 4°C to 8-10°C). *Oblitacythereis* Benson, 1977 is likewise regarded (Benson 1973, 1976, 1977) as typical of the lower thermosphere (waters with temperature from 10°C to 16-20°C overlying the psychrosphere in the open ocean or filling restricted basins).

The aim of the present note is to discuss briefly the palaecological significance of the ostracod fauna from the middle Serravallian-basal Tortonian of the Tremiti Islands. In addition, some few, essential information on the Langhian-early Serravallian assemblages from the Tremiti Islands succession, which have been recently studied by the present author (Dall'Antonia 2000, Ph.D. thesis 2001, in review), are incorporated. The sampling and bio-chronostratigraphical framework used for the ostracod study are essentially those of Iaccarino et al. (2001), although herein, the foraminiferal zonal scheme has been modified according to the new proposals of Sprovieri et al. (2002). This note supplements the more extensive palaeoecological analysis performed on the benthic foraminifera from a coeval composite section of the Tremiti Islands by Russo et al. (2002), notwithstanding that the sampling and temporal framework utilized are quite different.

Material and methods

The middle Serravallian-basal Tortonian [MMi 7 (*P. partimlabiata*) Zone-base of the MMi 10 (*G. obliquus obliquus*) Zone] succession of the Tremiti Islands consists of whitish indurated hemipelagic marls intercalated with grey or reddish marls belonging to the Cretaccio Formation. The succession is well exposed in the San Nicola Island and is documented entirely in Section 9 and partially in Sections 5, 6, 7 and 8 (Fig. 1) of Iaccarino et al. (2001). All together, 59 samples from the

Dipartimento di Scienze della Terra, Università di Pisa, Via S. Maria 53, 56126 Pisa, Italy, e-mail: barbarad@dst.unipi.it



◀Fig. 1 - Geological map of the Tremiti Islands with location, lithology and biostratigraphical correlation of the middle Serravallian-basal Tortonian sections used for the ostracod study (modified after Iaccarino et al. 2001).

▶Tab. 1 - Ostracod range charts for the middle Serravallian-basal Tortonian of the Tremiti Islands.

above-mentioned sections have been used for the ostracod study.

Systematic analysis revealed the presence of assemblages of deep-water character in all the examined samples. Only in a single sample (sample 172 of Section 8) a few juvenile specimens pertaining to the shallow-water genus *Aurila* Pokorny, 1955 have been recovered. These specimens have been regarded as allochthonous and have been consequently disregarded in the palaecological considerations. Collectively a total of 69 taxa were identified, of these 11 are yet undescribed. Synthetic range charts for ostracod species are reported in Tab. 1. Some species temporarily disappear from the record within the interval under discussion, but are already present below and/or reappear higher in the Miocene (Langhian-Messinian) succession of the Tremiti Islands. Local First Occurrence (FO) and Last Occurrence (LO) records are, therefore, indicated in Tab. 1.

Since biozonal resolution is inadequate to enable a detailed correlation between samples of the various sections to be made, no rigorous quantitative analysis has been carried out on the ostracod faunas and only long-term compositional changes have been investigated. Fig. 2 gives the relative abundance (percent value) of the most significant (major component or palaeoecologically noteworthy) taxa recorded in the studied interval.

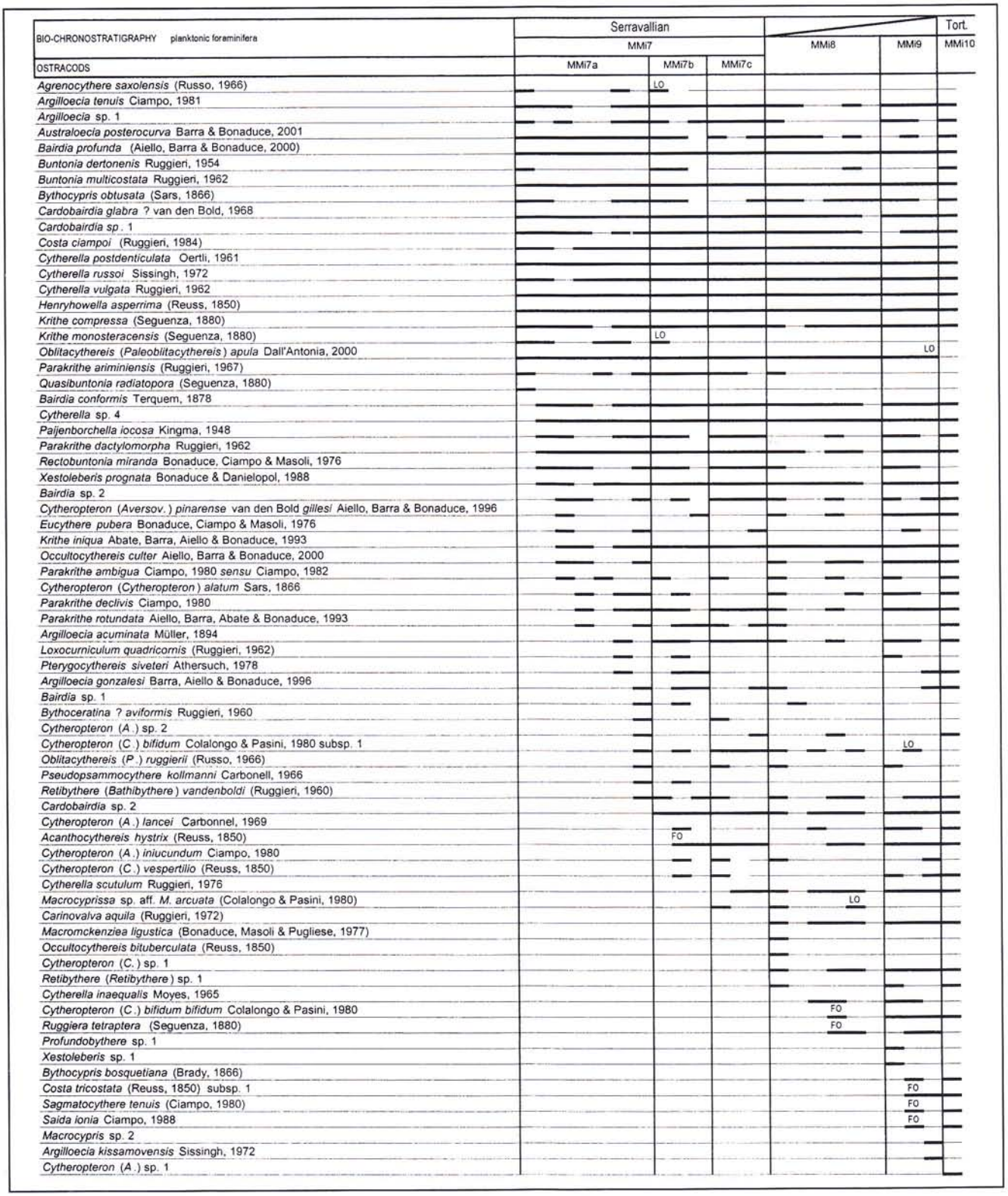
Palaeoecological significance of the ostracod fauna

The ostracod faunal composition is typical of bathyal environment throughout the investigated interval. Both qualitative and quantitative changes in the assemblages, however, indicate that bottom-water conditions altered during the middle Serravallian-basal Tortonian interval.

In the middle Serravallian [MMi 7a (*P. partimlabiata/G. drury*) Subzone-lower part of the MMi 7b (*P.*

mayeri) Subzone] the major components of the fauna (mean percent value > 2%) are, in order of relative abundance, *Henryhowella asperrima* Reuss, *Cytherella vulgata* Ruggieri, *Buntonia multicostata* Ruggieri, *Cytherella postdenticulata* Oertli, *Cardobairdia glabra*? van den Bold, *Bairdia profunda* (Aiello, Barra & Bonaduce), *Oblitacythereis* (*Paleoblitacythereis*) *apula* Dall'Antonia, *Krithe iniqua* Abate, Barra, Aiello & Bonaduce, *Cytherella* sp. 4, *Costa ciampoi* Ruggieri, *Australoecia posterocurva* Barra & Bonaduce, *Xestoleberis prognata* Bonaduce & Danielopol and *Cytherella russoi* Sissingh. The deep thermospheric genus *Oblitacythereis* is represented mostly (99%) by the above-mentioned *O.* (*P.*) *apula* and to a lesser extent by *O. ruggierii* (Russo).

Such a faunal composition characterized by the common occurrence of typical deep water taxa, i.e. *Australoecia, Cardobairdia, Cytherella* (smooth species), *Henryhowella, Krithe, Xestoleberis prognata* and notably



Oblitacythereis (for explicative remarks on the palaeoecology of these taxa see Dall'Antonia et al. 2001), suggests bottom water conditions characteristic of the lower thermosphere. The assemblage, however, includes rare psychrospheric forms. *Agrenocythere saxolensis* (Russo) is, in fact, randomly present with mostly juvenile specimens and very low values of relative abundance (1-2%). It is noteworthy that psychrospheric ostracods, comprising both *A. saxolensis* and *Agrenocythere hazelae* (van den Bold), are relatively common in the Langhian and in the earliest Serravallian [upper part of the MMi 5 (*O. suturalis-P. peripheroronda*) Zone] of the Tremiti Islands (Dall'Antonia Ph.D. thesis 2001, in review). Their occurrence documents that before the time interval investigated herein, deep oceanic water-masses characterized the circulation pattern of the area. Psychrospheric forms temporarily disappear from the record (Dall'Antonia Ph.D. thesis 2001, in review) during the early Serravallian [MMi 6 (*D. altispira altispira*) Zone] to re-appear sporadically (as previously discussed) in the middle Serravallian [MMi 7a (*P. partimlabiata/G. drury*) Subzone and lower part of the MMi 7b (*P. mayeri*) Subzone]. In the above outlined context, the occurrence of *A. saxolensis* within a typical deep thermospheric fauna seems to be suggestive of a late, very weak influx of psychrospheric water-masses in the area.

Within the late Serravallian [upper part of the MMi 7b (*P. mayeri*) Subzone-lower part of the MMi 8 (*N. atlantica praeatlantica*) Zone], major components of the assemblages do not show significant change and the fauna appears to be typical of the lower thermosphere as indicated by the common occurrence of *Oblitacythereis (P.) apula* and the absence of psychrospheric taxa.

The latest Serravallian-basal Tortonian interval [upper part of the MMi 8 (*N. atlantica praeatlantica*) Zone-base of the MMi10 (*Gd. obliquus obliquus*) Zone] is characterized by a gradual shift from deep thermospheric to higher temperature tolerating species. Such a compositional change includes:

- a decreasing incidence of the genus *Oblitacythereis* and notably the LO of *O. (P.) apula* at the top of the Serravallian [top of the MMi 9 (*P. siakensis*) Zone];
- a decrease in the relative abundance of *Australoecia posterocurva* and the genus *Cardobairdia*;
- an increase in the relative abundance of the genus *Costa* Neviani, 1928 represented by *Costa ciampoi* and *Costa tricostata* (Reuss) subsp. 1 [the genus *Costa* is mainly typical of the shelf (Ruggieri 1961; Benson 1973), but most tolerant species are able to live in deeper environments (Ruggieri 1992, p. 176-178), as are presumably those encountered in the present study];
- an increase in the relative abundance of *Acanthocythereis hystrix* (Reuss) [the optimum of this species lying between 100 and 200 meters in the modern Mediterranean (Bonaduce et al. 1976; Ruiz & Gonzalez-Regalado 1996)];
- the FO of *Sagmatocythere tenuis* (Ciampo) [recent congeneric species live most often in the inner-outer shelf (Bonaduce et al. 1976, 1988)].

Conclusions

Ostracods from the middle Serravallian-basal Tortonian of the Tremiti Islands are indicative of a bathyal environment. Within the middle Serravallian bottom water conditions are essentially those of the lower thermosphere, but the scattered occurrence of *Agrenocythere saxolensis* (mostly as juveniles specimens) seems to be suggestive of the presence of feeble deep oceanic influences. From this time onward, in contrast to indications from the benthonic foraminifera (Russo et al. 2002), ostracods are unable to provide evidence of further psychrospheric influences in the area and the faunas of the late Serravallian appear to be typical of a deep thermospheric environment. In addition, in the latest Serravallian-basal Tortonian the decreasing frequency of the genera *Oblitacythereis, Australoecia* and *Cardobairdia* and the increasing incidence of taxa mainly related to shelf environments indicate the start of a transition from lower thermospheric to upper thermospheric bottom water conditions.

Appendix - Taxonomic note on *Agrenocythere saxolensis* (Russo, 1966)

The examination of the type material of *Bradleya* (?) *saxolensis* Russo, 1966 and further specimens from the Miocene succession of the Tremiti Islands indicates that this species should be assigned to the genus *Agrenocythere* Benson and that its original description requires amendment. The terminology of the external carapace features employed herein is that proposed by Benson (1972). The figured specimens are housed in the Ostracoda Collection of Prof. A. Bossio (C.O.B. 165-166), Dipartimento di Scienze della Terra, Università di Pisa, Italy.

Class Ostracoda Latreille, 1806

Order Podocopida Müller, 1894

Suborder Podocopa Sars, 1866

Superfamily Cytheracea Baird, 1850

Family Trachyleberididae Sylvester-Bradley, 1948

Subfamily Trachyleberidinae Sylvester-Bradley, 1948

Genus *Agrenocythere* Benson, 1972

Type Species *Agrenocythere spinosa* Benson, 1972

Agrenocythere saxolensis (Russo, 1966)

(Fig. 3a-d)

1966 *Bradleya* (?) *saxolensis* Russo, p. 241, text-fig. 3, pl. 44, fig. 3a-d.
? 1979 *Agrenocythere* sp. 1 - Ducasse & Peypouquet, pl. 2, fig. 7.

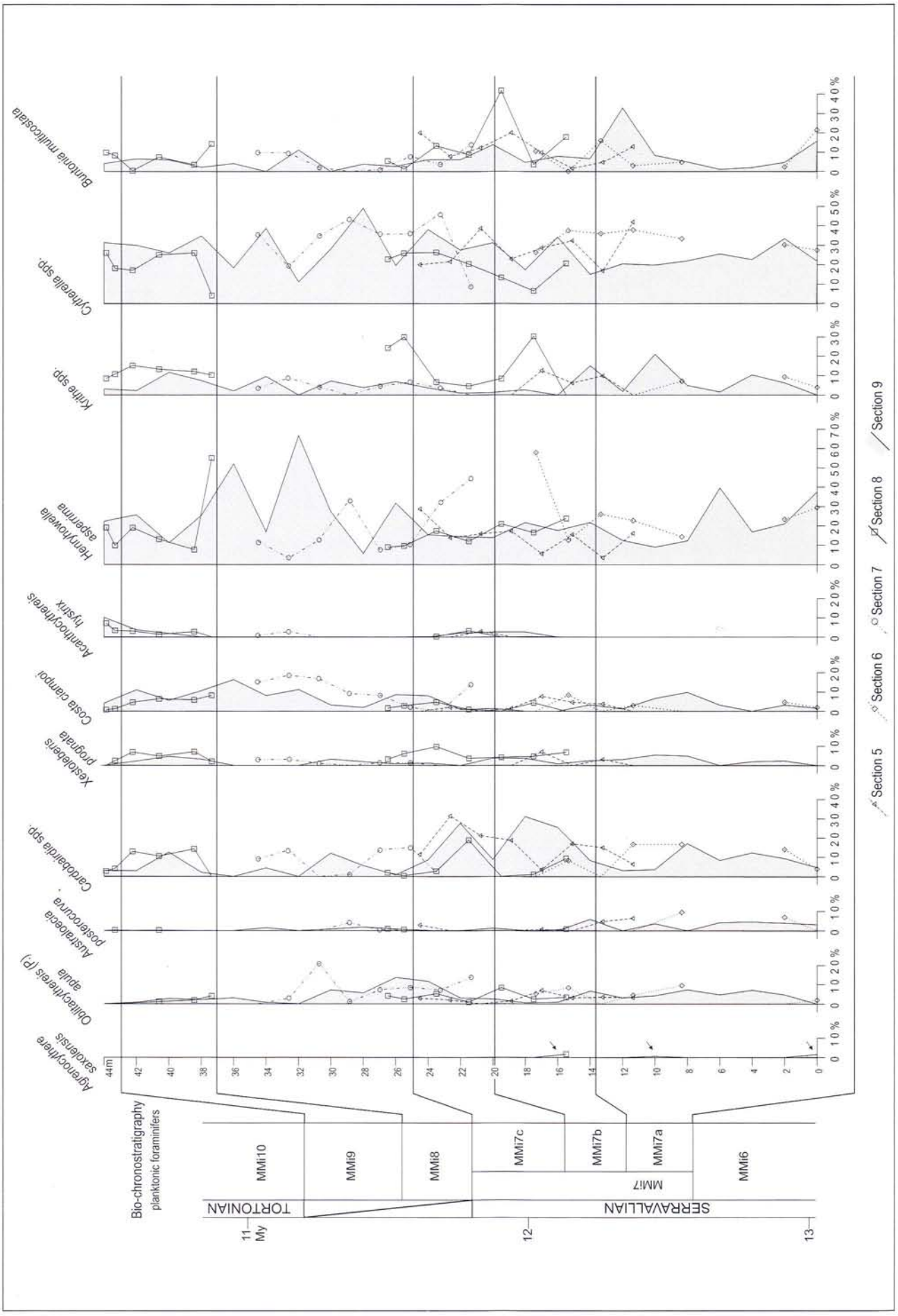


Fig. 2 - Relative abundance (percent value) of the most significant ostracod taxa through the middle Serravallian-basal Tortonian interval.

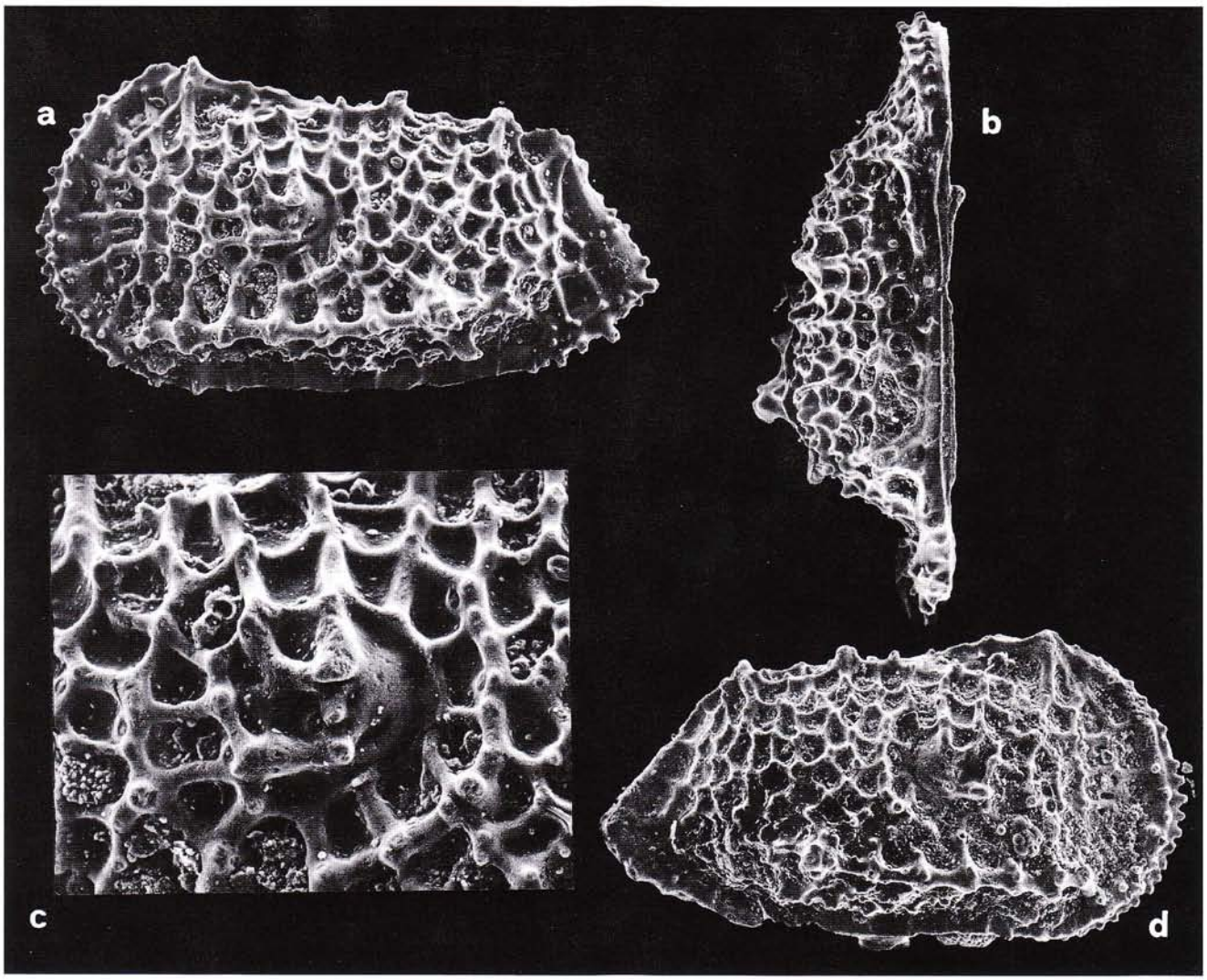


Fig. 3a-d - SEM microphotographs of *Agrenocythere saxolensis* (Russo, 1966). (x 80 unless otherwise stated). a, b, c) LV, C.O.B 165, Section 3III of Iaccarino et al. (2001) sample 37, early Langhian: a, external view; b, dorsal view; c, detail of *castrum*, x 180; d) RV external view, C.O.B 166, Section 3III of Iaccarino et al. (2001) sample 37, early Langhian.

? 1993 *Agrenocythere* sp. - Riha, pl. 1, fig. 1-6.

Material. 22 valves of which many are juveniles.

Emended diagnosis. A species of *Agrenocythere* characterized by a thin, regular reticulate ornament with quadrangular meshes; *castrum* distinctive and moderately prominent; *bullar series* reduced to blunt spines. Posterior end markedly acuminate.

Emended description. Left valve subtrapezoidal, elongate in lateral view. Anterior margin broadly rounded with tuberculate perimarginal rib; posterior margin triangular with apex below mid height. Both extremities are furnished with short marginal spines. Dorsal margin straight, sloping downwards to posterior; ventral margin rectilinear to slightly convex. Reticular pattern quite regular, with quadrangular fossae and short, obtuse conjunctive spines. In the posterior area the fossae are rhomboidal and the muri are aligned into opposed crossed system. *Castrum* moderately prominent and characterized by a regular *ballium; parapectus* confined to the three through six *ballial fossae*. The *arx* consists of a U-shaped upper portion (bearing a prominent *specula*), which surrounds the *pervial fossa* and of a L-shaped lower part, which delimits the *fossa arcis*. The *forum* is wide and depressed. The *dorsal bullae* are reduced to more or less prominent spines. Eye-tubercle absent. Ventro-lateral rib well developed and ponticulate. In dorsal view carapace swollen medianly; both extremities laterally compressed. Internal features typical of the genus.

Size (mm).

LV (C.O.B. 165) L = 1.25, H = 0.68, h = 0.36

RV (C.O.B. 166) L = 1.04, H = 0.55, h = 0.30

Remarks. *A. saxolensis* strongly differs from *A. hazelae* (*Cythereis hazeli* van den Bold, 1946, p. 92, pl. 10, fig. 4a-c) in the less massive and more regular reticular pattern and the structure of the castrum. These features make *A. saxolensis* quite similar to *Agrenocythere radula* (*Cythere radula* Brady, 1880, p. 102, pl. 19, fig. 4a-b). The two species, however, differ in the lateral outline (*A. saxolensis* having a more acuminate posterior end and a

less convex ventral margin), development and nature of the ventro-lateral rib (*A. saxolensis* having a clearly ponticulate and more prominent ventro-lateral rib) and, finally, the structure of the *castrum*. *Agrenocythere* sp. 1 in Ducasse & Peypouquet (1979) and *Agrenocythere* sp. in Riha (1993) strongly resemble the present species in the ordinate and regular reticulate ornament, but quality of the illustrations and lack of description prevent their positive assignment to Russo's species.

Previous records.

? Late Palaeocene-Early Pliocene of the North Atlantic (Ducasse & Peypouquet 1979) - Reported from Leg 48 Site 400A, Site 401 (Northern Continental Margin of the Bay of Biscay) and Site 403 (Rockall Area). In Site 403 *Agrenocythere* sp. 1 Ducasse & Peypouquet was found in association with *Bradleya, Poseidonamicus* and *Echinocythereis*. According to Ducasse & Peypouquet (1979, p. 346) this association is indicative of a depth close to that of the site today (about 2700 m).

? Early Badenian of Moravia (Riha 1993) - Reported in a mixed association of shallow-water and deep-water ostracods, which is not characteristic of typical psychrospheric conditions (Riha 1993, p. 158). The estimated depth of this association is of 700-1000 m (Riha 1989, 1993).

Langhian of Pescale, Northern Apennines (Russo 1966) - Reported associated with *Macrocypris, Argilloecia, Krithe, Bythocypris, Buntonia radiatopora radiatopora* (Seguenza), *Bairdia* and *Cytherella* (Russo 1966, p. 230-231).

Occurrence in the Tremiti Islands succession.

Early Langhian [upper part of the MMi 4a (*P. glomerosa sicana*) Subzone] and mid Serravallian [MMi 7a (*P. partimlabiata/G. drury*) Subzone-lower part of the MMi 7b (*P. mayeri*) Subzone].

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