

Evidence of brackish lagoons in the Pliocene of Irpinia (Southern Italy)

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KEY WORDS – *Ostracods, Palaeoecology, Systematics, Lagoonal deposits, Pliocene, Southern Apennines.*

SUMMARY – *The sedimentary section outcropping in the locality S. Andrea near Montecalvo Irpino has indicated the presence of paleo-environmental characters which are referred to as a marine basin margin evolving to the regressional phase. This succession is constituted by coastal sandy sediments which end at the top with silty-clays lagoonal sediments.*

The analysis of the sedimentary facies and the studied ostracod fauna allowed the definition of 4 facies assemblages (A1-A4) each of which is characteristic of different environmental conditions: upper shoreface - foreshore, coastal eolic dunes, washover fan and brackish lagoon.

As far as the ostracodes are concerned, two new species are established and illustrated, Euxinocythere (Maeotocythere) nasseri n. sp. and Leptocythere lagunaris n. sp. from brackish environments.

RIASSUNTO – [Evidenza di lagune salmastre nel Pliocene dell'Irpinia (Italia meridionale)] – *La successione sedimentaria esposta in località S. Andrea presso Montecalvo Irpino ha evidenziato la presenza di caratteri paleoambientali riferibili al margine di un bacino marino in evoluzione regressiva. Tale successione è costituita da depositi sabbioso-costieri e termina in alto con sedimenti argilloso-siltosi di ambiente lagunare.*

L'analisi delle facies sedimentarie e l'esame delle ostracofaune hanno consentito di differenziare quattro associazioni di facies (A1-A4) caratteristiche di altrettante condizioni ambientali: marino di bassa profondità, eolico di duna costiera, ventaglio di washover e lagunare.

Per quanto riguarda le ostracofaune, 2 nuove specie sono state descritte ed illustrate da sedimenti di ambiente lagunare: Euxinocythere (Maeotocythere) nasseri n. sp. e Leptocythere lagunaris n. sp.

INTRODUCTION

A short sedimentary succession of Pliocene age, located NW of Ariano Irpino (Southern Apennines) has been studied from the sedimentological and palaeoecological point of view. The section examined and the samples studied indicate the presence of shallow marine sedimentation evolving from the upper shoreface to a brackish lagoon, with a continuous regressive trend.

The sediments outcropping in the area have been attributed to the Early - Middle Pliocene by Dessau (1953) and subsequently by D'Argenio *et al.* (1973) consequent to the presence of an infraPliocene sedimentary cycle (Unità di Ariano). Previously, the surveyors of the Sheet 174 "Ariano Irpino" (Italian Geological Survey, 1963) first attributed these sediments to the Pliocene, and later doubtfully to the Middle - Late Pliocene (Iacobacci & Martelli, 1967).

Recently, Chiocchini *et al.* (1992) dated to the Early - Middle Pliocene (*G. punctulata* and *G. aemiliana* Zones) the sediments of the Ariano Irpino Basin between the Ufita and Miscano rivers, in agreement with Cantalamessa *et al.* (1988) who had accomplished a preliminary study of the sandy sediments occurring between Ariano Irpino and Montecalvo Irpino.

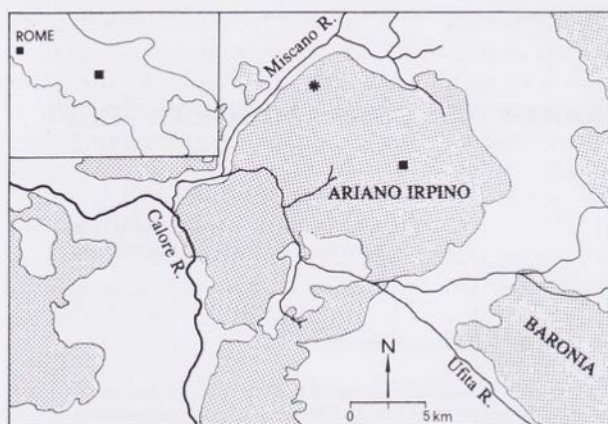
Ciarcia & Torre (1996) observed that the gradual

evolution from sands to the top conglomerates in the Unità di Ariano in the Ariano area and in Baronis is locally marked by thin clayey layers rich in an oligotypic microfauna indicative of a hypohaline lagoonal environment and by thin ash layers. Volcanoclastic layers in the same sedimentary cycle were found in the Paternopoli conglomerates (Chiocchini, 1969), in the conglomerates of the middle River Ufita Valley (Chiocchini *et al.*, 1971) and in the sands of Anzano di Puglia (Guerrera & Veneri, 1989).

Finally, Amore *et al.* (1997) split into two distinct sedimentary cycles the Pliocene sediments outcropping in Eastern Irpinia; taking into consideration the lateral continuity of lower cycle layers with the present section, it is possible to attribute them to the top part of the Early Pliocene (Biozone M Pl 4a).

SEDIMENTARY FACIES ANALYSIS

The sediments examined belong to a short sequence (about 9 m thick) outcropping in a quarry along the left slope of the River Miscano, S. Andrea locality, near Montecalvo Irpino (Text-fig. 1). The lithology consists mainly of sands and subordinately of pelites with some pebbles. The stratification dips about 20°W. Four sedimentary facies associations have been recognized, whose description and interpretation are schematically reported below (Text-fig. 2).



Text-fig. 1 - Sketch-map showing the areal distribution of the Lower to Middle Pliocene sediments of the Unità di Ariano (pattern) and location of the studied section (asterisk) (modified from S.G.I., F°174, Ariano Irpino, 1:100 000).

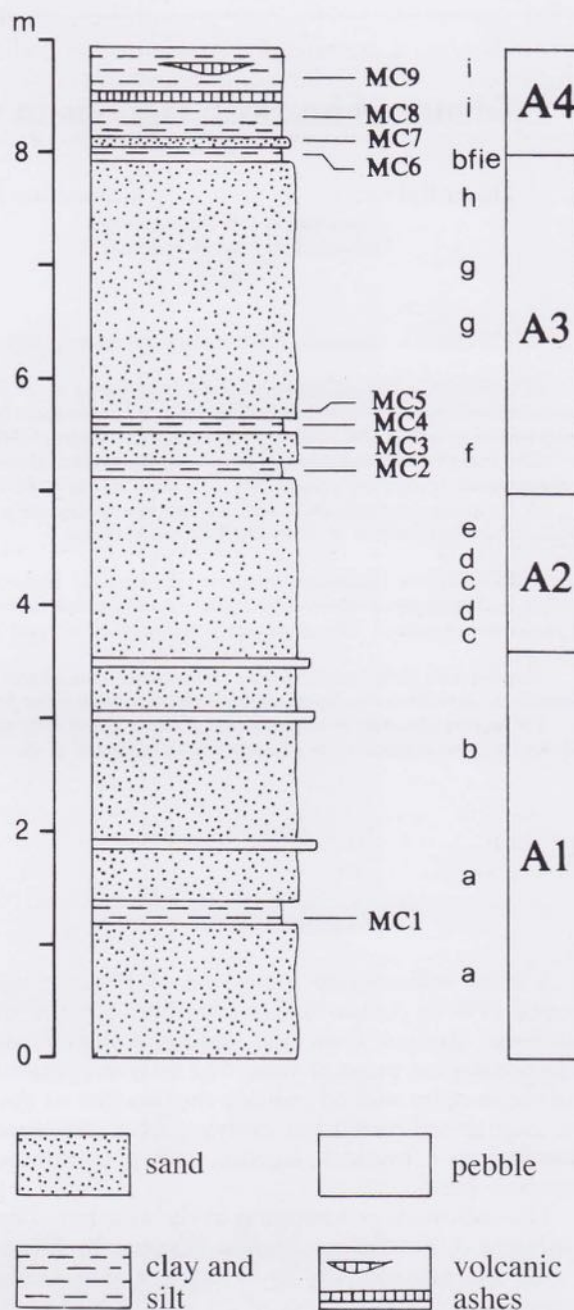
A1 - Upper shoreface - foreshore deposits

The basal part of the section is constituted by about 3.5 m of yellowish, poorly cemented, quartz-lithic sands with medium to thin well-classed grain-size. The boundaries of the different sedimentary bodies are rarely evident; the parallel laminations are not always visible, while the wedge-shaped one with megaripple foreset, sometimes with opposite dipping, is noted. The foreset packages are truncated and sometimes separated from the following event by shell debris and small pebbles. The symmetrical ripples are rather rare.

A gray clay layer, slightly silty and about 15 cm thick, occurs in the lower part of this interval and shows a lateral continuity. The boundaries with the underlying and overlying sands are abrupt. Sedimentary structures and shell remains are absent, while a microfaunal assemblage is present. Upward, frequent decimetric layers with aligned pebbles, shell detritus and mud clasts occur. The pebbles, of maximum diameter of 10 cm, are of sedimentary origin, polygenic, and rounded to discoidal in shape.

Few thin and silty clay lenses of limited extension (1-2 m), gray-brown in colour, are also present. They contain abundant vegetal remains of subaerial origin with some well-preserved leaves of arboreal plants.

The features reported above allows for their attribution to a marine sedimentation influenced by waves from upper shoreface to foreshore. The opposite foreset lamination of the megaripples (similar to the herringbone cross-bedding structures) can be explained with a littoral migration due to variations in the energy conditions, and to the subsequent truncation by erosion during storms, in a zone at the boundary between the foreshore and the shoreface (Clifton *et al.*, 1971) or to the interaction between



Text-fig. 2 - Stratigraphic column of the studied succession with the position of the samples examined for the ostracod fauna and the identified sedimentary facies (a = ripples, b = leaves, c = rhizolithes, d = cross concave lamination, e = pulmonate gastropods, f = gypsum crystals, g = cross lamination, h = burrows, i = bivalves).

longshore currents and the effect of waves in the surf zone (McCubbin, 1982). The symmetry of the ripples' shape is a clear indication of an energy regime dominated by wave action (Komar, 1974).

The aligned pebbles have probably been accumulated in peaks of littoral drift during short intervals of

higher energy; the strongly elaborated clasts should be correlated to more extended conglomeratic bodies which were accumulated in a contiguous coastal braid plain (Ciarcia & Torre, 1996). The accumulation of vegetal remains of subaerial origin occurred sporadically in local conditions of low energy indicating a close continental area. The prevailing deepening of the foreset packages suggests (Clifton *et al.*, 1971) the westward position of the land.

A2 - Coastal eolian dunes

Light coloured sand, fine grain-sized, well-sorted, of lithic composition, generally poorly cemented, sometimes with arenaceous layers. The trough-cross bedding at medium-large scale (lengths over 10 m) occurs with foresets deepening around NE - SW in some cases more than 30°. The sands are barren, and there is the sporadic occurrence of rhizcretions and scattered shells of gastropods.

These sedimentary bodies in the area show a thickness at times greater than 10 m and the lateral and vertical relation to the other facies are not exposed. This facies is interpreted as an eolic deposit in a subaerial coastal environment. The morphotypes are dune-shaped and, according to the distribution of the other facies, accumulated near the shoreline. This interpretation agrees with the well-developed clinostratifications, the clear sorting and presence of rhizolithes, and the paucity of terrestrial gastropods. The strong inclinations of the foreset laminae, S and W dipping, suggest a dominant wind action toward the western and southern quadrants.

A3 - Washover fan

Yellowish, medium-grained sands with massive appearance but, occasionally, with "ghosts" of tabular cross-lamination in some packages of foreset. In the lower part, in an interval some decimeters thick, the sand alternating with silty clay and grey-brown clay is arranged in thin and badly defined horizontal layers. Each sedimentary episode, varying within a decimeter, evolves from the lower part, more or less evident fining up, from medium sand with abundant debris of mollusks to dark clay with oligotypic fauna (mainly turricolate mollusks with maximum size of 3 - 4 cm) and vegetal debris. Centimetric crusts and gypsum crystals of 3 - 4 cm maximum size occur in the clay. The relationships with the foreshore sands and the eolian underlying sediments are not visible; toward the top, where burrow casts have been observed, these sediments pass to the pelitic facies above an erosional surface.

The characters of these sediments suggest that their accumulation corresponds to a zone included landward by the limit of coastal dunes to pond environments, described in the washover fan sands by Schwartz (1982). They are relatively widespread and

are transitional to a proper lagoon. The generally massive appearance of the sandy sediments is possibly indicative of flow conditions analogue to the grain flow noted in the beach backwash by Clifton (1969). The occasionally found, poorly defined clinostratifications of the foresets could be referred to a microdelta (Schwartz, 1982).

The clay layers point out to low energy phases alternating with storm activity. The water salinity was undergoing strong variations up to saturation conditions and salt precipitation, as testified by the saline crusts and gypsum crystals.

A4 - Lagoonal deposits

Clay and marly clay, silty clay, dark in color, yellowish by weathering, without sedimentary structures, with badly defined thin stratifications. These clays correspond to the top of the sequence having a thickness of about 1 m.

The lagoonal pelites are separated from the underlying washover sands by an erosional surface on which small canals occur, scarcely incised and up to a dm wide; directly in contact with this surface, a transitional surface, some cm thick, is constituted by sand clasts reworked from the underlying deposits, mud clasts and by vegetal remains. At the base of the clay, a layer of small gypsum crystals has been observed. In the clay, centimetric horizons of volcanic ashes, pink in colour, have been noted. The lowermost volcanoclastic layer appears laterally continuous. Above it, it has been noted that the clay layers are notably lighter in colour and the mollusk valves (thin shelled bivalves) found in them are larger than those occurring in the underlying layers.

In general, the sedimentary characters are consistent with a lagoonal environment, with pelitic sedimentation under a low energy regime. The presence of cineritic horizons also indicates deposition in a prevailing calm environment. The basal sediments are relics of a transitional environment which occurred before the formation of the lagoon.

THE OSTRACOD FAUNA

MATERIAL AND METHODS

The material examined consists of 9 samples collected along the section. The position of the samples examined is indicated in the column (Text-fig. 2). Each sample (200 gr each) has been washed with a 150 mesh screen and semiquantitatively analyzed. The picking allowed the definition of the ostracode abundance of each sample and its diversity.

Eleven species have been identified, 3 of which are left in open nomenclature because they are represented only by instars, and 2 are proposed as new. The classification followed is that of Hartmann & Puri (1974).

The specimens illustrated are housed in the Bonaduce Ostracode Collection (B.O.C.), Paleontological Department of the University "Federico II" of Naples.

DESCRIPTION OF THE ASSEMBLAGES

Among the 9 samples examined, one was barren of microfauna while the other 8 resulted in the following assemblages:

MC1 - Very poor ostracod fauna both in species and number of specimens with rare *Leptocythere multipunctata* (Seguenza, 1884), *Xestoleberis* gr. *X. communis* G.W. Müller, 1894 and only juveniles of *Procytherideis retifera* Ruggieri, 1978, *Loxoconcha* sp., *Sagmatocythere* sp., *Urocythereis* sp. and *Cytheretta adriatica* Ruggieri, 1952, which, even if represented exclusively by instars, show a relatively high frequency.

MC2 - Barren.

MC3 - Rare specimens of *Cyprideis* gr. *C. torosa* (Jones, 1850).

MC4 - Great abundance of *C. gr. C. torosa* associated with frequent *Loxoconcha? krajinae* Krstic, 1992, and rare *Euxinocythere (Maeotocythere) nasseri* n. sp.

MC5 - Abundant *C. gr. C. torosa* associated with rare *L.? krajinae*.

MC6, MC7, MC8 - Assemblages monospecific constituted by *C. gr. C. torosa* which is rare in MC6, very abundant in MC7 and frequent in MC8.

MC9 - Abundant *C. gr. C. torosa* and rare *Leptocythere lagunaris* n. sp.

PALEOECOLOGY OF THE SECTION

The species and/or genera found along the section can be subdivided into the following ecological groups:

Typically marine: *Cytheretta adriatica*, *Leptocythere multipunctata*, *Procytherideis retifera*, *Sagmatocythere*, *Urocythereis*, *Xestoleberis* gr. *X. communis*.

Brackish (hypohaline): *Euxinocythere (Maeotocythere)*, *Loxoconcha? krajinae*.

Brackish (from hypohaline to hyperhaline): *Cyprideis*.

According to the environmental habitats of the genera and species we are concerned with (well defined by the previous literature, e.g. Van Morkhoven, 1963; Puri et al., 1964; Stancheva, 1964; 1968; Uffenorde, 1972; Bonaduce et al., 1976; Krstic & Bossio, 1992; van Harten, 1996), it has been possible to reconstruct the environmental evolution of the sequence through time.

The base of the section yields an assemblage corresponding to a clear, very shallow marine environment (sample MC1) that evolved in sample MC3 to an undefined brackish environment as supported by the presence of very few *Cyprideis* gr. *C. torosa*. MC4 fauna represents an hypohaline environment demonstrated by the occurrence of *L.? krajinae* and *Euxinocythere (M.) nasseri* n. sp. together with abundant *C. gr. C. torosa*. The same interpretation is given for sample MC5.

The monospecific and abundant ostracod fauna of samples MC6, MC7 and MC8, in the absence of hypohaline species, seems to indicate an hyperhaline environment.

In MC9 corresponding to the top of the section, a re-occurring hypohaline environment is hypothesized as demonstrated by the occurrence of a species of *Leptocythere*, a genus typical of marine and meso-polyhaline environments.

CONCLUSIONS

The analysis of the lithological facies and the ostracod microfaunal assemblages of the clastic sediments outcropping in S. Andrea locality indicate the presence of a sedimentary paleoenvironment corresponding to a marine basin margin.

At the base of the sequence, the sand shows characters of shallow marine environments which represent the upper shoreface - foreshore sedimentation. Ripple marks are preserved and, in various parts of the section, the layers of aligned pebbles are interpreted to be produced by short storm events. Intervals of reduced energy allowed for the sedimentation of few pelitic layers with rare clearly marine microfauna (sample MC1). The presence of a close

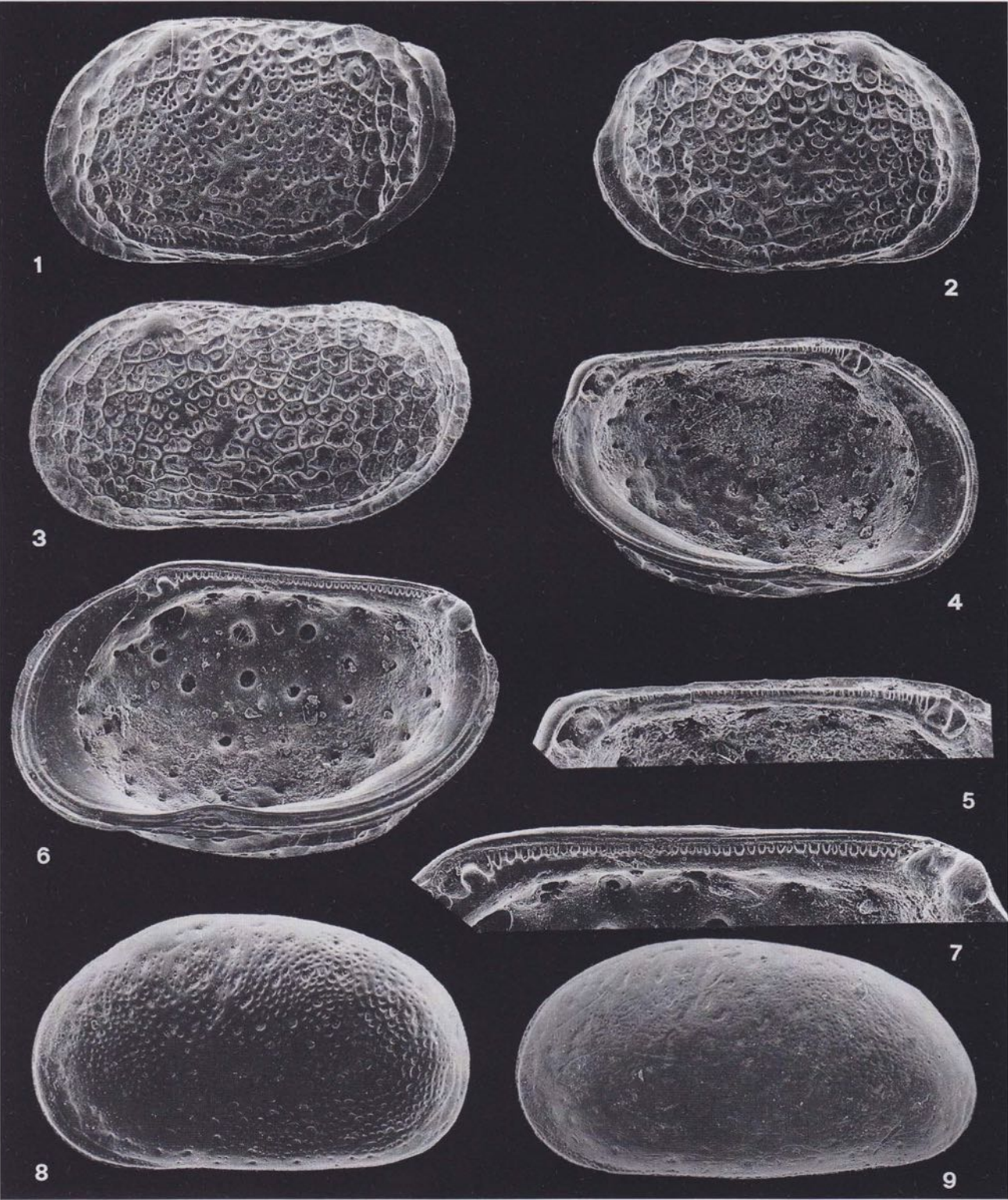
EXPLANATION OF PLATE 1

Figs. 1-7 - *Loxoconcha? krajinae* Krstic, 1992. Monte Calvo (Ariano Irpino), Stn. MC4.

- 1) LV female, B.O.C. 2338, (x 113);
- 2) RV female, B.O.C. 2339, (x 113);
- 3) LV male, B.O.C. 2340, (x 120);
- 4) LV female from inside, B.O.C. 2341, (x 127);
- 5) Hinge of the same specimen of fig. 4, (x 187);
- 6) RV female from inside, B.O.C. 2342, (x 140);
- 7) Hinge of the same specimen of fig. 6, (x 240).

Figs. 8-9 - *Cyprideis* gr. *C. torosa* (Jones, 1850). Monte Calvo (Ariano Irpino), Stn. MC4.

- 8) LV female, B.O.C. 2343, (x 77);
- 9) LV male, B.O.C. 2344, (x 78).



shore-line is also documented by the thin layers of vegetal debris and by the remains of broad plant leaves occurring in the upper part of the sand. Above the marine sands subaerial sediments occur, composed by fine well sorted sands with rare rhizocretions and occasional small pulmonate gastropods. The sedimentary structures allow for the recognition of aeolian action forming coastal dunes which acted as a barrier between the sea and the adjacent lagoon. During storms, the strongest waves spilled marine waters and sand beyond the backshore, sedimenting washover sandy bodies. Clays and silty clays occur within the wash-over sediments and include thin salt crusts and aggregates of gypsum crystals. The salinity in this interval underwent strong changes from hypo-haline (as indicated by the ostracods of samples MC4 and MC5) to saturation conditions with salt precipitation. On the whole, they represent pond deposits and testify the short termed alternating periods of flooding (marine or continental in origin) and of severe evaporation.

After a subaerial event during which the top of the sandy body became red by alteration, the lagoon became stabilized in term of sedimentation at the top of the section. Such a low energy conditions favoured the sedimentation and preservation with the lagoonal mud even of fine volcanoclastic deposits, caused by a contemporaneous explosive activity.

As a whole, the section represents the evolution from a very near shore marine environment to a lagoon subject to salinity fluctuations, with an hyperhaline interval indicated by the fossil contents of samples MC6, MC7 and MC8 and the return to an hypo-haline environment at the top of the section (MC9).

Pelitic lagoonal sediments, very similar to those described here, are also found in other localities of Irpinia (Baronia) and Daunia Apennines (Prof. M. Torre, pers. comm.). They testify the regional diffusion of the lagoonal environment transitional between the shallow marine sands and the conglomerates of braid-plain (Ciarcià & Torre, 1996), corresponding in these areas to the end of the cycle of Early to Middle Pliocene age.

SYSTEMATICS

Order PODOCOPIDA G.W. Müller, 1894
Suborder PODOCOPINA Sars, 1866
Superfamily CYTHERACEA Baird, 1850

Family CYTHERIDEIDAE Sars, 1925
Subfamily CYTHERIDEINAE Sars, 1925

Genus CYPRIDEIS (Jones, 1850)
CYPRIDEIS gr. *C. TOROSA* (Jones, 1850)
Pl. 1, figs. 8-9

Due to the complexity of the systematics of the genus *Cyprideis* we attributed the illustrated specimens to *C. gr. C. torosa*. Two "forms" have been identified, one (male) almost smooth (Pl. 1, fig. 9) and a second one (female) regularly and deeply pitted (Pl. 1, fig. 8), as generally occurs in males and females.

Family LEPTOCYTHERIDAE Hanai, 1957

Genus EUXINOCYTHERE Stancheva, 1968
Subgenus EUXINOCYTHERE (MAEOTOCYTHERE)
Stancheva, 1968
EUXINOCYTHERE (MAEOTOCYTHERE) NASSERI Barra
& Bonaduce n. sp.
Pl. 2, figs. 1-6; text-fig. 3A

Etymology – In honour of Dr. Nasser Mostafawi (Universität Kiel) for his contribution to the knowledge of the ostracods of the Neogene Hellenic Arc.

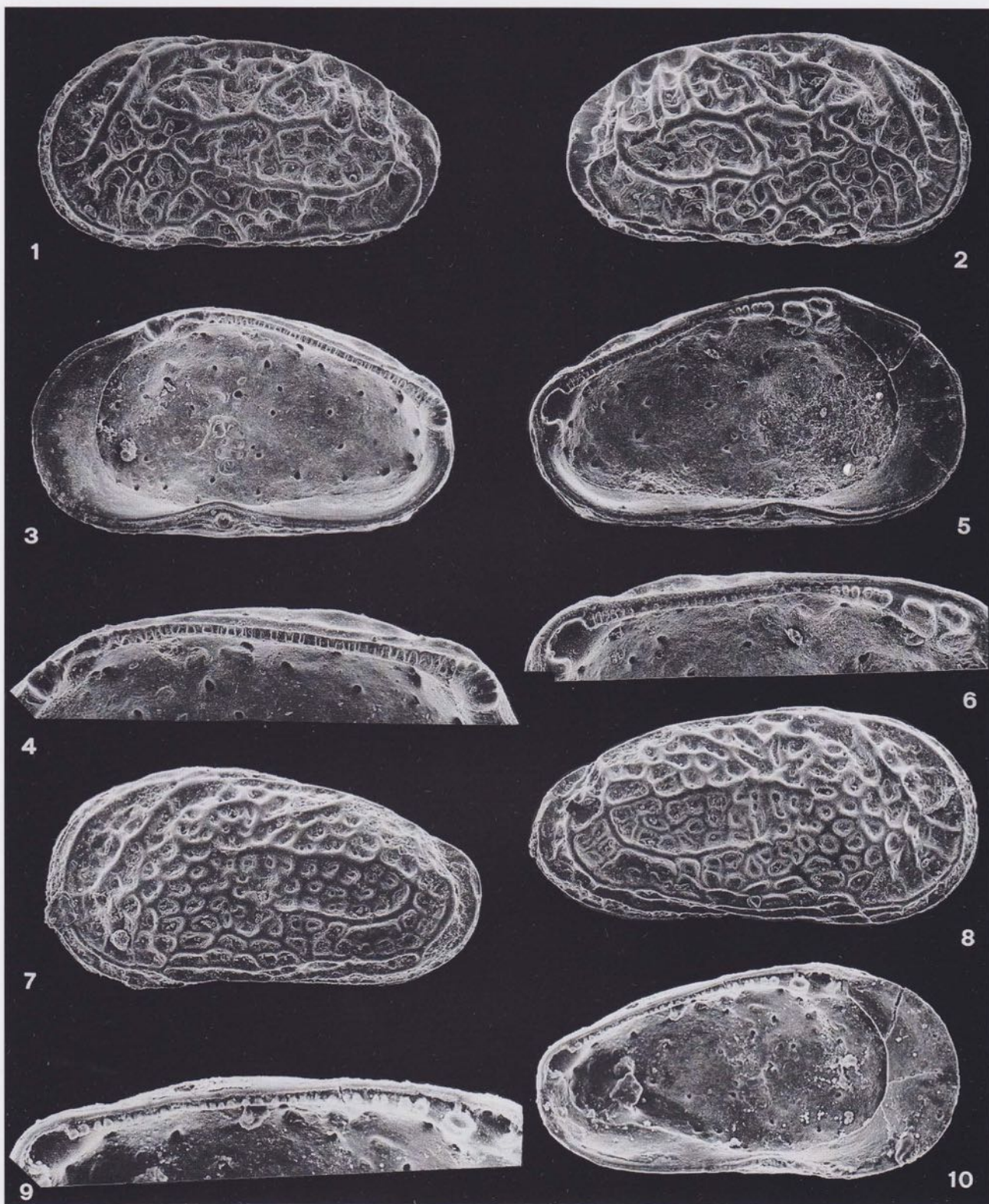
Holotype – LV (Pl. 2, fig. 1), Stn. MC4, B.O.C. 2345.

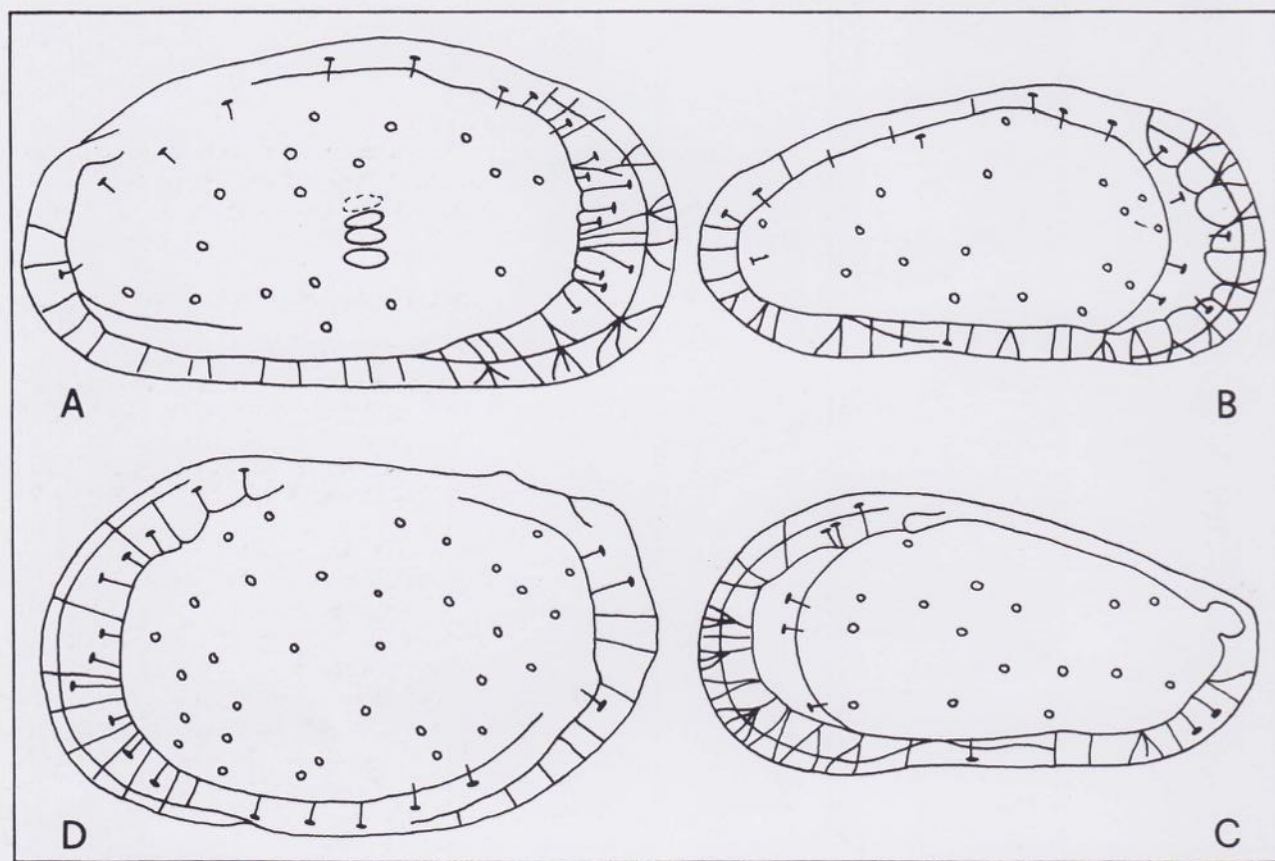
Paratypes – 1RV (Pl. 2, fig. 2, B.O.C. 2346), 1RV (Pl. 2, figs. 3,4; text-fig. 3A, B.O.C. 2347) and 1LV (Pl. 2, figs. 5,6, B.O.C. 2348).

Type locality – Monte Calvo (Ariano Irpino, Southern Apennines).

EXPLANATION OF PLATE 2

- Figs. 1-6 - *Euxinocythere (Maeotocythere) nasseri* Barra & Bonaduce, n. sp., Monte Calvo (Ariano Irpino), Stn. MC4.
1) Holotype, LV, B.O.C. 2345, (x 173);
2) Paratype, RV, B.O.C. 2346, (x 173);
3) Paratype, RV from inside, B.O.C. 2347, (x 180);
4) Hinge of the same specimen of fig. 3, (x 273);
5) Paratype, LV from inside, B.O.C. 2348, (x 187);
6) Hinge of the same specimen of fig. 5, (x 267).
Figs. 7-10 - *Leptocythere lagunaris* Barra & Bonaduce, n. sp., Monte Calvo (Ariano Irpino), Stn. MC9.
7) Holotype, LV, B.O.C. 2349, (x 227);
8) Paratype, RV, B.O.C. 2350, (x 227);
9) Hinge of the same specimen of fig. 8, (x 316);
10) Internal view of the same specimen of fig. 8, (x 213).





Text-fig. 3 - A) *Euxinocythere* (*Maetocythere*) *nasseri* Barra & Bonaduce, n. sp., Paratype, RV, same specimen of Pl. 2, fig. 3, B.O.C. 2347, (x 201); B) *Leptocythere lagunaris* Barra & Bonaduce, n. sp., Paratype, RV, same specimen of Pl. 2, fig. 8, B.O.C. 2350, (x 201); C) *Leptocythere lagunaris* Barra & Bonaduce, n. sp., Holotype, LV, same specimen of Pl. 2, fig. 7, B.O.C. 2349, (x 201); D) *Loxoconcha*? *krajinae* Krstic, 1992, LV female, Monte Calvo, Stn. MC4, B.O.C. 2351, (x 139).

Diagnosis – A *Leptocytherid* species of the subgenus *Maetocythere* characterized by the strong ornamentation constituted of numerous cordiform ridges, two of which, one above and the second below, at mid-height, subhorizontally disposed and fused together toward the anterior and posterior, defining an area approximately subelliptical (Pl. 2, figs. 1, 2).

Description – Valves in lateral view *Callistocythere*-shaped and with ornamentation very similar to that of this genus.

Fundamentally, the ornamentation is constituted by an anterior oblique ridge which from the anterior cardinal angle reaches the mid-height where it curves ending near the anterior margin.

Two subhorizontal undulating ridges occupy the central part of the valves defining a subelliptical area which is occupied by large subpolygonal foveolae. The top ridge at the anterior extremity ramifies upward for a short distance.

Departing from the previously defined area, the

posterodorsal shows a series of secondary almost vertical ridges which reach the dorsal margin. The centro-dorsal area is occupied by a complicated system of small ridges.

A defined ridge starts from the posterior extremity of the subelliptical area and runs parallel to the postero-ventral and ventral margin, interrupted for a short distance just before the mid-length and re-occurring anteriorly where it runs parallel to the anterior margin reaching the anterior cardinal angle.

The antero-ventral area is occupied, below the anterior part of the subelliptical area, by numerous, large and deep foveolae, sometimes fused together.

The ventral inflexion is characterized by the presence of an evident snap-knob, like in *Callistocythere* (Pl. 2, fig. 3).

Hinge: typical of the subgenus. In particular, the posterior tooth of the RV is 5-lobed (Pl. 2, figs. 4,6).

Inner lamella: very wide anteriorly (Pl. 2, figs. 3, 5) and without vestibule. Anterior marginal pore-canals mostly ramified especially below the mid-height. False marginal pore-canals numerous all around the

lamella. Posterior inner lamella reduced and with few simple marginal pore-canals (text-fig. 3A).

Size (in mm) – LV: L = 0.39; H = 0.20 (Pl. 2, fig. 1).
RV: L = 0.38; H = 0.20 (Pl. 2, fig. 2).

Remarks – The proposed new species, with its peculiar and defined ornamentation, cannot be compared with any other known species, except for *L. lagunaris* n. sp. which shows a similar ornamentation but belongs to a different genus.

Genus LEPTOCYTHERE Sars, 1925

LEPTOCYTHERE LAGUNARIS Barra & Bonaduce n. sp.
Pl. 2, figs. 7-10; text-figs. 3 B, C

Etymology – From Italian laguna = lagoon.

Holotype – LV (Pl. 2, fig. 7; text-fig. 3C), Stn. MC9, B.O.C. 2349.

Paratype – RV (Pl. 2, figs. 8-10; text-fig. 3B), B.O.C. 2350.

Type locality – Monte Calvo (Ariano Irpino, Southern Apennines).

Diagnosis – A small species of *Leptocythere*, characterized by a well-defined ornamentation constituted by two longitudinal ridges fused together posteriorly and ending anteriorly at about mid-length. Posterior extremity very flattened (Pl. 2, figs. 7, 8).

Description – Valves in lateral view elongated with the anterior margin regularly rounded and the posterior one more acutely rounded. Ornamentation constituted by two lateral ridges, well-defined but not very protruding, which are located below and above the mid-height, respectively. They are restricted to the posterior part of the valves and at their posterior end fuse together forming an almost regular arch. A third ridge runs inside the posterior margin and follows the postero-ventral margin reaching the anterior margin, even if not well defined, where it upturns reaching the anterior cardinal angle. Another oblique ridge between the anterior cardinal angle defines with the anterior ridge a semilunar area. All the surface of the valves is covered by large and relatively deep and mostly rounded foveolae.

Hinge – typical of the genus as shown in Pl. 2, fig. 9.

Inner lamella: wide anteriorly with a large vestibule from which relatively numerous branching marginal pore-canals depart. Few false marginal pore-canals occur between the real ones (Pl. 2, fig. 10; text-figs. 3 B, C).

Size (in mm) – LV: L = 0.32; H = 0.16 (Pl. 2, fig. 7).
RV: L = 0.33; H = 0.16 (Pl. 2, fig. 8).

Remarks – Even if only 2 valves have been found, the species is so well defined that it allows for an accurate description. The species is similar in general shape and secondary ornamentation to *L. aegea* Mostafawi, 1989, described from the Neogene of Rhodos. In any case, the presence of the two defined longitudinal ridges allows the evident separation of the two species.

Family LOXOCONCHIDAE Sars, 1925

Genus LOXOCONCHA Sars, 1866

LOXOCONCHA ? KRAJINAE Krstic, 1992

Pl. 1, figs. 1-7; text-fig. 3D

?1992 *Loxoconcha krajinae* KRSTIC, in Krstic & Bossio, pp. 183-184, pl. 8, figs. 17-23.

Remarks – The species *L. krajinae* has been described from the Upper Meotian (Late Miocene) of Eastern Serbia. Even if the original illustrations are poor, the excellent description (Krstic, 1992) allows a reliable comparison with our material. The Pliocene descendant exhibits a strong similarity with Krstic's species, but it appears a little higher in lateral view. For this reason *L. krajinae* was identified only tentatively. To improve the iconography of this species, we illustrated both males (Pl. 1, fig. 3) and females (Pl. 1, figs. 1, 2) and the internal characters (Pl. 1, figs. 4-7; text-fig. 3D).

This species is vaguely similar to *L. pseudohastata* Stancheva, 1964 from which it differs clearly for the reticulated and not organized ornamentation.

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