

Lagoonal-continental Oligocene of southern Apulia (Italy)

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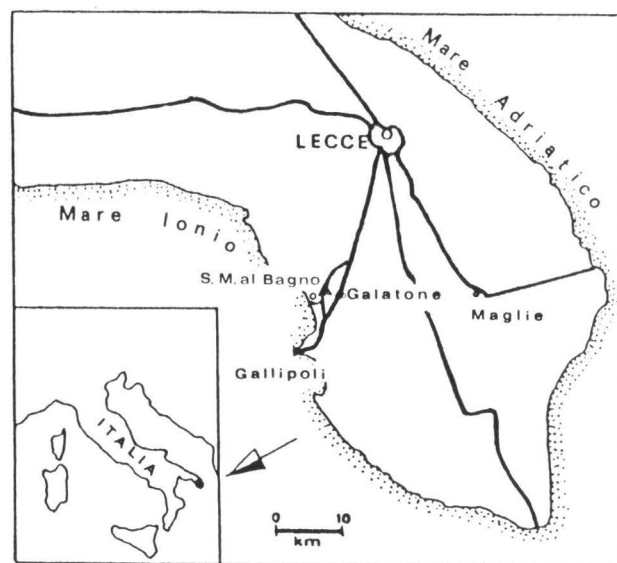
KEY WORDS — Oligocene, Sedimentology, Paleocology, Foraminifera, Mollusca, Apulia.

ABSTRACT — *In the frame of investigations on the continental and transitional Oligo-Miocene mollusk assemblages of southern Apulia, we present evidence of a spectacularly exposed succession recording a range of distinct depositional paleoenvironments and faunas. A first account is given on the sedimentological and paleoecological characters of this sedimentary succession, outcropping near Galatone (Lecce district, southern Apulia). Its age is tentatively referred to the Late Oligocene, in the light of the evidence from foraminiferal and mollusk assemblages. The succession records unusual taxonomic associations, as yet unrecorded from the Italian peninsula, and distinctive depositional features. This allows us to discuss some features of the rarely recorded shallow-water/continental transition, commonly biased in the Mediterranean Oligocene sedimentary record. While the foraminifera testify to the existence of similarities with coeval assemblages from the Middle East and SW Spain, the malacofaunas suggest strong affinities with eastern and southeastern Europe.*

RIASSUNTO — [Depositi lagunari-continentali dell'Oligocene della Puglia meridionale] — *Nel quadro di ricerche sui depositi continentali e di transizione dell'Oligo-Miocene salentino, vengono esposti i risultati di uno studio sulle caratteristiche sedimentologiche e paleoecologiche di una successione sedimentaria affiorante presso Galatone (Lecce). Rapporti geometrici con le formazioni dell'area salentina ed elementi microfaunistici particolarmente significativi permettono di attribuire la successione all'Oligocene probabilmente terminale, in analogia con le facies di acque sottili a macroforaminiferi della Spagna e del Medio Oriente. Tale età è confermata dalle macrofaune a molluschi continentali, lagunari e di ambienti di transizione, sinora sconosciute per l'area in esame e uniche nel panorama italiano, che trovano termine di confronto naturale in quelle dell'Europa orientale e sudorientale.*

INTRODUCTION

Aim of the present paper is to give a first account on the sedimentological and paleoecological characters of a lagoonal and continental succession of southern Apulia, as yet unrecorded in the Salento area and with few analogues in the Mediterranean area. The succession is referred to the Oligocene and likely to the Chattian on the base of both micro- and macrofaunal evidences and regional formational correlations. The investigated section, averaging 35 m in thickness, is well exposed along the roadside of the Gallipoli-Lecce highway, near the Galatone-S. Maria al Bagno intersection (Salento peninsula; Lecce district) (Text-fig. 1). The preliminary results obtained, instrumental in reconstructing the regional stratigraphy and the paleoecology of the examined paleoenvironments, allow us to focus on some poorly investigated oligotypic Late Oligocene assemblages rich in shal-



Text-fig. 1 - Geographical location of the investigated area.

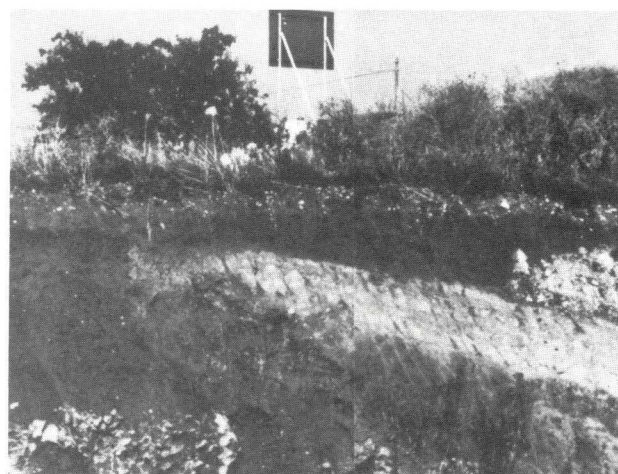
low-water imperforated foraminifera and lagoonal-freshwater mollusks.

Geometrical reasons and biostratigraphy suggest that the deposition of the investigated succession took place in the timespan in which either the Castro Limestone (Martinis, 1967) or the Porto Badisco Calcarene (Rossi, 1969) were formed. There are several controversial aspects in the debate on the nomenclature and stratigraphical relationships of the Paleogene lithostratigraphic units of the Salento region (Ciaranfi *et al.*, 1988, Bosellini & Russo, 1922; Barbera *et al.*, 1993). This reflects the necessity of a more complete investigation of the Oligocene to Lower Miocene deposits of the Salento area, in particular as concerns the discontinuous outcrops towards the interior of the peninsula. We prefer thus for the time being to consider the investigated unit as lithostratigraphically distinct. This appears justified also on the base of the lithological, sedimentological and macrofaunal characters of the investigated succession. These distinctive characters cannot be compared with those of either above-mentioned formation and point out that the succession was formed in a very different and much shallower depositional setting.

DESCRIPTION OF THE INVESTIGATED SUCCESSION

In the examined outcrop, the ca. 35 m thick studied succession is formed of carbonate-terrigenous deposits which unconformably overly the Senonian-Maastrichtian Altamura Limestone. A bauxitic unit of about 1.5-2 m thickness is interposed between the two mainly carbonate formations (Text-fig. 2). The lithology of the succession is relatively uniform, represented by dominating biomicritic-dolomitic, stromatolitic, chemically precipitated, bioclastic and marly limestones, alternating with carbonatic-terrigenous silts and clays (Text-fig. 3).

Bedding is mostly distinct and uniform. In general, thin-layered levels, with scarce fossiliferous content, represent the bulk of the succession, sometimes changing to micritic limestones. More rare are intercalations of silty and clayey levels and massive (40-50



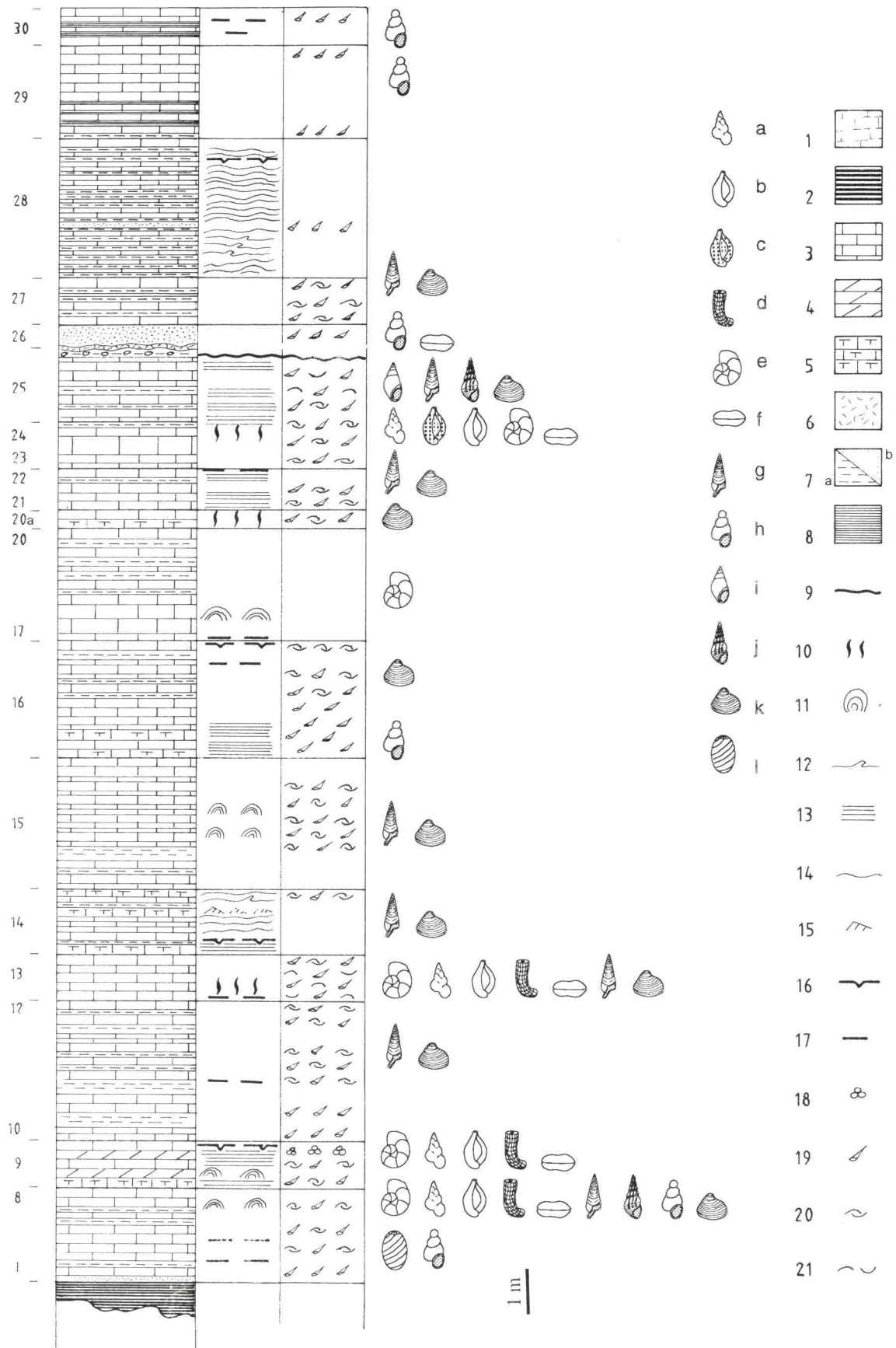
Text-fig. 2 - Lower part of the studied outcrop, western roadside. From the left (bottom) to the right the karstified Upper Cretaceous limestones are visible, followed by red bauxitic levels and the basal layers of the investigated succession.

cm thick) and/or laminated lime mudstones with abundant macrofauna. Layer thickness, although variable, ranges from a few centimeters to several decimeters, while thicker layers are rare. In some instances notable lateral variations in thickness occur, causing lenticular or indistinct bedding.

In the upper part of the succession, a main discontinuity surface (Text-fig. 4) is evidenced by a level of dark clay, interpreted by us as a paleosol, underlying a soft carbonate lime layer, rich in continental gastropods. In detail, as concerns this interval of chemically precipitated carbonate, containing extremely rich mono- to oligotypic populations of *Hydrobia* and *Pseudamnicola* and smooth-shelled ostracods, the following succession has been found from bottom to top:

- a basal hard, undulated travertine crust, yellowish-reddish in colour (thickness: 1 cm);
- a layer of lime mudstone, compact at its base, with subrounded intraclasts and glauclites in its upper portion, containing fragments of *Hydrobia*, Potamididae and molds of small bivalves (thickness: 40 cm);
- a layer of generally yellowish-greenish clay (thickness: 3-4 to 10 cm), showing apparently gra-

Text-fig. 3 - Lithostratigraphy and biostratigraphy of the studied section, showing the schematic distribution of sedimentary structures. Symbols: a) textulariids; b) miliolids; c) *Austrotrillina*; d) *Praerhapydionina*; e) rotaliids; f) ostracods; g) Potamididae; h) Hydrobiidae; i) *Melanopsis*; j) *Melanoides*; k) bivalves; 1) characeans; 1) Altamura Limestone Formation; 2) red bauxitic levels; 3) micritic and biomicritic limestones; 4) dolomitic limestones; 5) marly limestones; 6) dark clays and paleosoils; 7a) calcareous-terrigenous silts; 7b) chemically precipitated lime mudstones; 8) clays; 9) erosional surfaces; 10) bioturbation structures and trace fossils; 11) stromatolitic laminae; 12) load structures; 13) parallel laminations; 14) undulated laminations; 15) ripple marks; 16) mud cracks; 17) calcareous laminated crusts; 18) benthic foraminifera; 19) gastropods; 20) bivalves; 21) disarticulated valves.





Text-fig. 4 - Lime mud layer (upper portion of the figure, sample 26) with oligotypic *Hydrobia* populations. The layer rests upon a paleosol level, formed of yellowish-greenish clays, containing clasts derived from the underlying layers and limestone glauconites.

dual transition from the underlying layer; the contact with the underlying lime mudstone is undulated and does not appear to be erosional; in its lower part this clay layer is light hazel in colour and contains tubular structures (ca. 1 mm diameter), which may be interpreted as rhizoliths, while further upwards the clays become grey in colour, with darker patches rich in organic matter; the layer terminates with a mm-thick carbonaceous veneer; within the whole layer clasts derived from the underlying lime mudstone, glauconites and mollusk fragments occur;

- a sharp change occurs just above the mm-thick carbonaceous veneer, represented by a layer of soft carbonate lime mud, containing a very rich monotypic (eventually oligotypic, i.e. composed of either one or two species) assemblage of well-preserved *Hydrobia* shells, occurring loose and uncemented in the sediment (thickness: ca. 60 cm); in the upper part of the layer also smooth-shelled ostracods occur, often with articulated valves.

We interpret the above mentioned basal, undulated travertine crust as indicative of a sharp, although not final, change in environmental control in respect to the previously dominating marine influences. This interpretation is supported by the occurrence in the overlying lime mud of fragments of reworked fossils and abundant whitish limestone glauconites, irregular in shape, generally regarded as evidences of erosion associated with paleosols (Retallack, 1988; Basilici, 1993). These glauconites also occur in the overlying clays, together with root casts, and their appearance closely resembles that of

a conglomerate in clayey matrix (Text-fig. 4). In spite of this superficial resemblance, we interpret this level as a pedogenized horizon, which includes the clays, topped by a thin veneer rich in organic matter and delimited at its base by the compact portion of the calcareous lime mud.

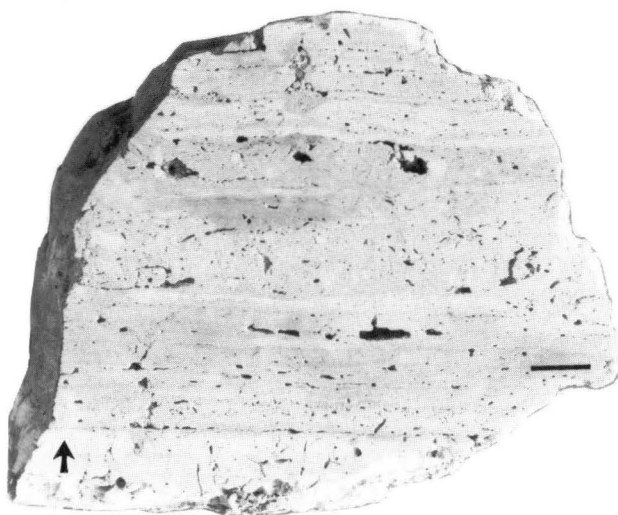
In conclusion, the travertine crust marks the temporary termination of marine control on sedimentation in the succession, as testified also by the faunas above it, and records the change towards continental sedimentation. Above this crust the sedimentation is continental, first interrupted by incipient soil formation, associated with gentle topography modeling (Text-fig. 4). Hydrobiids and ostracods of the following lime mud unit indicate oligohaline to hypohaline waters. The silty micritic sediments contains small cylindrical structures, smaller than 1 mm in diameter, which are interpreted as carbonate encrustations on plants.

No current marks are visible. All these evidences point to the development of lacustrine facies. The occurrence of brackish forms (Potamididae) is confined to a single episode. The uppermost portion of the succession records mainly continental sedimentation, with silts and finely laminated micritic limestones. In some levels, however, very poorly preserved, oxydated and possibly reworked foraminifera were found. Towards the top of the section, some *Hydrobia*-rich, chemically precipitated lime mud levels occur again.

Extreme variation in degree of lithification characterizes the whole succession, even within lithological units of homogeneous composition.

Fine-grained biogenous and biochemical lime sediments prevail in the whole succession on silicoclastic deposits. Common sedimentary structures in the calcareous lithotypes are stromatolitic laminated layers (Text-fig. 5), often associated with birdseyes and fenestrae, parallel laminations, typically evidenced by granulometric variations or bioclast concentrations (Text-fig. 6).

Evidences of subaerial exposure and soil formation are testified by mud cracks (Text-fig. 7),



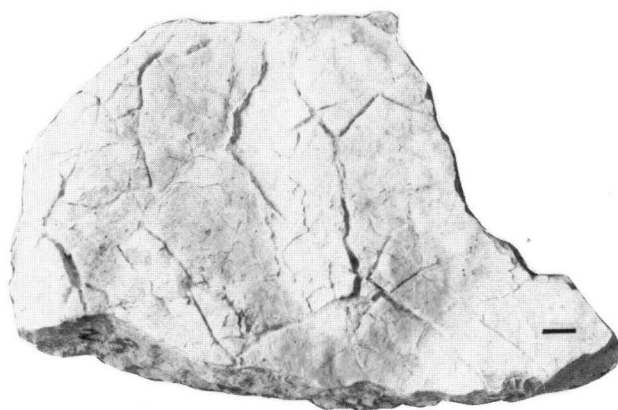
Text-fig. 5 - Lime mudstone layers with mud pebbles and desiccation structures alternating with stromatolitic layers with birdseyes and fenestrae. Sample 19. Bar length: 1 cm.



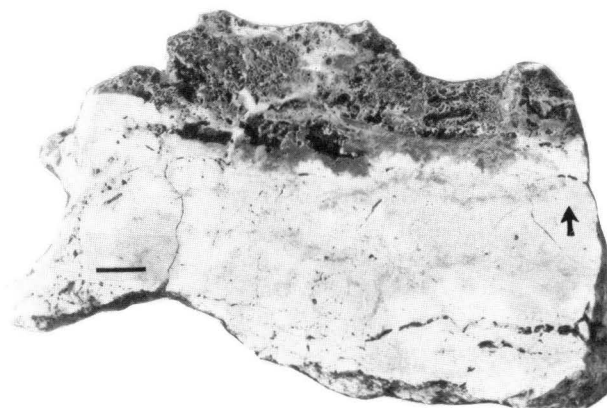
Text-fig. 6 - Laminated lime mudstones. The lamination is evidenced both by variations in color and by levels with bioclast concentrations. The isolated valves are randomly arranged («convex up» or «convex down»). Sample 25. Bar length: 1 cm.

thin laminated crusts, rhizoliths and travertine levels (Text-fig. 8). The terrigenous intercalations typically show current marks, as e.g. undulated laminae and millimeter-scale ripple-marks (Text-fig. 9). Locally, small-scale load structures occur (Text-fig. 10), often at the contact between the thin carbonate levels due to chemical precipitation and the silty-clayey intercalations. Bioturbations and trace fossils are also diffuse. Text-fig. 11 shows the occurrence of cylindrical-conical decapod burrows (1 cm diameter; 4-5 cm length) in the upper part of the succession (sample 24). These burrows may suggest an intertidal environment (Hasidis & Bown, 1992).

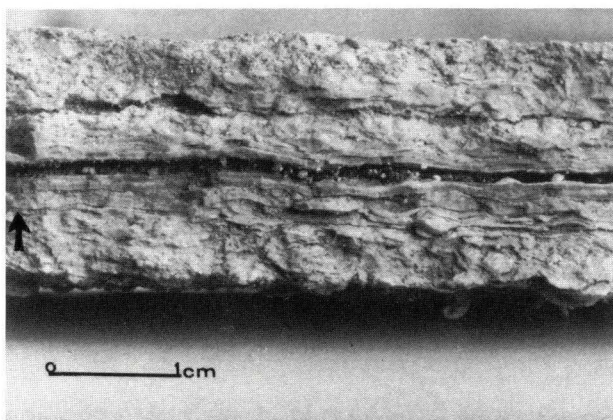
In the development of the succession both macro- and microfaunas show remarkable variation in distribution and frequency. They are scarce or absent in the silty-clayey levels except in the chemically precipitated lime mud of sample 26 and more



Text-fig. 7 - Bed upper surface with mud cracks. Sample 28. Bar length: 1 cm.



Text-fig. 8 - Un laminated homogeneous limestone, showing inorganic irregular crusts in its upper part. Bar length 1 cm.

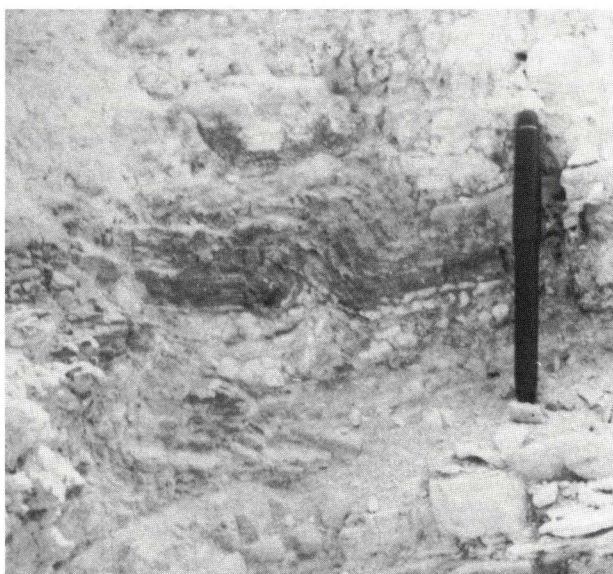


Text-fig. 9 - Detail of centimetric parallel bedding showing tractive laminae, small ripple marks and wavy lamination. Sample 16.

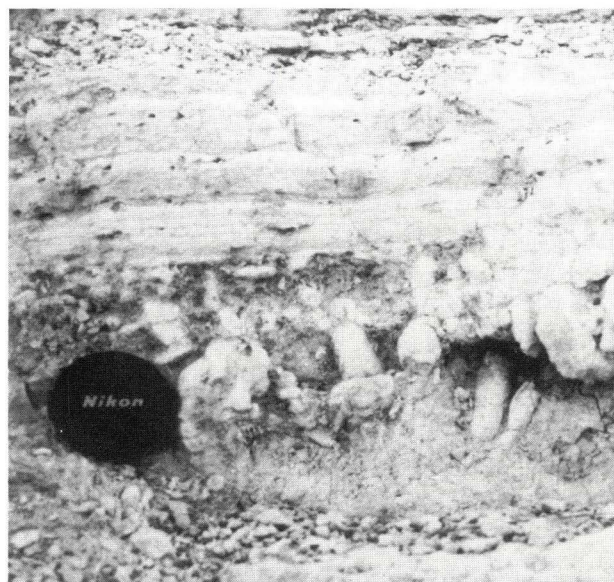
abundant in the limestone layers, sometimes forming true bioclastic levels. Skeletal hardparts are only rarely preserved in life position or iso-oriented; scattered lamellibranch valves are generally un-oriented and do not show preferential arrangement.

FORAMINIFERAL ASSEMBLAGES

Foraminiferal assemblages occur in the main in two intervals of the investigated section. In the basal portion of the succession (samples 8-13), the



Text-fig. 10 - Small-scale load structures at the interface between thin inorganic carbonate levels and silty-clayey intercalations. Sample 28.



Text-fig. 11 - A level characterized by cylindrical decapod burrows is followed by calcareous silts and micritic limestones with bivalves and gastropods, oriented along thin horizons, parallel to bedding. Sample 24.

foraminiferal assemblages are fairly diverse and abundant, although limited to or concentrated at some horizons. The dominant forms are miliolids and peneroplids, among which in particular *Praerhapydionina delicata* Henson, 1950 and few specimens doubtfully referred to *Peneroplis* cf. *elegans* d'Orbigny, 1839. All these forms are indicative of shallow water lagoonal conditions. *P. delicata* (Pl. 1, figs. 1-6) is characterized by an elongate test, circular in transversal section, of medium size (incomplete specimens reach up to 3.5 mm), with an early stage formed of few, possibly planispirally coiled chambers, followed by a long succession of uniserial chambers. Typically, the chambers possess radial primary and secondary partitions. The aperture is terminal, stellate. The generations are dimorph.

Associated forms in this lower portion of the succession, as recognizable from thin sections, include textularids, buliminids, smaller rotraliids, and *Cibicides* and ostracods. Further upsection, sample 16 yielded rare foraminiferal specimens. In sample 18, few specimens of elphidiids and abraded *Asterigerina* were found. Ostracods are absent in both samples.

The second level in which abundant microfaunas occur is sample 24. This sample yielded both foraminifera and ostracods, which occur isolated in the uncemented detrital sediment; faecal pellets of

crustaceans are common. While overall preservation of the lamellar-perforate benthic foraminifera is fairly good, most imperforate forms occur only as inner molds with fragmentary shells. The assemblage is characterized by *Bolivina* spp., *Cibicides* sp., *Planorbulina bronnimanni* Bignot & Decrouez, 1981, *Nonion* sp., *Austrotrillina* sp., *Quinqueloculina* sp. and other undetermined miliolids. Ostracods, mainly inornate, are much more abundant than foraminifera. The foraminiferal assemblage clearly indicates fully marine conditions. The abundance of miliolids suggests shallow waters, while the frequent *Bolivina* spp. suggest the existence of interstitial environments in which nutrient levels were relatively high. Planorbulinids are known from a wide range of littoral environments. They generally live attached with their spiral side on seagrass and algae, occasionally on hard substrates or sandy bottoms. The presence of algal or seagrass substrates may be inferred as well from the occurrence of epiphytic miliolids. This assemblage, although devoid of peneroplids and *Spirolina*, may be likely considered as correlative of those figured by Sartorio & Venturini (1988, p. 167) and Pignatti (1990) from the Chattian of the Salento region. Limestone thin sections from the Oligocene of the Salento area (Castro) yielding *P. bronnimanni* are figured in Bignot & Decrouez (1981).

Our isolated specimens are clearly distinct from *Planolinderina*, another common Oligocene planorbulinid.

The uppermost portion of the succession records mainly continental sedimentation, with silts and finely laminated micritic limestones. In some levels, however, very poorly preserved, oxydated and possibly reworked foraminifera were found.

MALACOFAUNAL ASSEMBLAGES

In the lowermost portion of the succession, directly overlying the basal bauxitic levels, the occurrence of small, smooth-shelled gastropods (?*Hydrobia*) as molds and casts and rare characean gyrogonites testifies to the existence of freshwater, estuarine or lacustrine conditions. Because of its reduced thickness, we interpret this freshwater facies as ephemeral and short-lasting.

Transitional facies are instead testified in the remaining lower third (about 10 m in thickness) of the studied succession, although slight changes towards either continental or littoral conditions occur repeatedly. Abundant, albeit oligotypic faunal assemblages, mainly formed of mollusks, foraminifera and ostracods, characterize this interval of the

succession, in which lagoonal conditions prevail. On the whole, the mollusk remains are poorly preserved occurring generally as molds and casts; solution and recrystallization are common. The macrofaunal assemblages are dominated by Potamididae (Cerithiacea) and by small Veneroid bivalves (Astartidae?), the latter forming at some levels loosely packed concentrations, in which the shells are iso-oriented and with closed valves, and representing virtually monotypic associations. The Potamididae are dominated by *Potamides* cf. *plicatum* (Bruguère) and by less abundant *Granulolabium* sp. (= *Pirenella* Auct., partim; see Lozouet, 1986). Recent representatives of the Potamidineae (*Terebralia*, *Potamides* (= *Pirenella*), *Cerithideopsis* and *Tympanotonus*) are typical in estuarine and lagoonal environments, although they may tolerate considerable salinity variations (from 5‰ to 100‰). High-density *Potamides* populations are indicative of high algal productivity on mud substrates (Plaziat, 1989). In some of the lower levels of the succession (e.g. in sample 8), the Potamididae coexist with rare continental forms, as *Melanoides* sp. and *Hydrobia* sp. In other levels (samples 12-15) the Potamididae occur in «thalassic» associations, along with typically marine bivalves (Veneroida, ?Astartidae). In sample 13, medium-sized bivalves occur (L=35 mm, H=25 mm, D=16 mm) as molds and fragmentary shells, showing faint concentric growth lines. Their hinges, although fragmentary, show characters which allow a provisional attribution to *Polymesoda convexa* (Brongniart) (= *Cyrena convexa* Auct.). *P. convexa* is widely recorded from Paleogene to Early Miocene brackish and littoral facies of Europe.

In the intermediate portion of the succession (samples 16-20), an environmental change towards continental conditions is evidenced both by sedimentary features and by the occurrence of some levels with monotypic *Hydrobia* sp. populations. This interval is followed by a further change towards brackish environmental conditions (sample 25), characterized by *Potamides* cf. *plicatum*, *Granulolabium* sp. and small Veneroid bivalves (?Astartidae), associated with forms indicative of hypohaline to oligohaline environments, as *Hydrobia* sp., *Melanopsis* sp. and *Melanoides* sp. Starting with sample 26, the development of continental facies is testified by monotypic to oligotypic populations, extremely rich in individuals, belonging to hypohaline representatives of the family Hydrobiidae. These forms, referred to *Hydrobia* sp. and *Pseudamnicola* (*Staja*) sp. (Fam. Hydrobiidae) and indicative of fluvial and lacustrine facies, are generally associated with ostracods. They

dominate in the whole upper portion of the studied succession after sample 26, except for a short fluctuation towards brackish conditions in the layers just above this lime mud sample, with assemblages formed of *Potamides* and small bivalves. The shells of *Hydrobia* and *Pseudamnicola* (*Staja*) are generally very well preserved in the chemically precipitated lime mud sediments, while in the laminated limestones of the uppermost portion of the succession they occur only as molds or casts.

Selected malacofaunal elements are figured in Pl. 2.

BIOSTRATIGRAPHY AND PALEOECOLOGY

The most reliable biostratigraphic marker found in the foraminiferal assemblages of the lower portion of the succession (samples 8-13) is *Praerhapydionina delicata* Henson. Analogous to Recent soritids and peneroplids, the genus *Praerhapydionina* characterized the shallowest Eocene to Oligocene larger foraminiferal assemblages with prevailing porcellaneous forms (Hottinger, 1983). It is recorded from near-reef and hyperhaline environments, sometimes subject to strong variations in salinity and temperature.

The particular ecological requirements of *Praerhapydionina* and its allies, taxonomically poorly understood, and the rareness of the correlative depositional facies are in part responsible for the scanty available biostratigraphic data. No revision of the species of this genus exists, the diagnostic characters and biometrical values being difficult to determine in random thin sections of limestone. A number of taxa, at least in part as yet informal, can be distinguished, starting at least from the Middle Eocene (L. Hottinger, pers. comm. to J.S.P., 1990). *P. delicata* allows biostratigraphic attribution to the Oligocene and possibly to the Chattian in the present association. Its vertical range has been variously interpreted in the past, but consensus exists in considering it as a typical Oligocene marker, ranging throughout the Rupelian and the Chattian.

This opinion has been queried by Eames *et al.* (1962), who consider it as ranging in the Middle East from the Rupelian (considered by them as a Middle Oligocene) to the Aquitanian, and as occurring in the Aquitanian of both the southern Mediterranean area (Sicily, Malta) and South-East Asia. However, it is noteworthy that in their opinion the occurrence of Chattian beds in the Mediterranean region is considered as unproven. «Well developed marine Chattian foraminiferal faunas, clearly younger than Rupelian and older than Aquitanian, are only to be found in the Middle East» (Eames *et al.*, 1962, p. 11). This circumstance – contrary to convincing evidence from a large number of more recent studies – may have biased their interpretation of Upper Oligocene to Aquitanian larger foraminiferal assemblages from the Mediterranean area. Similarly, Adams (1968; 1970) following in part Eames *et al.* (1962), considered the species to range from the «Latdorfian» to the Aquitanian in the Eastern Tethys. Later, however, Adams *et al.* (1983) expressed doubts on the validity of Eames *et al.* (1962)'s «Aquitanian».

The species is typical of shallow-water deposits along the Neotethyan Mediterranean and Arabic segments. Its paleobiogeographic distribution is very wide, centered on the Middle East (Iran, Iraq, Turkey, Arabic Peninsula, Oman) and Somalia (Henson, 1950) and ranging as far as South-East Asia (Eames *et al.*, 1962; Adams, 1968). Records from Europe are limited to northern France («Latdorfian»/Rupelian transition; Bignot & Neumann, 1991), southwestern Spain (Late Oligocene; Hottinger, 1963), Sicily (Aquitanian; Eames *et al.*, 1962), Basilicata (Early Oligocene; Sartorio & Venturini, 1988), and Venetia (Early Oligocene; Barbin, 1988). Finally, *P. delicata* has been recently recorded also from the Late Oligocene of the Caribbean area (Robinson, 1993). Although bearing in mind the limitations on the interpretation of the biostratigraphical range of *P. delicata*, the present findings allow to extend its distribution to the Oligocene of the Apulian area.

EXPLANATION OF PLATE 1

Praerhapydionina delicata Henson. Thin sections. Sample 9.

Fig. 1 - Megalospheric specimen, longitudinal section. (100x).

Fig. 2 - Megalospheric specimens, transversal sections. (100x).

Fig. 3 - Megalospheric specimen, transversal section, showing the stellate aperture and radial primary and secondary partitions. (100x).

Fig. 4 - Megalospheric specimen, longitudinal section. (100x).

Fig. 5 - Microspheric specimen, longitudinal section. (33x).

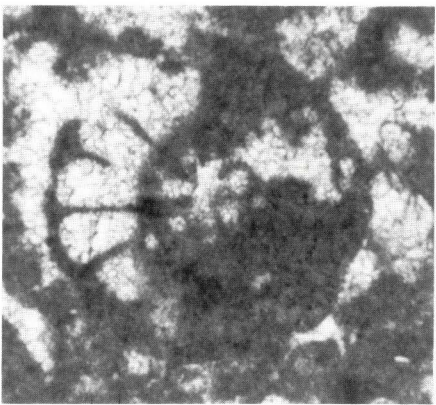
Fig. 6 - Early growth stage of megalospheric specimen, longitudinal section. (100x).



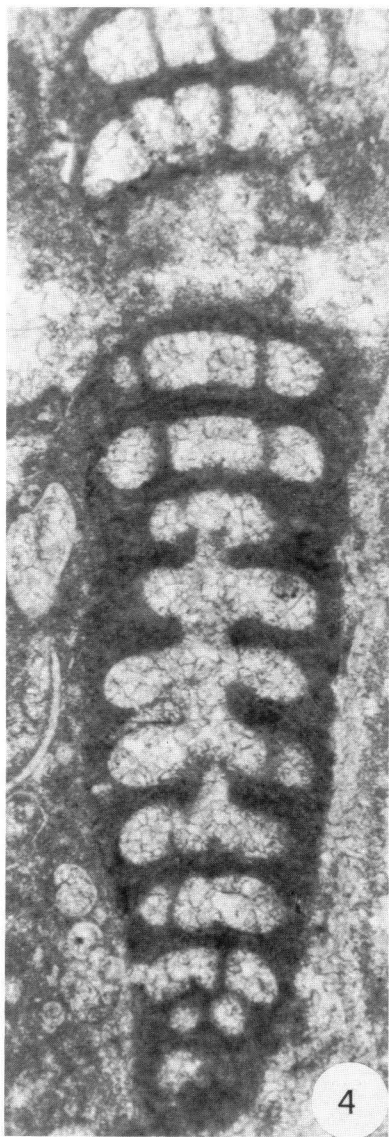
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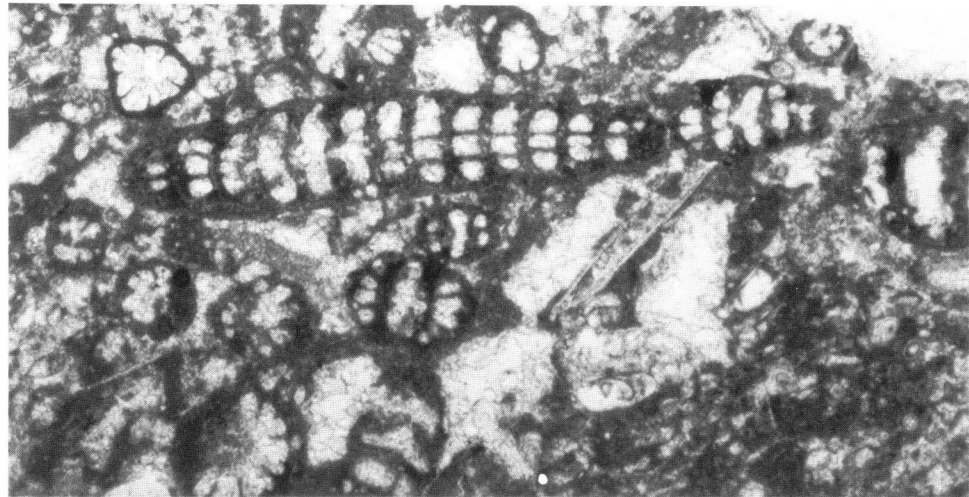
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In sample 24, the occurrence of *Austrotrillina* sp., represented by few incomplete individuals, suggests a Late Chattian to ?Early Aquitanian age. The specimens show an irregular, loose reticulation pattern similar to that of a new, unnamed species (C.G. Adams, pers. comm., 1990), recorded by Pignatti (1990) from the Upper Chattian of Uggiano La Chiesa (Salento). Samples from the latter locality yielded foraminiferal assemblages which are analogous and likely coeval to those figured by Sartorio & Venturini (1988: p. 167) from an unnamed locality of the Salento region. The presence of *Planorbulina bronnimanni* in sample 24 has little biostratigraphic meaning in the present context, although its youngest known occurrence is Chattian (Bignot & Decrouez 1981). Along with *Austrotrillina* and other miliolids, however, it may indicate the development of some vegetal cover.

The age inferred from the larger foraminiferal assemblages is supported also by malacofaunal evidence. *Polymesoda convexa* (Brongniart) (= *Cyrena convexa* Auctt.) is recorded from the Latdorfian to the Aquitanian in brackish to littoral facies from Europe. In the Late Oligocene, *P. convexa* characterizes the so-called lagoonal «*Cyrena* beds» from the Egerian (Chattian) of Hungary, where it is typically associated with hypo- to oligohaline (as *Theodoxus*, *Hydrobia*, *Melanopsis*), mesohaline (as *Potamides*, *Tympanotonus* and *Congerina*) or marine-littoral mollusks (as *Ostrea* and *Gari*). These deposits are sometimes intercalated within limnic facies characterized by *Viviparus* and *Brotia* (= *Melanoides*) (Báldi, 1969; 1970). Similar coeval facies, in which *P. convexa* brongniarti Basterot is associated with hypohaline and oligohaline species, occur in the Late Oligocene of northern Thrace, both in Bulgaria (Kojumdzieva & Sapundzieva, 1981) and in Greece (Mitzopoulos, 1961). In these facies also *Potamides plicatum* often occurs, which ranges from the Early Oligocene to the Miocene (and eventually to the Pliocene).

The hypohaline genera *Melanopsis* and *Melanoides* are widely distributed in continental to

brackish deposits from Europe, starting from the Paleocene. In particular, their occurrence is very distinctive in the Chattian «*Cyrena* beds» from central-eastern and southeastern Europe (Wenz, 1923-1930; Báldi, 1969; 1970). Representatives of the hypohaline subgenus *Pseudamnicola* (Staja) seem instead so far to be stratigraphically limited from the Middle-Late Miocene to the Early Pliocene of southern and southeastern Europe and Anatolia.

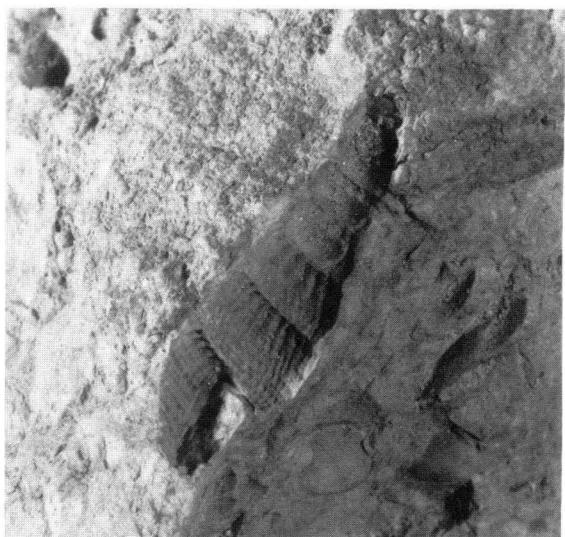
In conclusion, as concerns the foraminiferal markers, although the ranges of *Praerhapydionina delicata* and possibly *Austrotrillina* sp. n. and *Planorbulina bronnimanni* may well extend to the Aquitanian, we feel more confident in attributing the investigated succession to the Oligocene and possibly to the (?late) Chattian, also in accordance with the regional lithostratigraphic evidence. Similar (*P. convexa*) or wider vertical ranges characterize the gastropod taxa, although a distinct disagreement exists with the first known records of the subgenus *Pseudamnicola* (Staja).

CONCLUSIONS

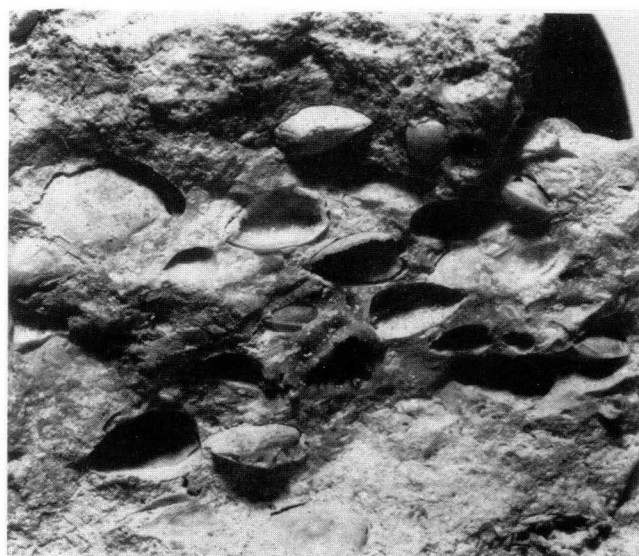
The investigated succession, spectacularly exposed in the vicinity of Galatone, records several distinct depositional paleoenvironments and faunas. We present a first account on the sedimentological and paleoecological characters of this sedimentary succession, tentatively referred to the Upper Oligocene. This preliminary investigation allows us to interpret the studied succession as mostly referable to a protected, shallow lagoonal environment, with temporary emersions in its lower portion. Throughout samples 8 to 13 shallow-water, lagoonal foraminiferal assemblages are common, characterized by abundant miliolids and peneroplids; the frequent occurrence of *Praerhapydionina delicata* is noteworthy. In the intermediate portion (samples 16 to 20) transitional, brackish and possibly continental conditions are testified by monotypic hydrobiid assemblages. However, fully marine condi-

EXPLANATION OF PLATE 2

- Fig. 1 - *Melanoides* sp. (Fam. Thiaridae). Cast. Sample 25. (2x).
 Fig. 2 - Concentration of small Veneroid bivalves (?Astartidae) with recrystallized shells. In the infilling sediment, specimens of *Praerhapydionina delicata* Henson are recognizable. (Sample 13; 2x).
 Fig. 3 - *Polymesoda convexa* (Brongniart). Mold. Sample 13. (2x).
 Fig. 4 - *Pseudamnicola* (Staja) sp. (a) and *Hydrobia* sp. (b), from an oligotypic association, extremely rich in individuals in the lime mudstone layer (see text). Sample 26. (10x).
 Fig. 5 - Inner molds and casts of *Melanopsis* (Fam. Thiaridae), associated with *Melanoides* sp., Potamididae and small Veneroid bivalves (?Astartidae). Sample 25. (1,5x).
 Fig. 6 - Oligotypic association, rich in Potamididae. Sample 8. (1,5x).



1

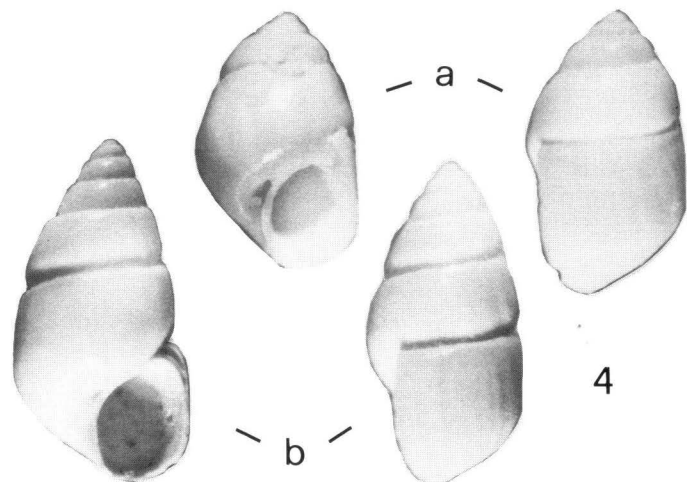


2



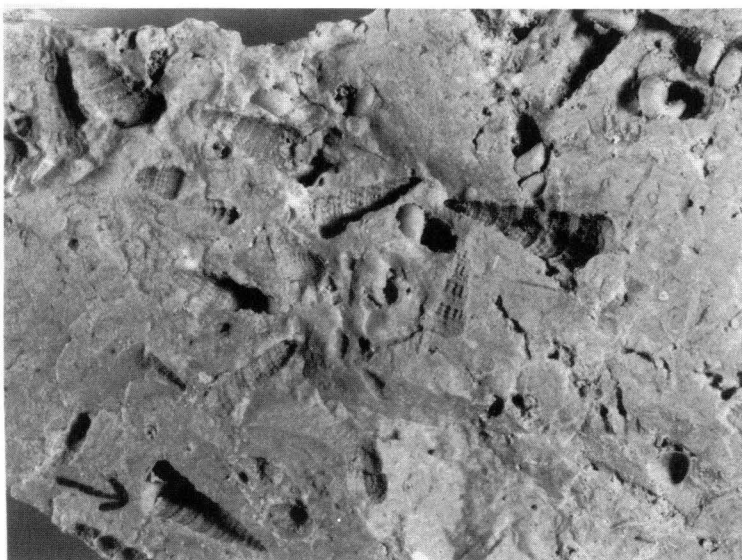
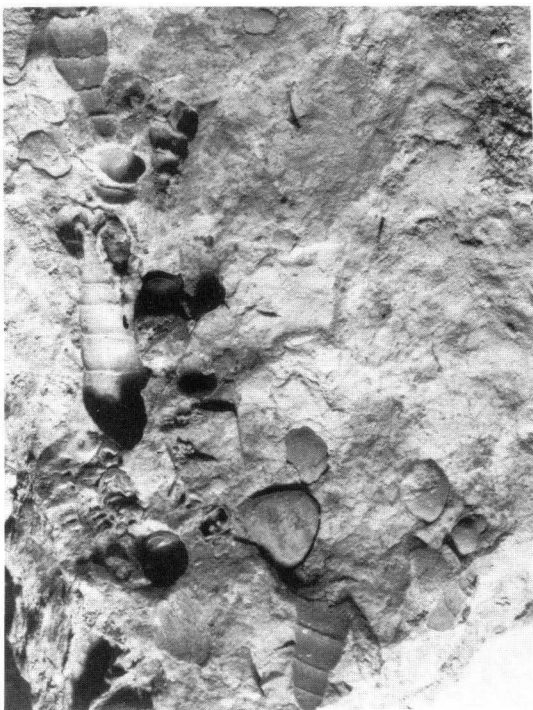
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4

6



tions are again recorded in sample 24, albeit apparently short-lasting; the fossil assemblages of this layer are dominated by diverse ostracod and benthic foraminiferal faunas and rich in faecal pellets. A definite change in depositional control in respect to the previously dominating marine to transitional conditions occurs in the upper portion of the investigated succession. Continental sedimentation is testified in correspondence of sample 26, with formation of a travertine crust, a layer of chemically precipitated lime mud with glauclites (interpreted as evidence of erosion associated with paleosoils), a layer of clays with rhizoliths and finally a layer of oligo- to hypohaline lacustrine lime mud extremely rich in mono- to oligotypic assemblages of Hydrobiids and ostracods. The latter forms, along with *Pseudamnicola* (*Staja*), dominate in the top of the studied succession, except for an initial fluctuation towards brackish conditions.

The succession records taxonomic associations as yet unrecorded from the Italian peninsula, and distinctive depositional features. This allows us to add some interpretative elements to the poorly investigated shallow-water/continental transition, commonly biased in the Mediterranean sedimentary record. While the foraminifera testify to the existence of similarities with coeval assemblages from the Middle East and SW Spain, the malacofaunas suggest strong affinities with eastern and southeastern Europe.

Studies are in progress in order to give full taxonomic description and biostratigraphy of the investigated faunas, along with other assemblages from neighbouring areas of southern Apulia, recording a variety of Oligocene to Early Miocene littoral, lagoonal, fluvial, lacustrine and continental paleoenvironments.

ACKNOWLEDGEMENTS

Financial support from MURST (60%) grants (Bari, Roma) and from the CNR-CSQEA (Roma) is gratefully acknowledged.

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(manuscript received July 7, 1994
accepted September 12, 1994)

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