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Autochthonous and allochthonous assemblages from Lower Pleistocene sediments (Palione river, Sicily)⁽¹⁾

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ABSTRACT – Fossil assemblages from Lower Pleistocene sediments cropping out along the Palione river (Grammichele, SE Sicily) and belonging to the basal part of the Poggio Spica Unit have been studied. Sediments, 12.5 m thick, are mainly pelitic and contain some fossiliferous layers in their upper part, where a coarse organogenic level, 30 cm thick, is also present.

Marls contain autochthonous fossil assemblages, mainly consisting of molluscs, bryozoans and fish otoliths, and indicating a shelf-margin environment grading into the bathyal zone, with an inferred depth of 100-200 m. The coarse organogenic bed is mostly formed by calcareous algae, for which an allochthonous origin from mid-shelf (40-80 m) current-swept bottoms is inferred. This algal bed is explained as caused by a gravitative mass deposition.

RIASSUNTO – [Associazioni autoctone ed alloctone in sedimenti del Pleistocene inferiore (Valle Palione, Sicilia)] – Sono state studiate le associazioni fossilifere presenti in livelli del Pleistocene inferiore affioranti lungo la valle Palione (Grammichele, Sicilia SE) e rientranti nell'Unità di Poggio Spica. I depositi marnosi, potenti 12,5 m, contengono alcuni livelli fossiliferi nella parte sommitale, dove è intercalato anche un livello ghiaioso organogeno spesso 30 cm.

Le marne contengono associazioni autoctone, costituite soprattutto da molluschi, briozoi e otoliti, che sono riferibili ad un ambiente di piattaforma esterna passante al Batiale per il quale viene stimata una profondità di sedimentazione di 100-200 m. Il livello organogeno, invece, è composto quasi esclusivamente da alghe calcaree che vivevano originariamente su fondali percorsi da corrente a profondità di 40-80 m, con popolamenti riferibili all'attuale Biocenosi del Detritico Costiero. La presenza di questo livello all'interno delle marne è dovuta a trasporto gravitativo in massa.

INTRODUCTION

Alternances of finer and coarser sediments are common in the stratigraphic successions, as they can form in different geological contexts and sedimentary settings, often as the result of cyclically changing sedimentary conditions. To explain alternances, a merely lithological and sedimentological analysis is usually not enough, while a palaeontological study may be necessary to improve interpretations.

In the present study an example is given from a coarse-grained layer interbedded within a marly succession cropping out in SE Sicily. These sediments deposited during the Early Pleistocene in the central region of the Gela-Catania Foredeep. The area was part of the narrow, steeply deepening shelf and the adjacent slope, which bordered the NW side of the emerged Hyblean Plateau Foreland. Uplifting and high sedimentation rate led to the shallowing up and definitive filling of the basin. In such a structural context, downslope slidings of unconsolidated or partially consolidated sediments were common (see Schmincke *et al.*, 1997; Pedley *et al.*, 2001). Palaeontological observations can be a useful tool to recognise allochthonous bodies and also to infer the original depositional setting, in order to achieve a basin-scale reconstruction.

The present paper is also an occasion to report on poorly known faunas and assemblages from relatively deep-water deposits. Other Pleistocene assemblages are known from the Grammichele area, namely from shallow-water current-swept coarse beds (Malatesta, 1960; Rosso, 1987; Di Geronimo & Sanfilippo, 1992; La Perna, 1997) and from deep-shelf to bathyal deposits (Di Geronimo, 1979; Di Geronimo *et al.*, 1982).

GEOLOGICAL SETTING

The studied assemblages are from Pleistocene beds cropping out along the Palione river (NE Grammichele, SE Sicily). They belong to the basal part of the Poggio Spica Unit, Pleistocene in age, consisting of basal packstones,

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overlaid by marly-to-clayey sediments and topped by coarse sands and calcarenite layers (Pedley *et al.*, 2001). In the studied area marls and clays directly overlie lavas and tuffs and are overlaid by calcarenites and organogenic sands (Malatesta, 1960; Rosso, 1987; Di Geronimo & Sanfilippo, 1992). The clayey layers, referred to the Lower Pleistocene, contain bathyal faunas which have been formerly studied by Di Geronimo (1979). Clays are partly heteropic with the marls studied in the present paper.

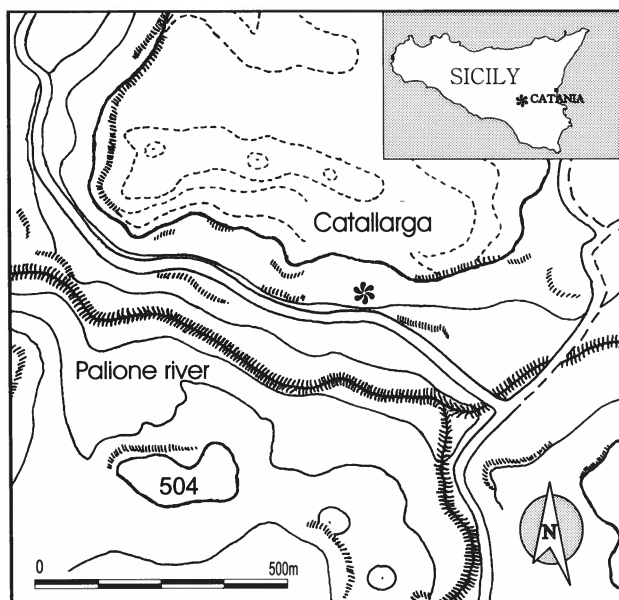
MATERIALS AND METHODS

Marls crop out at the head of the Palione river (Text-fig. 1), along its right side, where they are 12.5 m thick (Text-fig. 2). The basal to mid part lacks macrofossils, but some fossiliferous layers are present at about 10 m from the base. In particular, a coarse-grained bed, 30 cm thick and mostly consisting of calcareous algae is interbedded at about 1 m below the top surface, and a shell concentration, 40 cm thick, is at 70 cm below the algal bed. The remaining sediments are pelitic, although they contain a remarkable (ca 30%) fine to very fine sandy fraction. CaCO_3 content ranges from 63 to 80%. Fossils in marls are generally dispersed, while they are loosely packed in the shell concentration, and densely packed (*sensu* Kidwell & Holland, 1991) in the algal bed. Marls have an ill distinct parallel thin stratification marked by some cemented layers and are indistinctly bioturbated. Fossil orientation is concordant to oblique. The algal bed is concordant and its lower contact is sharp. Its internal structure is homogeneous. Matrix is scarce and consists of a mixture of sand and mud.

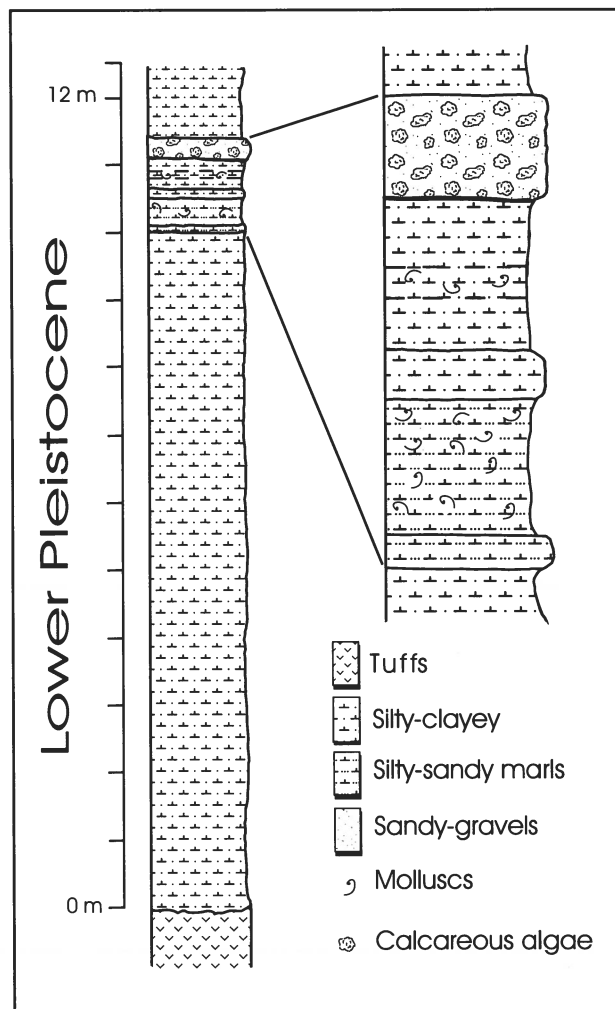
Macrofossils were bulk-sampled from the organogenic coarse bed and from the fossiliferous marly layer. Samples were routinely washed and macrofossils picked up from the fractions larger than 500 μm , focusing on molluscs, bryozoans, fishes (otoliths) and calcareous algae. Specimens of the last group are only from the coarse organogenic sample and were studied on thin sections.

DESCRIPTION OF THE ASSEMBLAGES

The pelitic bulk sample provided abundant fossils, mainly consisting of molluscs, whose shells are in rather good pristine condition, although mostly disarticulated and fractured. Aragonitic hard parts (otoliths and most mollusc shells) show degree of dissolution and weakening, which explains the diffuse fragmentation.



Text-fig. 1 - Location of the studied section, along the Palione river (SE Sicily).



Text-fig. 2 - Stratigraphic section at the head of the Palione river (SE Sicily).

The mollusc assemblage (about 70 species) is dominated by bivalves (80%) with a single species, the proto-branch *Ledella messanensis*, accounting for about 20% (Tab. 1). Other species are fairly well represented (dominance 2-6%), namely the gastropod *Alvania testae*, the bivalves *Batharca pectunculoidea*, *Limopsis friedbergi*, *L. minuta*, *Pseudamussium septemradiatum*, *Pododesmus aculeatus*, *Corbula gibba*, *Cuspidaria rostrata*, and the scaphopods *Fissidentalium rectum*, *Entalina tetragona* and *Cadulus attenuatus*.

The bryozoan assemblage (Tab. 2) is rather poor and is represented by 14 species, among which *Adeonellopsis distoma* (36%), and *Tervia irregularis*, *Characodoma mamillatum* and *Exidmonea atlantica* (9-14%) are particularly abundant. Among other species only *Hornera frondiculata* and *H. lichenoides* are well represented.

The otolith assemblage (Tab. 3) mainly consists (ca 70%) of pelagic taxa, mostly represented by micropods, of which *Ceratoscopelus maderensis*, *Myctophum punctatum*, *Notoscopelus elongatus* and *Diaphus taaningi* are dominant. The pelagic group also includes the extinct species *Parascombrops mutinensis*. The remaining taxa are nektobenthic and benthic. The nektobenthic group is dominated by the gadoids *Gadiculus argenteus* (70%) and *Micromesistius putassou* (7%), while the 5 macrourids species (*Hymenocephalus italicus*, *Nezumia sclerorhynchus*, *Trachyrincus scabrous*, *Coelorinchus coelorhynchus* and *C. stellaris*) are poorly represented. The benthic group (ca 7%) includes only 5 taxa, of which *Bellottia* cf. *apoda* and *Echiodon dentatus* are the most abundant.

It is worth to note also the presence of plates of *Coronula* sp., a barnacle epibiont on whales.

The coarse organogenic sample is almost exclusively composed by calcareous algae encrusted by scant bryozoans, molluscs and serpuloids. Algae (Tab. 4) mainly belong to melobesoids, such as *Phymatolithon calcareum*, *Lithothamnion ramosissimum*, *Mesophyllum lichenoides* and *L. corallioides*, whereas lithophylloids, with *Titanoderma pustulatum*, are subordinate. Specimens are small, not exceeding 3 cm in diameter, and are mostly

spheroidal rather than ellipsoidal in shape, developing branched and, less commonly, columnar growths. They are represented by multispecific rodolithes *sensu* Bosellini & Ginsburg (1971) i.e. "nodules and detached branched growths with a nodule form". Among rodolithes, pralines i.e. "small (a few centimetres in diameter), roundish, monospecific rodolithes developing tubercular protuberances or branches" (Basso, 1998), usually formed by *Lithothamnion ramosissimum* and *L. minervae*, are frequent.

DISCUSSION

The palaeoecological bearing of the benthic assemblages from the marly sample is rather homogeneous, i.e. molluscs, bryozoans and otoliths all point to a deep circalittoral to epibathyal depositional palaeoenvironment.

The composition of the mollusc assemblage is characterized by diverse protobranches (15 species), scaphopods (8 species) and other taxa (*Limopsis*, *Cuspidaria*, *Batharca*, etc.) with a deep-water distrib-

MOLLUSCS		
Gastropoda	A	D(%)
<i>Alvania testae</i> (Aradas & Maggiore)	37	2.99
<i>Nassarius cabrierensis</i> (Fontannes)	14	1.13
<i>Pagodula vaginata</i> (De Crist. & Jan)	3	0.24
<i>Turriclavus harpula</i> (Brocchi)	7	0.57
Bivalvia		
<i>Nucula sulcata</i> Bronn	13	1.05
<i>Brevinucula glabra</i> (Philippi)	15	1.21
<i>Ledella messanensis</i> (Jeffreys)	272	22.01
<i>Neilonella pusio</i> (Philippi)	10	0.81
<i>Bathyspinula excisa</i> (Philippi)	12	0.97
<i>Katadesmia confusa</i> (Seguenza)	2	0.16
<i>Pseudomalletia isseli</i> (Bellardi)	23	1.86
<i>Asperarca scabra</i> (Poli)	18	1.46
<i>Batharca pectunculoidea</i> (Scacchi)	45	3.64
<i>Limopsis friedbergi</i> Glibert & van de Poel	50	4.05
<i>Limopsis minuta</i> (Philippi)	61	4.94
<i>Pseudamussium septemradiatum</i> (Mueller)	67	5.42
<i>Delectopecten vitreus</i> (Gmelin)	47	3.80
<i>Hyalopecten simile</i> (Laskey)	23	1.86
<i>Pododesmus aculeatus</i> (Mueller)	73	5.91
<i>Myrtea spinifera</i> (Montagu)	35	2.83
<i>Kelliella abyssicola</i> (Forbes)	12	0.97
<i>Corbula gibba</i> (Olivi)	79	6.39
<i>Pholadomya loveni</i> Jeffreys	1	0.08
<i>Verticordia granulata</i> Seguenza	19	1.54
<i>Cuspidaria maxima</i> (Mayer)	3	0.24
<i>Cuspidaria rostrata</i> (Spengler)	37	2.99
Scaphopoda		
<i>Dentalium agile</i> Sars	10	0.81
<i>Fissidentalium rectum</i> (Gmelin)	41	3.32
<i>Entalina tetragona</i> (Brocchi)	27	2.18
<i>Cadulus attenuatus</i> Monterosato	48	3.88
Other species	132	12.54
Total specimens	1236	

Tab. 1 - Systematic list of molluscs from Pleistocene marls of the Palione river. "Other species" comprise a lot of about 40 "accompanying" taxa, each accounting for a subordinate relative dominance. A = Abundance; D = Relative abundance.

BRYOZOANS	A	D (%)
<i>Annectocyma tubulosa</i> (Busk)	1	0.88
<i>Entalophoroecia gracilis</i> Harmelin	1	0.88
<i>Entalophoroecia deflexa</i> Couch	2	1.77
<i>Tervia irregularis</i> (Meneghini)	16	14.16
? <i>Tubulipora notomale</i> (Busk)	1	0.88
<i>Exidmonea atlantica</i> (Forbes)	10	8.85
<i>Hornera frondiculata</i> Lamouroux	3	2.65
<i>Hornera lichenoides</i> (Linnaeus)	3	2.65
<i>Amphiblestrum lyrulatum</i> Calvet	1	0.88
<i>Adeonellopsis distoma</i> (Busk)	41	36.28
<i>Characodoma mamillatum</i> (Seguenza)	12	10.62
<i>Diporula verrucosa</i> (Peach)	1	0.88
<i>Tessaradoma boreale</i> (Busk)	1	0.88
<i>Myriapora truncata</i> (Pallas)	1	0.88
Undetermined	19	16.81
Total specimens	113	

Tab. 2 - Systematic list of bryozoans from Pleistocene marls of the Palione river. A = Abundance; D = Relative abundance.

PELAGOS	A	D(%)
<i>Benthosema glaciale</i> (Reinhardt)	14	2.11
<i>Ceratoscopelus maderensis</i> (Lowe)	432	65.16
<i>Diaphus holti</i> Taaning	2	0.30
<i>Diaphus rafinesqui</i> (Cocco)	2	0.30
<i>Diaphus taaningi</i> Norman	24	3.62
<i>Diaphus</i> sp.	5	0.75
<i>Electrona rissoi</i> (Cocco)	15	2.26
<i>Hygophum benoiti</i> (Cocco)	7	1.06
<i>Hygophum hygomi</i> (Lutken)	9	1.36
<i>Hygophum</i> sp. 1	18	2.71
<i>Lampanyctus crocodilus</i> (Risso)	3	0.45
<i>Lobianchia dofleini</i> (Zugmayer)	12	1.81
<i>Myctophum punctatum</i> Rafinesque	53	7.99
<i>Notoscopelus elongatus</i> (Costa)	40	6.03
<i>Parascombrops mutinensis</i> (Bassoli)	27	4.07
total specimens	663	
BENTHONECTON		
<i>Gadicus argenteus</i> Guichenot	241	76.27
<i>Gaidropsarus</i> sp. ind.	2	0.63
<i>Micromesistius poutassou</i> (Risso)	23	7.28
<i>Phycis blennoides</i> (Brunnich)	6	1.90
<i>Coelorinchus coelorhincus</i> (Risso)	6	1.90
<i>Coelorinchus stellaris</i> Nolf & Girone	3	0.95
<i>Hymenocephalus italicus</i> Giglioli	1	0.32
<i>Nezumia sclerorhynchus</i> (Valenciennes)	2	0.63
<i>Trachyrhynchus scabrus</i> (Rafinesque)	2	0.63
<i>Trisopterus capelanus</i> (Linnaeus)	1	0.32
BENTHOS		
<i>Bellottia</i> cf. <i>apoda</i> Giglioli	16	5.06
<i>Echiodon dentatus</i> (Cuvier)	6	1.90
<i>Deltentosteus quadrimaculatus</i> (Valenciennes)	1	0.32
<i>Lesueurigobius friesii</i> (Malm)	3	0.95
Gobiidae ind.	3	0.95
total specimens	316	

Tab. 3 - Systematic list of fish otoliths from Pleistocene marls of the Palione river. A = Abundance; D = Relative abundance.

CORALLINACEAE	
Lithophylloideae	D(%)
<i>Lithophyllum grandiusculum</i> (Mont.) Woelk., Pen. & Cham.	1.75
<i>Lithophyllum nitidum</i> Adey & Adey	3.51
<i>Titanoderma pustulatum</i> (Lamouroux) Naegeli	26.32
<i>Titanoderma pustulatum</i> v. <i>confine</i> (P. & H. Crouan) Cham.	3.51
Mastophoroideae	
<i>Spongites fruticulosus</i> Kutzing	1.75
Melobesioideae	
<i>Lithothamnion corallioides</i> Crouan & Crouan	7.02
<i>Lithothamnion minervae</i> Basso	5.26
<i>Lithothamnion philippi</i> Foslie	3.51
<i>Lithothamnion ramosissimum</i> (Reuss) Piller	14.04
<i>Lithothamnion valens</i> Foslie	5.26
<i>Mesophyllum lichenoides</i> (Ellis) Lemoine	8.77
<i>Phymatolithon calcareum</i> (Pallas) Adey & McKibbin	14.04
<i>Phymatolithon</i> cf. <i>tenue</i> (Rosenige) Duwel & Wegeberg	1.75
SPOROLITACEAE	
<i>Sporolithon ptychoides</i> Heydrich	3.51

Tab. 4 - Systematic list of calcareous algae from the Pleistocene coarse organogenic layer of the Palione river. D = Relative abundance.

1997). Some particularly deep species, such as *Bathyspinula excisa* and *Katadesmia confusa* are extremely poorly represented, while others are absent (e.g. *Ennucula corbuloides*, *Thestylea cuspidata*, etc.). It is also worth noting the occurrence of some species which are more typically distributed on the outer shelf, such as *Pseudamussium septemradiatum*, *Hyalopecten simile*, *Myrtea spinifera*, *Corbula gibba* and *Fissidentalium rectum*.

The bryozoan assemblage is almost exclusively made up by taxa thriving in lower circalittoral-to-bathyal environments. Some of these species are not present on bottoms shallower than 60-80 m, such as *Tervia irregularis* (Harmelin, 1976) and *Characodoma mamillatum* (Rosso, 1999). Other species have been recorded only from waters deeper than about one hundred metres in the Recent Mediterranean. Among them *Adeonellopsis distoma*, the dominant bryozoan species, has been usually found on deep detritic sediments (Harmelin, 1976; Zabala, 1986; Rosso, 1989). Also *Tessaradoma boreale* and *Hornera lichenoides* have a similar bathymetric upper limit (cf. Harmelin, 1976; Rosso & Di Geronimo, 1998).

The benthic and nektobenthic otolith assemblage is characterized by the abundance (80%) of epibathyal species, mainly ranging from 200 to 400 m, such as *Gadicus argenteus*, *Micromesistius poutassou* and *Coelorinchus coelorhincus* (Maurin, 1968; D'Onghia *et al.*, 1998; 2000). Also the extinct *C. stellaris* probably had a similar range (Nolf & Girone, 2000). A group of deeper species, namely *Hymenocephalus italicus*, *Trachyrhynchus scabrus* and *Nezumia sclerorhynchus*, is also present although poorly represented (ca 2%) and only consisting of juveniles, which live at shallower depths than adults. The assemblage also includes a group (5%) of benthic species living on circalittoral bottoms, such as *Deltentosteus quadrimaculatus*, *Lesueurigobius friesii* and *Echiodon dentatus*, as well as an eurytopic group (6%) composed by the benthic species *Bellottia* cf. *apoda* and the nektobenthonic *Trisopterus capelanus*.

Basing on these data, the depositional depth of marls (at level of the sampled layer, at least) can be referred to be 100-200 m, i.e. within the transitional belt between the Circalittoral and the Bathyal Zones. Topographically, this belt is located at the shelf margin at mid latitudes. Bottom hydrodynamism was weak, allowing a considerable amount of pelites to be deposited. The taphonomic traits indicate a certain sedimentary starvation, but assemblages were buried *in situ*, with a moderate rate of within-habitat displacement.

Algae from the coarse organogenic layer show a sharp dominance of melobesioids which could point to a circalittoral environment where these algae appear to be particularly frequent, in spite of some local variations in abundance. Adey (1986) reports them as typically living in shallow circalittoral environments down to 40 m, whereas Braga & Aguirre (2001) record as, in temperate carbonate settings, melobesioids increase in abundance on deep circalittoral bottoms. In particular, most of the examined algae, such as *Phymatolithon calcareum*, *Lithothamnion corallioides*, *L. valens* and *L. minervae*, live in the Coastal Detritic Assemblage, which is well represented in the western Mediterranean between 30 and 90 m (Giaccone *et al.*, 1994; Di Geronimo, 1996; Basso, 1998). It is also worth noting that the studied rodolithes have mainly spheroidal and subordately ellipsoidal shapes with densely branched growths. This morphology is typical of algal thalli growing under high energy conditions (Bosellini & Ginsburg, 1971; Bosence, 1991; Basso, 1996). Also columnar growth forms and abraded tips are caused by rolling movements during nodule growth (Bosence & Pedley, 1982; Freiwald *et al.*, 1991). A strong environmental energy is also indicated by pralines, which in the studied sample are formed by *Lithothamnion ramosissimum* and *L. minervae*. Also *Titanoderma pustulatum* is adapted to live in similar conditions (Chamberlain, 1991).

The studied algal assemblage thus consists of species which are usually found associated in the Recent Mediterranean, forming typical circalittoral communities, and this is also supported by the growth form and shape of thalli. We can then assume that these fossil algae originally lived in the same palaeocommunity, on current-swept bottoms, 40-80 m deep, and forming a praline facies of the Coastal Detritic Assemblage of Pérès & Picard (1964).

However, the stratigraphic position of the algal bed, interbedded within marly deposits, which point to a markedly different bathymetric and depositional setting, allows the algal assemblage to be considered as allochthonous. The compositional and textural homogeneity of the algal bed, and its sharp basal contact with marls, suggest an event of gravitative mass deposition from adjacent shallower bottom. The organogenic material was transported at greater depths, but probably without strong alteration of the original taxonomic composition.

REFERENCES

- ADEY, W. H., 1986, Coralline algae as indicators of sea-level. In Von de Plassche, O. (ed.), Sea Level Research. A Manual for the Collection and Evolution of Data. Free Univ. Amsterdam Geo Books: 229-280, Norwich.
- BASSO, D., 1996, Adaptive strategies and convergent morphologies in some mediterranean coralline algae: Boll. Soc. Paleont. Ital., Special Vol. 3: 1-8.
- , 1998, Deep rhodolith in the Pontian Islands, Italy: a model for the paleoecology of a temperate sea: Palaeogeogr., Palaeoclimatol., Palaeoecol., 137: 173-187.
- BOSELLINI, A. & GINSBURG, R.N., 1971, Form and internal structure of recent algal nodules (Rhodolites) from Bermuda: Journ. Geol., 79: 669-682.
- BOSENCE, D.W.J., 1991, Coralline Algae: Mineralization, Taxonomy and Palaeoecology. In Riding, R. (ed.), Calcareous Algae and Stromatolites. Springer-Verlag: 98-113, Berlin.
- & PEDLEY, M., 1982, Sedimentology and palaeoecology of a Miocene coralline algal biostrome from the Maltese Islands: Palaeogeogr., Palaeoclimatol., Palaeoecol., 38: 9-43.
- BRAGA, J.C. & AGUIRRE, J., 2001, Coralline algal assemblages in upper Neogene reef and temperate carbonates in Southern Spain: Palaeogeogr., Palaeoclimatol., Palaeoecol., 175: 27-41.
- CHAMBERLAIN, Y.M., 1991, Historical and taxonomic studies in the genus *Titanoderma* (Rhodophyta, Corallinales) in the British Isles: Bull. Br. Mus. Nat. Hist. (Bot.), 21 (1): 1-80.
- DI GERONIMO, I., 1979, Il Pleistocene in facies batiale di Valle Palione (Grammichele, Catania): Boll. Malacol., 15 (5-6): 85-156.
- & LA PERNA, R., 1997, Pleistocene bathyal molluscan assemblages from Southern Italy: Riv. It. Paleont. Strat., 103 (3): 389-426.
- & SANFILIPPO, R., 1992, Policheti serpuloidi pleistocenici di Catallarga (Grammichele, Catania): Nat. siciliano, S. IV, 16 (3-4): 159-173.
- , D'ATRI, A., LA PERNA, R., ROSSO, A., SANFILIPPO, R. & VIOLANTI, D., 1998, The Pleistocene bathyal section of Archi (Southern Italy): Boll. Soc. Paleont. Ital., 36 (1-2): 189-212.
- , LI GIOI, R. & SCIACCA, V., 1982, La fauna pleistocenica dell'Abbeveratoio Conzo (Grammichele, Catania): Geol. Rom., 21: 577-601.
- DI GERONIMO, R., 1996, Morfotipi di Melobesie nel Circalitorale di Lampedusa (Isole Pelagie): Atti VII Congr. Naz. S.It.E.: 345-348, Napoli 11-14 settembre 1996.
- D'ONGHIA, G., BASANISI, M. & TURSI, A., 2000, Population structure, age and growth of macrurid fish from the upper slope of the Eastern-Central Mediterranean: Journ. Fish. Biol., 56: 1217-1238.
- , TURSI, A., MAIORANO, P., MATARRESE, A. & PANZA, M., 1998, Demersal fish assemblages from the bathyal grounds of the Ionian Sea (middle-eastern Mediterranean): Ital. J. Zool., 65: 287-292.
- FREIWALD, A., HENDRICH, R., SCHAFER, P. & WILKOMM, H., 1991, The Significance of High-Boreal to Subarctic Maerl Deposits in Northern Norway to Reconstruct Holocene Climatic Changes and Sea Level Oscillations: Facies, 25: 315 - 340.
- GIACCONE, G., ALONGI, G., PIZZUTO, F. & COSSU, A., 1994, La vegetazione marina bentonica sciafila del Mediterraneo: III. Infralitorale e Circalitorale. Proposte di aggiornamento: Boll. Acc. Gioenia Sci. Nat. Catania, 27, 346: 201-227.
- HARMELIN, J.-G., 1976, Le sous-ordre des Tubuliporina (Bryozoaires Cyclostomes) en Méditerranée. Ecologie et systématique: Mém. Inst. Oceanogr., 10: 1-326.
- KIDWELL, S. M. & HOLLAND, S., 1991, Field description of coarse bioclastic fabrics: Palaios, 1: 228-238.

- LA PERNA, R., 1997, *Pteromeris jozinae* Van Aartsen, 1985 (Bivalvia, Carditidae) from the Lower Pleistocene of Sicily: Boll. Malacol., 32:1-6.
- , in press, The Quaternary deep-sea protobranch fauna from the Mediterranean: composition, depth-related distribution and changes: Boll. Malacol.
- MALATESTA, A., 1960, Malacofauna Pleistocenica di Grammichele (Sicilia): Mem. Descr. Carta Geol. Ital., 12, 392 pp.
- MAURIN, C., 1968, Ecologie echtyologique des fonds chalutables atlantiques (de la Baie ibero-marocaine à la Mauritanie) et de la Méditerranée occidentale: Rev. Trav. Inst. Pêches marit., 32 (1): 147 pp.
- NOLF, D. & GIRONI, A., 2000, *Coelrinchus stellaris* n. sp. (poisson macrouridé) de l'Oligocene terminal d'Aquitaine et son intérêt paléobiogéographique: Bull. Inst. R. Sci. Nat. Belgique, Sci. Terre, 70: 179-184.
- PEDLEY, H.M., GRASSO, M., MANISCALCO, R., BEHNCKE, B., DI STEFANO, A., GIUFFRIDA, S. & STURIALE, G., 2001, The sedimentology and palaeoenvironment of Quaternary temperate carbonates and their distribution around the northern Hyblean Mountains (SE Sicily): Boll. Soc. Geol. It., 121: 233-255.
- PÉRÈS, J.M. & PICARD, J., 1964, Nouveau manuel de Bionomie Benthique de la Mer Méditerranée: Recueil des Travaux de la Station Marine d'Endoume, 47 (31): 5-137.
- ROSSO, A., 1987, Nota preliminare sulla fauna a briozoi di Catallarga (Grammichele, Catania): Boll. Acc. Gioenia Sci. Nat., Catania, 20, 330: 301-316.
- , 1989, Contributo alla conoscenza di alcuni popolamenti, tanatocenosi e tafocenosi a briozoi di alcuni fondi mobili circolatori: Tesi di Dottorato inedita, Università di Messina.
- , 1999, Recent and fossil species of *Characodoma* Mapleston, 1900 (Bryozoa) from the Mediterranean with description of two new species: Journ. Nat. Hist., 33: 415-437.
- & DI GERONIMO, I., 1998, Deep-sea Pleistocene Bryozoa of Southern Italy: Géobios, 30 (3): 303-317.
- SCHMINCKE, H.-U., BEHNCKE, B., GRASSO, M. & RAFFI, S., 1997, Evolution of the northwestern Iblean Mountains, Sicily: uplift, Pliocene/Pleistocene sea-level changes, palaeoenvironment, and volcanism: Geol. Rundsch, 86: 637-669.
- ZABALA, M., 1986, Fauna dels bryozous dels Països Catalans: Institut d'Estudis Catalans, sec. Ciències, 84: 1-833.

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