

## Pleistocene deposits of Salento leccese (Southern Italy): Problematic relationships

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**KEY WORDS** — *Marine Pleistocene deposits, Salento leccese, Apulia, Italy.*

**ABSTRACT** — *New data allow to better define the stratigraphic relationships of Pleistocene deposits of the Salento leccese. Five lithostratigraphic units have been recognized: the lower-Pleistocene «Calcareniti di Gravina» is overlaid by the post-Sicilian «Sabbie a Brachiopodi». The Middle Pleistocene «Argilliti di S. Pietro» in the northern side of the area, and the «Argilliti di Mondo Nuovo» to the South are transgressive on the «Sabbie a Brachiopodi». A younger deposit, the pre-Tyrrhenian «Panchina superiore del Salento», ends the local stratigraphic sequence. This is a thin sedimentary body located between 80 and 45 m of altitude, forming a wide terrace bordered to the east by the Aradeo-Cutrofiano «cliff».*

**RIASSUNTO** — [I depositi pleistocenici del Salento leccese (Italia meridionale)] — *Nuovi dati raccolti nel Salento leccese permettono di definire le relazioni tra differenti depositi pleistocenici affioranti in quest'area. Sono state riconosciute cinque unità litostatigrafiche: sulle «Calcareniti di Gravina» del Pleistocene inferiore trasgredisce l'unità delle «Sabbie a Brachiopodi» di età post-Siciliana. Le «Argilliti di S. Pietro» nel settore settentrionale e le «Argilliti di Mondo Nuovo» in quello meridionale sembrano trasgredire sulle «Sabbie a Brachiopodi». La pre-tirreniana «Panchina Superiore del Salento» chiude la locale sequenza stratigrafica; questo sottile corpo sedimentario marino dà luogo ad un ampio terrazzo situato tra 80 e 45 m di quota e delimitato verso Est dalla «falesia» di Cutrofiano-Aradeo.*

### INTRODUCTION

In the southern Salento (Fig. 1), the Pleistocene «Calcareniti di Gravina» are covered by greenish clayey-sands characterized by the presence of large brachiopods (*Terebratula scillae* Seguenza). D'Alessandro & Palmentola (1978) instituted for this facies a new formation named «Sabbie a Brachiopodi» and attributed it to a Pleistocene cold interval. Later, Fiore & Palmentola (1987) and Palmentola (1987) dubitatively referred it to the Sicilian. However, other Authors (Bossio *et alii*, 1987a, b) did not accept this formation and considered it as a part of the Sicilian pelitic succession, known as the «Formazione di Gallipoli», previously related by Ricchetti (1972) to the «Formazione delle Argille Subappennine». New data, collected from quarries and building excavations, allow to clarify this problem; however, due to the presence of at least two younger units overlying the «Sabbie a Brachiopodi», a more complex situation is pointed out. At the moment the exposures are inadequate to resolve completely the stratigraphic significance of these latter units and their relationships with the other Pleistocene sediments occurring in the Salento area.

### STRATIGRAPHICAL AND GEOMORPHOLOGICAL DATA

The «Sabbie a Brachiopodi» are composed of greenish muddy sands upward grading into mud. *Terebratula scillae*, *Neopycnodonte cochlear* and *Pseudamussium septemradiatum* characterize the macrofauna assemblages occurring in the coarse sediments. The «Sabbie a Brachiopodi» outcrop mainly in three areas, divided by low ridges modelled on Mesozoic limestones: a) the area around the cities of Lecce, Novoli and Lequile, b) the surroundings of Copertino-Leverano and, c) the area located among the towns of Aradeo, Neviano, Galatone, Nardò and S. Maria al Bagno. Moreover, D'Alessandro & Palmentola (1978) studied the southernmost known outcrop of this unit, near the village of Ugento.

a) In the first area, the «Sabbie a Brachiopodi» are transgressive on the Lower Pleistocene «Calcareniti di Gravina», overlapping a locally irregular erosive surface (Fig. 2). The contact can be observed in several quarries opened in a gentle and NW-SE trending, narrow depression at about 35 m of altitude. The erosional scars (Fig. 4 B,C), locally deep

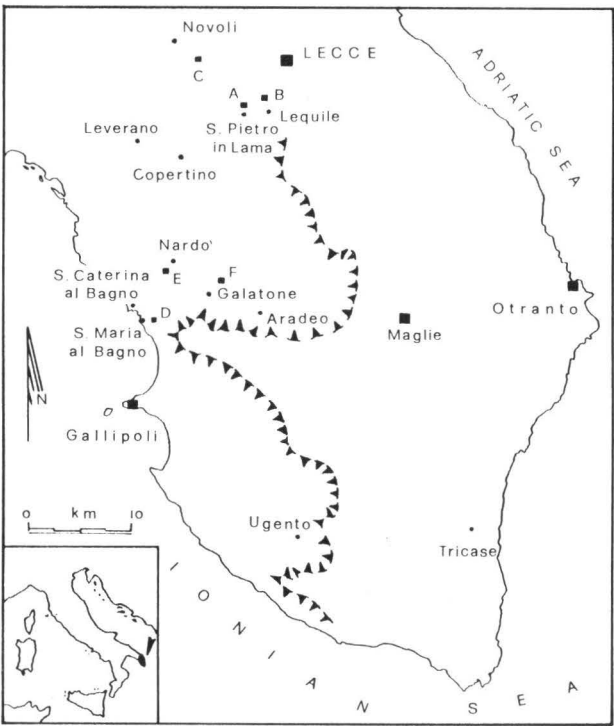


Fig. 1 - Geographic position of the stratigraphic sections described in the text, and of the Aradeo-Cutrofiano cliff. (A) San Pietro in Lama, (B), Lequile, (C) Novoli, (D) Santa Maria al Bagno, (E) Nardò, (F) Galatone.

up to 8 m, are filled by yellow-greenish silty-sand of the overlying «Sabbie a Brachiopodi», including dispersed, commonly unworn, both articulated and unmatched shells. A transgressive lag, up to 40-50 cm thick overlies the erosional surface where this flattens (Fig. 4A); the dominant fossils are repre-

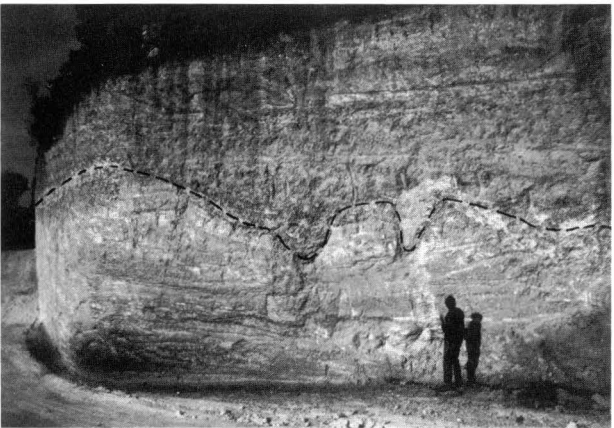


Fig. 2 - Irregular surfaces marking the transgression of «Sabbie a Brachiopodi» on the «Calcareniti di Gravina» in the surroundings of Lequile.

sented by randomly oriented casts of bivalve shells (*Acanthocardia*, *Glycymeris*, *Thracia*, subordinately pectinids, and ostreids), rhodolits, and, locally, *Ditrupa* tubes. The hard parts of the shallow infaunal or epifaunal organisms are strongly incrustated and bored. Clusters of the *B. cochlear* and *T. scillae* and dispersed pectinids characteristically occur into the overlying bioclastic silty sand. Near S. Pietro in Lama and Santa Maria al Bagno, blue clayey-silts passing upward to bioclastic silty-sands cover the «Sabbie a Brachiopodi» (Fig. 3; Fig. 4 A, D). The lower contact is sharp and indicated by dark sands including an horizontally developed *Thalassinoides* system that is missing within the underlying sediments. This interval is about 10 m thick and it will be called from now on «Argilliti di S. Pietro».

b) In the surroundings of Copertino-Leverano, D'Alessandro & Palmentola (1978) report the «Sabbie a Brachiopodi» transgressive both on Mesozoic limestones («Dolomie di Galatina»), on Miocenic calcarenites («Pietra Leccese») and on the Pleistocenic «Calcareniti di Gravina». In the latter case, a thin layer of brown paleosoil, including pebbles of Pleistocene calcarenite, marks the transgressive surface.

c) Between Nardò and Galatone, three Pleistocene sedimentary bodies (Fig. 4 E, F) are recognizable beneath a wide plain westward trending from the base of Aradeo-Cutrofiano cliff (about 80 m of altitude), to the coastal area of S. Maria al Bagno - S. Caterina (about 45 m a.s.l.). The oldest unit is represented by the «Calcareniti di Gravina», covered by the «Sabbie a Brachiopodi» above which are lying greenish-grey clays, up to 15 m thick. A decimetric soil layer is interbedded between these units near Galatone (Fiore & Palmentola, 1987)

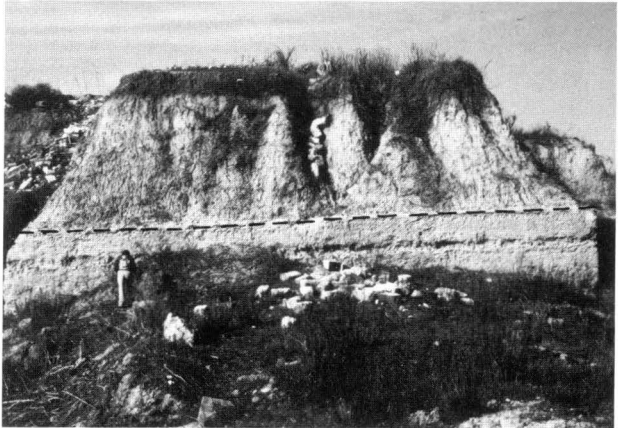


Fig. 3 - The sharp contact between the «Argilliti di S. Pietro» (above) and the «Sabbie a Brachiopodi» (below) recognizable in a quarry near S. Pietro in Lama.

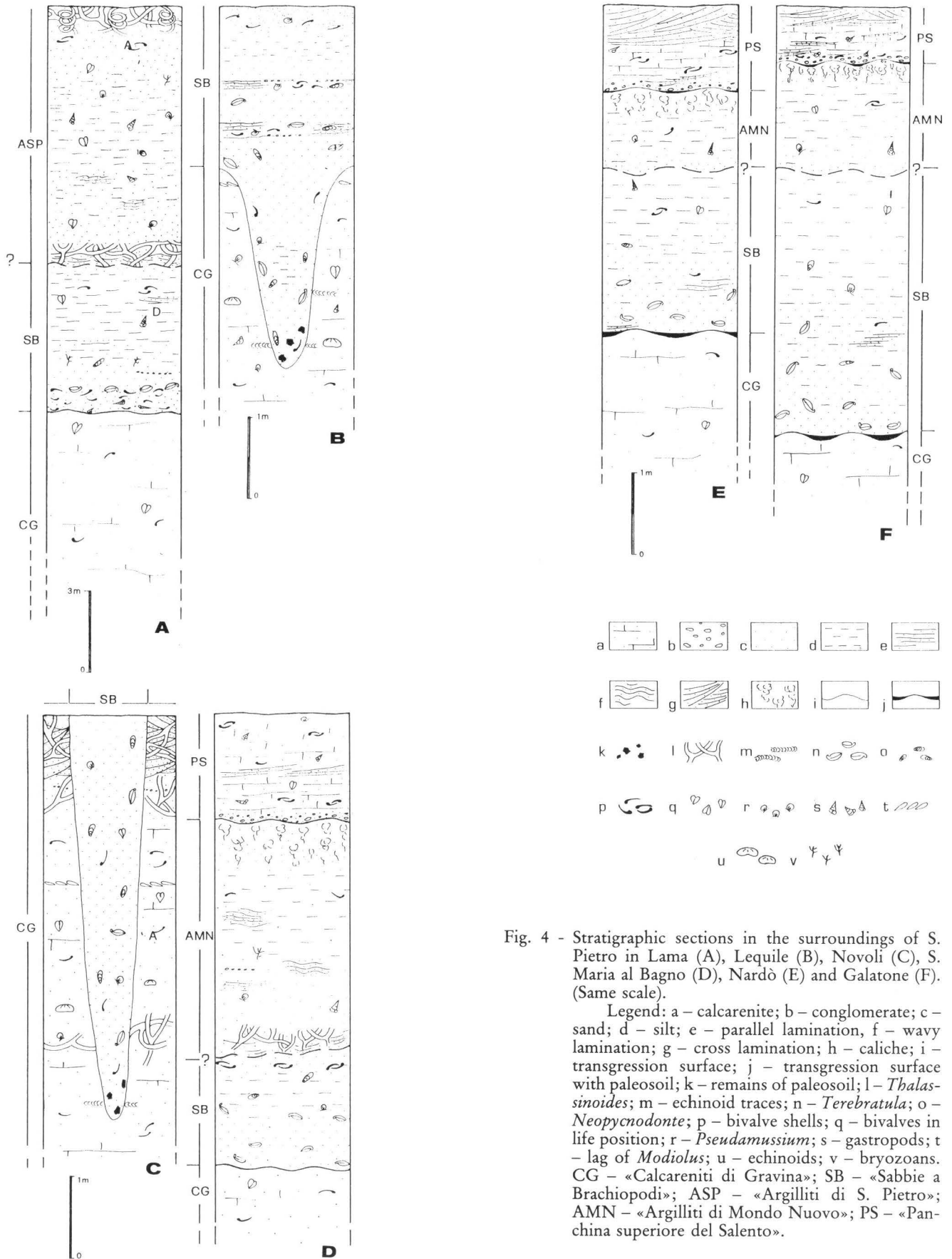


Fig. 4 - Stratigraphic sections in the surroundings of S. Pietro in Lama (A), Lequile (B), Novoli (C), S. Maria al Bagno (D), Nardò (E) and Galatone (F). (Same scale).

Legend: a - calcarenite; b - conglomerate; c - sand; d - silt; e - parallel lamination; f - wavy lamination; g - cross lamination; h - caliche; i - transgression surface; j - transgression surface with paleosol; k - remains of paleosol; l - *Thalassinoides*; m - echinoid traces; n - *Terebratula*; o - *Neopycnodonte*; p - bivalve shells; q - bivalves in life position; r - *Pseudamussium*; s - gastropods; t - lag of *Modiolus*; u - echinoids; v - bryozoans. CG - «Calcareni di Gravina»; SB - «Sabbie a Brachiopodi»; ASP - «Argilliti di S. Pietro»; AMN - «Argilliti di Mondo Nuovo»; PS - «Panchina superiore del Salento».

(Fig. 5). The stratigraphic sequence is locally covered by biocalcarenitic, about 2 m thick, flat beds here named «Panchina superiore del Salento»; elsewhere a decimetric layer of small well-rounded pebbles occurs at its base.

Near S. Maria al Bagno (Mondo Nuovo village) the «Sabbie a Brachiopodi» are covered by two younger deposits. The lower one, 2 m thick, is represented by beach grey sands rapidly shading upward into deeper facies of clay-sands, comparable both to the greenish clays cropping out in the Galatone-Nardò area and to the «Argilliti di S. Pietro». As the correlation between these deposits and the «Argilliti di S. Pietro» cannot be proved at the present, we temporarily refer to them as «Argilliti di Mondo Nuovo». The previously mentioned «Panchina superiore del Salento» ends the local stratigraphic succession (Fig. 4D).

The calcareous nannoplankton collected in the «Sabbie a Brachiopodi» suggests a post-Sicilian age. The presence of abundant *Gephyrocapsa* sp. 3 (*sensu* Rio, 1982) in the Argilliti di S. Pietro would indicate a Middle – Pleistocene age for this deposit (Rio, personal communication). At present, reliable data on the age of «Panchina superiore» are not available.

## PALAE ECOLOGICAL NOTES

### SABBIE A BRACHIOPODI

The macrofossil assemblages occurring in the «Sabbie a Brachiopodi», were considered representative of a fossil facies of the Atlantic *Venus ova-*

*ta* sub-community (belonging to *Amphiura* Communities) and were, dubitatively, compared to the Mediterranean «Offshore Detritic» (DL) biocoenosis (D'Alessandro & Palmentola, 1978). Further analyses on palaeocommunities characterized by significant populations of *Terebratula scillae*, coupled with *Neopycnodonte cochlear* and *Pseudamussium septemradiatum*, confirm the suggested parallelism with the Atlantic sub-community. However, from a biocoenotic point of view, they can be better framed into a fossil biocoenosis mirrored by the Mediterranean «Muddy Detritic» (DE *sensu* Pérès & Picard, 1964) biocoenosis (Fig. 6). The differences of faunal composition in the *Terebratula scillae*-dominated assemblages recurring in the «Sabbie a Brachiopodi» would reflect minor changes in the controlling factors, inadequate to produce a biocoenotic replacement. Therefore, as a whole, the assemblages can be considered as Pleistocene facies of the DE biocoenosis, and we will refer to them as «Muddy Detritic Association».

The facies of the Muddy Detritic Association suggest palaeodepths of about 80-100 m, southward increasing to about 150 m; likewise the energy level decreases. Indeed, depth-related organisms (e.g. *Propeamussium lucidum*, *P. fenestratum*, *P. hoskynsi*, *Funiculina quadrangularis*, micromorph brachiopods) commonly occur in the Ugento facies whereas elements characteristic of modern DC/DE (e.g. *Nuculana commutata*, *Nucula nucleus*, *Palliolum simile*, *Parvicardium minimum*) as well as the current-related *Spatangus purpureus* are signifi-

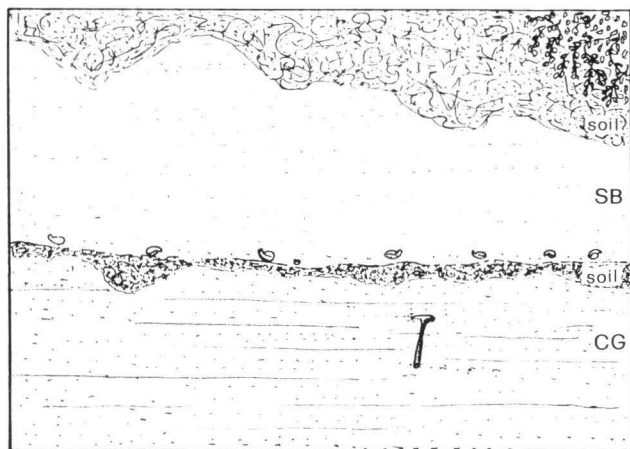


Fig. 5 - The transgressive contact of Sabbie a Brachiopodi (SB) and the Calcarene di Gravina (CG) is marked by a thin layer of paleosol in the Galatone area.

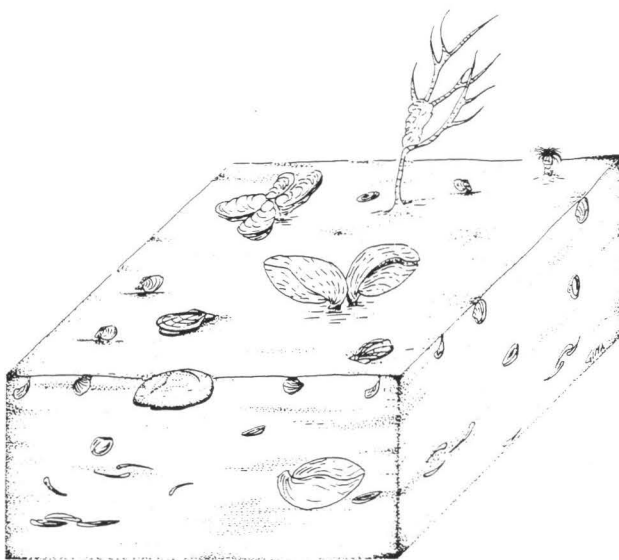


Fig. 6 - Sketch of an outer shelf environment inhabited by Muddy Detritic Association.

cantly more abundants in the northern facies (S. Pietro in Lama). *Spatangus* is in turn replaced both upwards and in the southern outcrops by *Schizaster canaliferus* and *Brissopsis lyrifera*. Dominance of sessile epifaunal suspension-feeders indicates low net rate of deposition and soft-firm bottom, in agreement with the glauconitic content.

#### ARGILLITI DI S. PIETRO

On the basis of taphonomic and ecological data, the fossil assemblages were judged evidences of infaunal-dominated palaeocommunities (cf. unit 3 of Lo Gullo, 1990). They can be considered as fossil counterparts of recent facies of Coastal Terrigenous Mud (VTC, *sensu* Pérès & Picard, 1964) and Muddy Sand (SE, *sensu* Gamulin-Brida, 1974) biocoenoses (Fig. 7). Consequently, the palaeocommunities have been grouped in bionomic units named, by their modern equivalents, Coastal Terrigenous Mud and Muddy Sand Associations.

The Coastal Terrigenous Mud Association occurs in the clayey-silts (lower 6 m) of the San Pietro sequence, and it is recorded by two facies: (1) *Turritella* facies, at the base, and the (2) *Nucula-Abra* facies above. (1) The modern equivalent of the first facies flourishes in soupy mud settings with high sedimentation rate and low water energy. The *Turritella* facies is well represented in the upper circalittoral of the northern Adriatic (Gamulin-Brida, 1974). (2) Consistent populations of VTC-

characteristic taxa (*Nucula sulcata*, *Abra nitida*, *Thyasira flexuosa*) associated with organisms related to mixed or more sandy sediments (*Nucula nucleus*, *Abra alba*) and a few epifaunal elements suggest less soupy seafloor, related to a lower sedimentation rate. A peculiar feature is the occurrence of numerous pieces of millimetric rusty galleries. They could be fragments of hardened muds that, surrounding the siphons of semeliids, were oxidized during the vital processes of the animals. Redox boundary at the water/sediment interface is in tune with absence of vagile deposit feeders. A further reduction of energy level at the bottom can be inferred taking into account the grain size of sediments, that are finer than facies 1 and not sorted.

The modern VTC shows a relative wide bathymetric range, commonly occurring from 24 to 95 m, although recorded up to 8 m and down to 110-120 m (in Bernasconi & Robba, 1993). The absence of the deepest-living characteristic species among the VTC and the increases abundance of shells belonging to species related to shallow biocoenoses (e.g. *Abra alba*, *Bittium reticulatum*) in the second facies suggest an allocation of the biotope at a depth around 30 m, possibly shallowing upward.

The transition of Muddy Sand Association occurs gradually, accompanied by sediment coarsening to fine-sandy-silt and silty-sand. The biocoenotic attribution of the fossil community is based on the high abundance of *Abra alba* and *Mya truncata* that, together with the mud-related *Abra nitida*, represent the dominant elements. The fossil facies is better mirrored by the atlantic equivalent of the Mediterranean SE biocoenosis, i.e. «*Syndosmia alba* community» that is reported from 8-10 m to about 20 m in boreal seas, somewhat less deeper than in the Mediterranean Sea (Thorson, 1957). Such a shallow allocation is supported also by several boxworks of *Thalassinoides*, dominated by vertical elements.

#### CONCLUSIVE REMARKS

Old and new data about the «Sabbie a Brachiopodi» could be summarized as follows:

1 – The formation is transgressive over older units in all the study areas, and the contact represents a classic coastal onlap. The base of unit is represented by a fossiliferous lag lying on a remarkable erosional surface, modelled on Mesozoic limestones, on Miocenic calcarenites or/and on the «Calcareniti di Gravina» (Fig. 8). In this last case the transgression surface is somewhere characterized by

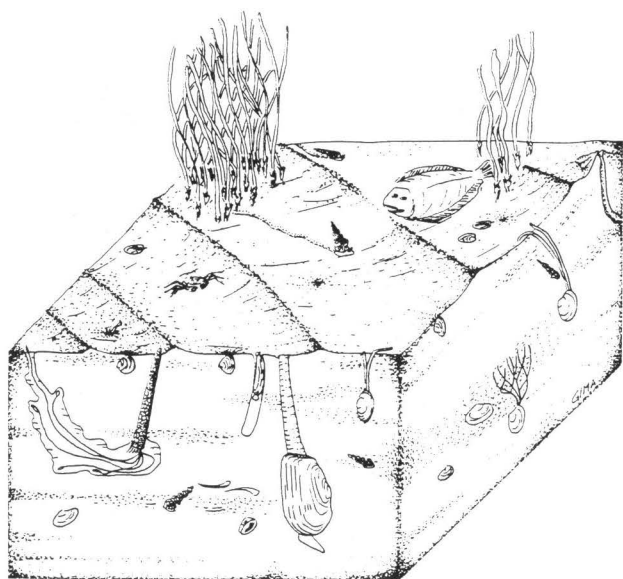


Fig. 7 - Sketch of a middle-inner shelf environment inhabited by Muddy Sand Association.

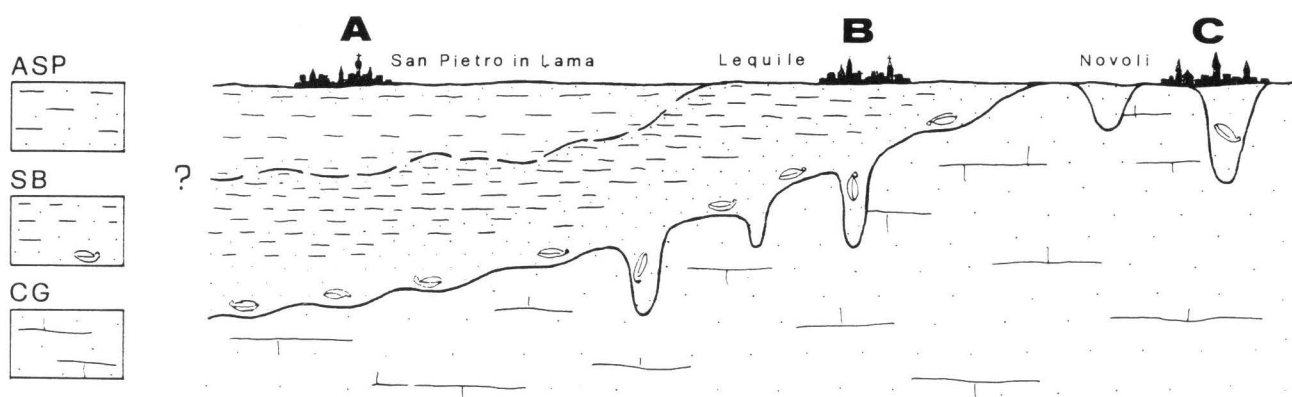


Fig. 8 - Stratigraphic relationships among the Pleistocene sediments in the area between Novoli and S. Pietro in Lama. CG - «Calcareniti di Gravina» (Lower Pleistocene); SB - «Sabbie a Brachiopodi» (post-Sicilian); ASP - «Argilliti di S. Pietro» (Middle Pleistocene).

erosional forms similar to the potholes and syphons presently modelled on shore platforms cutted in calcarenitic deposits; their genesis appears to be related to cavitation processes (Mazzanti & Parea, 1977).

2 - The «Sabbie a Brachiopodi» show some facies variability in relation to the basin morphology and to the different clastic supply from inland. However, a layer of glauconitic fine sand including records of outer shelf communities (Muddy Detritic Association), regularly occurs at the base. Nannoplankton content and stratigraphic position would suggest a post-Sicilian age.

3 - In the surroundings of S. Pietro in Lama the unit is upward cut and covered by the Middle Pleistocene clayey-silt body of the «Argilliti di S. Pietro». The macrofauna content (Coastal Ter-

igenous Mud and Muddy Sand Associations) indicate middle-inner shelf environment.

4 - The following transgressive episode brought to the deposition of the youngest unit (the «Panchina Superiore del Salento», Fig. 9) and to the moulding of the Aradeo-Cutrofiano «cliff». It covers the post-Sicilian «Sabbie a Brachiopodi» and it is older than Tyrrhenian marine deposits with remnants of *Strombus bubonius* located at lower altitude along the western coast of the Apulia region.

In conclusion, the erosional forms at the contact «Sabbie a Brachiopodi»/«Calcareniti di Gravina» support the transgressive relationship between the two units previously recognized by D'Alessandro & Palmentola (1978).

Bathymetric information from the fossil assemblages occurring in the «Sabbie a Brachiopodi»

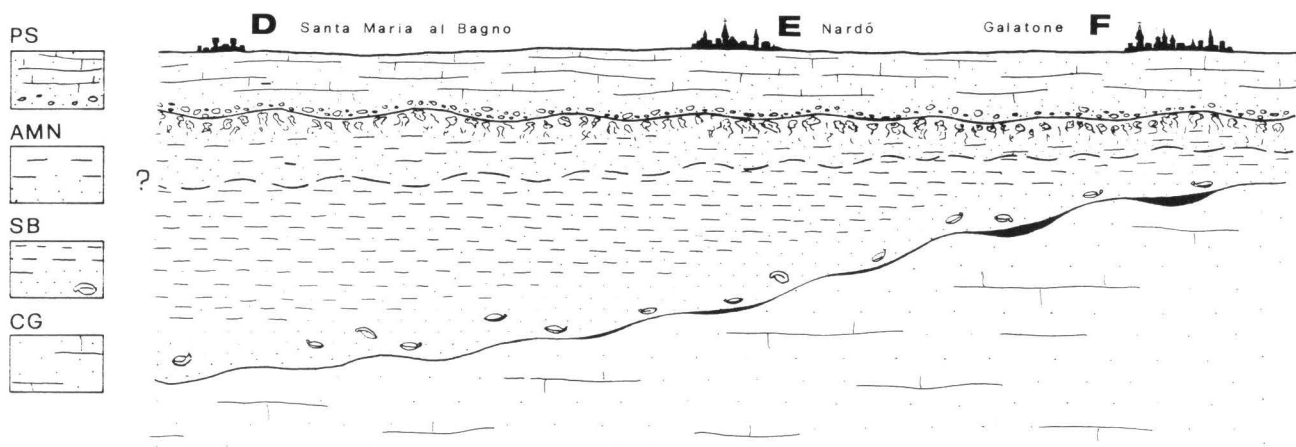


Fig. 9 - Stratigraphic relationships among the Pleistocene sediments in the Nardò, Galatone and Santa Maria al Bagno area. CG - «Calcareniti di Gravina» (Lower Pleistocene); SB - «Sabbie a Brachiopodi» (post-Sicilian); AMN - «Argilliti di Mondo Nuovo» (Middle Pleistocene); PS - «Panchina superiore del Salento» (pre-Tyrrhenian).

di» let us to infer that the Penisola Salentina was probably almost completely submerged at the end of the Lower Pleistocene. Taking into account also the altimetric position of the unit, an uplift of about 150 m during the Middle-Upper Pleistocene must be assume. This result well matches with the mean rate of regional uplift calculated on the base of present altitude of Tyrrhenian shoreline (Cosentino *et al.*, 1988); in both cases, this uplift rate reaches values of about 0.22 m/ka.

However, this inference could be limited to the western side of the Penisola Salentina; in fact, large areas of its eastern side do not show any record of Pleistocene marine modelling.

The area needs further research in order to specify the stratigraphic relationships between the different clayey-silt units of the «Argilliti di S. Pietro» and the «Argilliti di Mondo Nuovo», and to define the depositional setting of the «Panchina superiore del Salento».

## REFERENCES

- BERNASCONI, M.P. & ROBBA, E., 1993, Molluscan palaeology and sedimentological features: an integrated approach from the Miocene Medusa section, northern Italy: *Palaeogeography, Palaeoclimatology, Palaeoecology*, 100: 267-290.
- BOSSIO, A., GUELF, F., MAZZEI, R., MONTEFORTI, B. & SALVATORINI, G., 1987, Studi sul Neogene e Quaternario della Penisola Salentina. VI – Precisazioni sull'età dei sedimenti pleistocenici di due cave del leccese (S. Pietro in Lama e Cutrofiano): *Qual. Ric. Centro Studi Ing.*, Lecce, 11: 147-154.
- , MAZZEI, R., MONTEFORTI, B. & SALVATORINI, G., 1987, Evoluzione paleogeografica dell'area di Leuca nel contesto della dinamica mediterranea: *Quad. Ric. Centro Studi Ing.*, Lecce, 11: 31-54.
- BROCCA, P., 1990, Evoluzione delle paleocomunità in rapporto agli ambienti di sedimentazione in una successione pleistocenica nei dintorni di Lecce: Tesi di laurea inedita, Dipartimento di Geologia e Geofisica, Bari.
- COSENTINO, D. & GLIOZZI, E., 1988, Considerazioni sulle velocità di sollevamento di depositi eutirreniani dell'Italia meridionale e della Sicilia: *Mem. Soc. Geol. It.*, 4: 653-665.
- D'ALESSANDRO, A. & PALMENTOLA, G., 1978, Sabbie a Brachiopodi, una nuova unità del Salento leccese (aspetti litostratigrafici e paleoambientali): *Riv. It. Paleont. Strat.*, 84(4): 1083-1120.
- FIGO, S. & PALMENTOLA, G., 1987, Le Sabbie a Brachiopodi del Salento leccese: dati e problemi: *Quad. Ric. Centro Studi*, Lecce, 11: 243-258.
- FÜRSICH, F.T. & OSCHMANN, W., 1993, Shell beds as tools in basin analysis: the Jurassic of Kachchh, western India: *Journal of Geological Society*, London, 150: 169-185.
- GAMULIN-BRIDA, H., 1974, Biocoenoses benthiques de la Mer Adriatique: *Acta Adriatica*, 15: 1-103.
- LO GULLO, A., 1990, Evoluzione paleoecologica di alcune comunità pleistoceniche nell'area di S. Pietro in Lama (Lecce): Tesi di laurea inedita, Dipartimento di Geologia e Geofisica, Bari.
- MAZZANTI, R. & PAREA, G.C., 1977, Erosione della «Panchina» sui litorali di Livorno e Rosignano. *Boll. Soc. Geol. It.*, 94: 457-489.
- PALMENTOLA, G., 1987, Lineamenti geologici e morfologici del Salento leccese: *Quad. Ric. Centro Studi Ing.*, Lecce, 11: 7-30.
- PÉRÈS, J.M. & PICARD, J., 1964, Nouveau Manuel de Bionomie Benthique de la Mer Méditerranée: *Recueil Travaux Station Marine d'Endoume*, 31(47): 1-137.
- RICCHETTI, G., 1972, Osservazioni geologiche e morfologiche preliminari sui depositi quaternari affioranti nel F° «Brindisi»: *Boll. Soc. Natur.*, 81: 543-566.
- RIO, D., 1982, The fossil distribution of Coccolithophore genus *Gephyrocapsa* Kamptner and related plio-pleistocene chronostratigraphic problems. *In*: Prell, W.L., Gardner, J.V. *et al.* 1982, *Init. rep. DSDP*, 68: 325-343, Washington.
- THORSON, J., 1957, Bottom Communities: *In*: Hedgpeth (ed.), *Ecology. The Geological Society of America, Memoir* 67, 1: 461-534.

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