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NEW VS. OLD INTERPRETATIONS OF THE CAPORALINO-SANT'ANGELO «ALPINE» UNIT (NE CORSICA)

Abstract - This paper focuses on the «Alpine» Caporalino-Sant'Angelo Unit outcropping between Corte and Ponte Leccia (NE Corsica). The achieved results show that the Caporalino-Sant'Angelo Unit is a Middle Eocene clastic prism, accumulated in a basin located between the European continental margin and the deforming Corsican accretionary wedge. Consequently, the previous hypothesis that considers the Caporalino-Sant'Angelo Unit as a Middle Jurassic to Eocene stratigraphic succession sedimented in a distensive basin on the European continental margin is rejected, and the early hypothesis that considers the Caporalino-Sant'Angelo Unit as a clastic Eocene unit is partly recover.

Key words - Clastic deposits, Stratigraphy, Eocene, Alpine Units, Corsica, France.

Riassunto - *Confronto fra vecchie e nuove interpretazioni sull'Unità «Alpina» di Caporalino-Sant'Angelo (NE Corsica).* In queste note vengono esposti i risultati lito- e biostratigrafici acquisiti dell'Unità di Caporalino-Sant'Angelo, affiorante tra Corte e Ponte Leccia (Corsica nord-orientale), la cui conoscenza è considerata da tutti gli Autori essenziale per la comprensione dell'evoluzione tettono-sedimentaria di questo settore della Corsica, dove affiora la sovrapposizione tra la Corsica «Ercinica» e quella «Alpina». Sulla base delle caratteristiche litostratigrafiche delle unità cartografate e datate all'Eocene medio, l'Unità Caporalino-Sant'Angelo si è depositata in un bacino posto tra il margine continentale Europeo ed il prisma di accrescione Corso in cui confluiscono sia apporti silicoclastici che carbonatici di cui il Calcare di Caporalino rappresenta l'esempio più vistoso. Pertanto il precedente modello, che considerava l'Unità di Caporalino-Sant'Angelo come una successione stratigrafica depositatasi in un bacino distensivo sul margine continentale europeo, in un arco di tempo compreso tra il Giurassico inferiore e l'Eocene, è da rigettare, mentre viene in parte recuperato il modello che considera l'Unità Caporalino-Sant'Angelo come un deposito clastico di età Eocenica.

Parole chiave - Depositi clastici, Stratigrafia, Eocene, Unità Alpine, Corsica, Francia.

INTRODUCTION

Since the 1970s, several works have dealt with the geodynamic evolution of the Corsica region, which is classically subdivided in two main structural domains (see references in Molli, 2008). The (western) autochthonous «Hercynian» Corsica is made of basement rocks intruded by granites, and remnants of a Permian-Eocene sedimentary cover (Durand-Delga, 1984). The

(eastern) «Alpine» Corsica comprises polydeformed units sedimented on oceanic and/or continental crusts, the main are the *Schistes Lustré*, the Balagne Nappe, the Nebbio and the Macinaggio units (Nardi *et al.* 1978; Dallan & Puccinelli, 1995). The «Alpine» Corsica also includes part of the autochthonous and the parautochthonous units of the French authors, that are interposed between the autochthonous «Hercynian» Corsica and the allochthonous «Alpine» Corsica. (Durand-Delga, 1984). In the study area (NE Corsica), between Corte and Ponte Leccia (Fig. 1a), the outcropping «Alpine» parautochthonous units are the Santa Lucia Nappe, the Caporalino-Sant'Angelo, the Corte and the Razzo Bianco (Durand-Delga, 1984). According to the literature, the tectono-sedimentary evolution of the so-called parautochthonous units helps to refine the timing of the Corsica orogenic history. The aim of this paper is to propose a new stratigraphic interpretation of the Caporalino-Sant'Angelo Unit. This unit is still a puzzle because the lithostratigraphic record and the scarce fossil record are still debatable, and hence the tectono-sedimentary evolution of the Caporalino-Sant'Angelo Unit is questionable. For Mattauer & Proust (1975) the «autochthonous» Sant'Angelo Unit is a clastic deposit accumulated in a distensive basin during the Eocene. This hypothesis was rejected by Amaudric du Chaffaut (1977) which according to De Boy (1957), Limasset (1958) and Durand-Delga (1975) assigned the entire Caporalino-Sant'Angelo Unit to the Jurassic-Middle Eocene time interval. This dating was confirmed by Amaudric du Chaffaut (1980) and Rieuff (1980); for these authors the sedimentary succession of the Caporalino-Sant'Angelo Unit settled on the European continental margin, affected by a strong extensional tectonic activity. This hypothesis has also been proposed for the Permian-Middle Eocene Caporalino-Pedani Unit (Durand-Delga, 1984, 1986; Rossi *et al.* 1994).

GEOLOGICAL SETTING

In the study area (Figs. 1b, 2), the Caporalino-Sant'Angelo Unit is usually interposed between the Castirla-Piedriggio Unit and the Santa Lucia Nappe (Durand-Delga, 1975, 1984, 1986; Amaudric du Chaffaut, 1980; Rieuff, 1980; Rossi *et al.*, 1994). The Castirla-Piedriggio Unit (cfr. Écailles de Corte, cfr. Soveria-Piedriggio p.p.; cfr. Éaille de Prado-Orienda p.p.) consists of

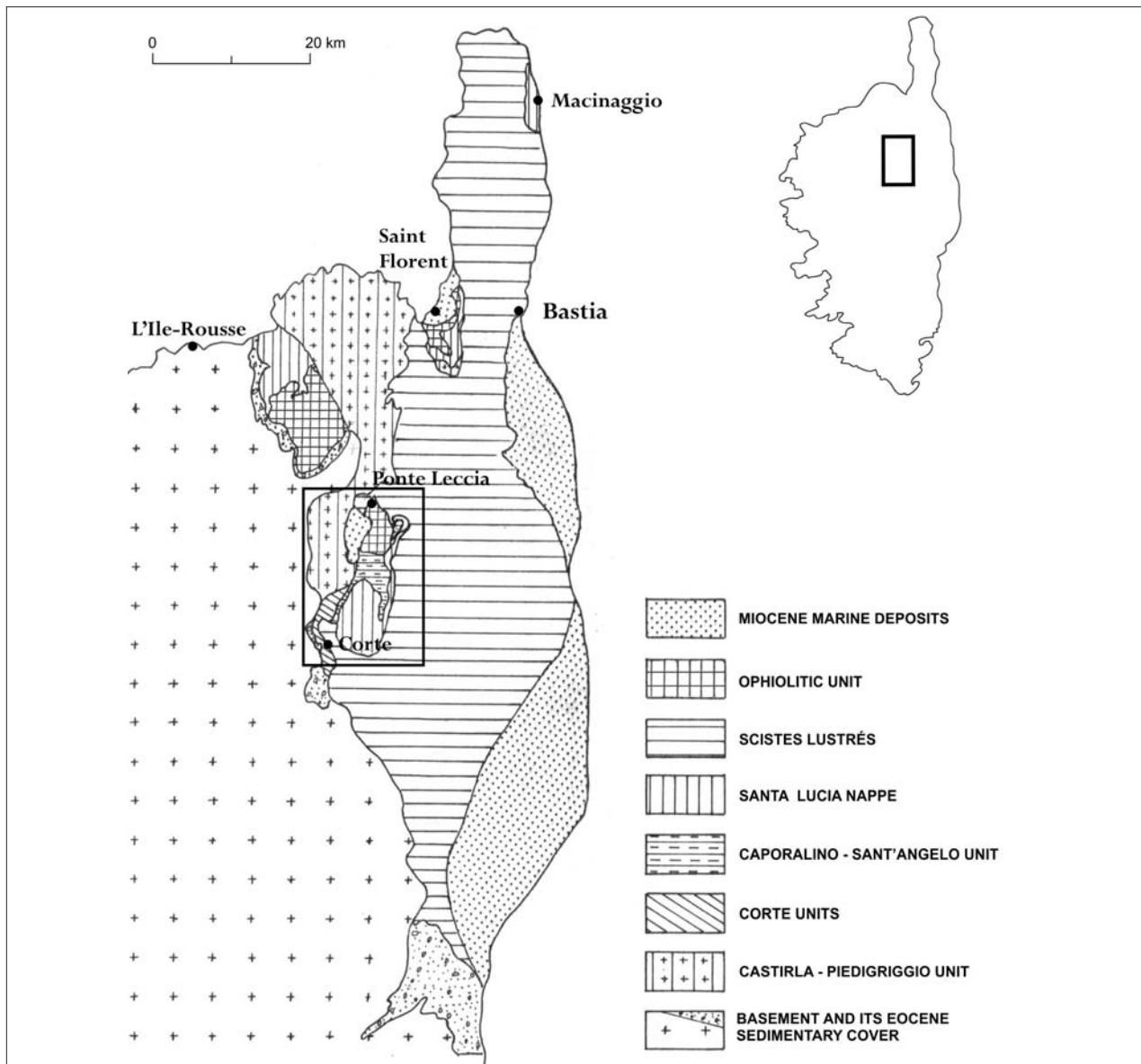


Fig. 1 - Tectonic sketch map of the NE of Corsica, and location of the studied area (within the rectangular frame).

imbricates of basement rocks, and remains of its Early Mesozoic-Eocene sedimentary cover. The basement is made of: Carboniferous calca-alcaline granites intruded in Paleozoic host-rocks (cornubianites = *cornéennes* Auctt.) such as micachistes, amphibolites, gneiss and metagabbros. The sedimentary cover includes: a Permo-Trias «volcanic-sedimentary serie» mainly made of rhyolites, phyllates, arkoses and rhyolitic arkoses, and remains of the Early Jurassic carbonatic cover composed of carnioles and breccias (Trias), dolomites and dolomitic breccias (Rhaethian), and limestones or dolomitic limestones (Lias). The tectonic contact with the overlying Caporalino-Sant'Angelo Unit is visible behind the Caporalino-Omessa train station, where the

Permo-Triassic succession of the Castirla-Piedriggio Unit is topped by the Eocene sandstones with *Nummulites*. In the Omessa-Caporalino area, the Santa Lucia Nappe consists of slabs of continental crust, i.e. granodiorites and gneisses, and its Late Cretaceous sedimentary cover, including the Tomboni conglomerates and the marly-calcareous turbidites of the Tralonca Flysch. The tectonic contact between the Caporalino-Sant'Angelo Unit and overlying Santa Lucia Nappe is exposed east of the Cima l'Orzale-Punta Capizzolo alignment. South of the Cima Pedani, the Caporalino-Sant'Angelo Unit is mainly topped by the Pineto gabbros of the Ophiolitic Unit. The *Schistes Lustrés*, which consists of ophiolites and meta-sediments (micachistes, calcschists, marbles,

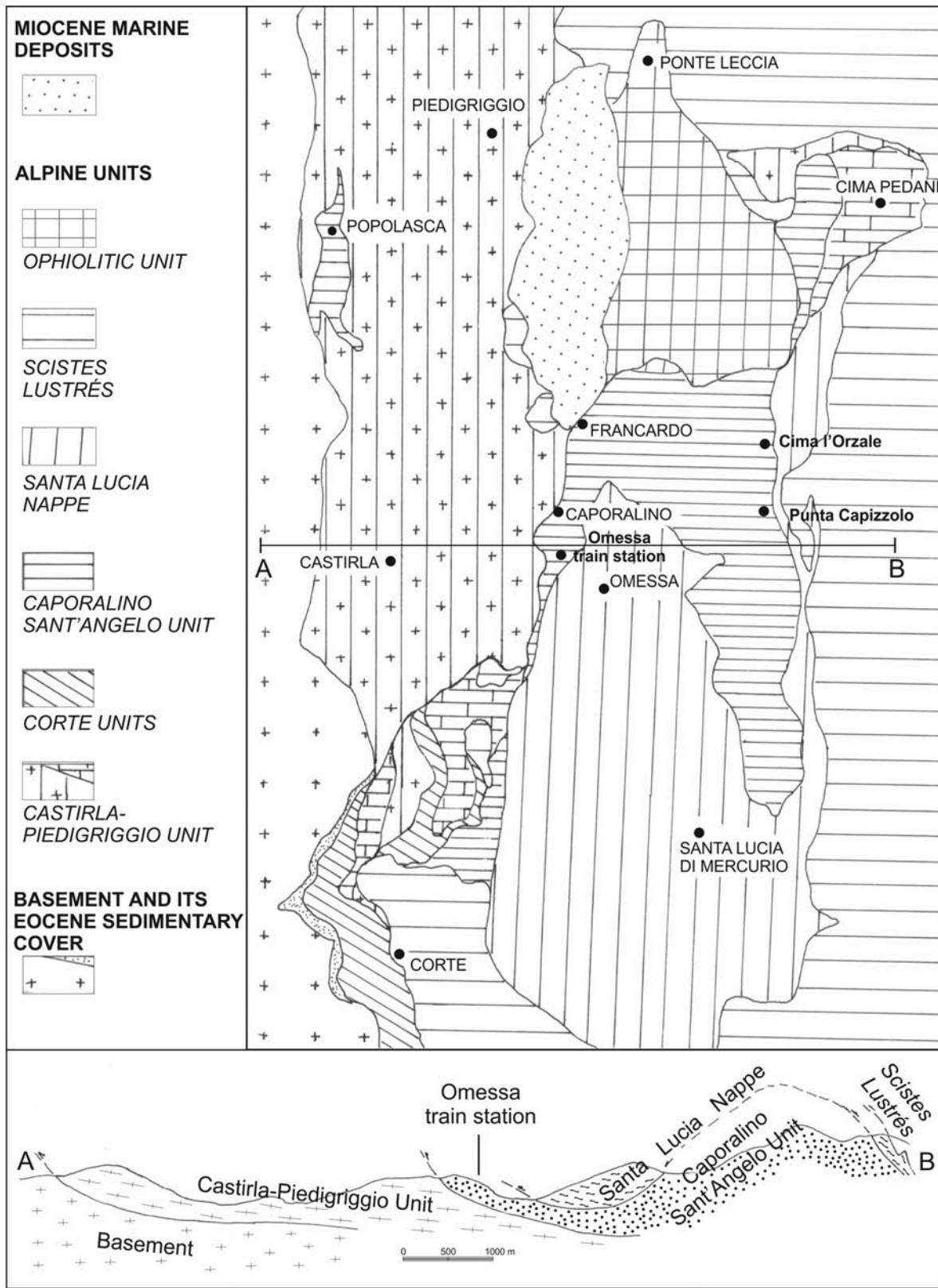


Fig. 2 - Schematic geological cross section (A-B in Fig. 1b) showing the relationship between the «Hercynian» Corsica and the tectonic units belonging to the «Alpine» Corsica.

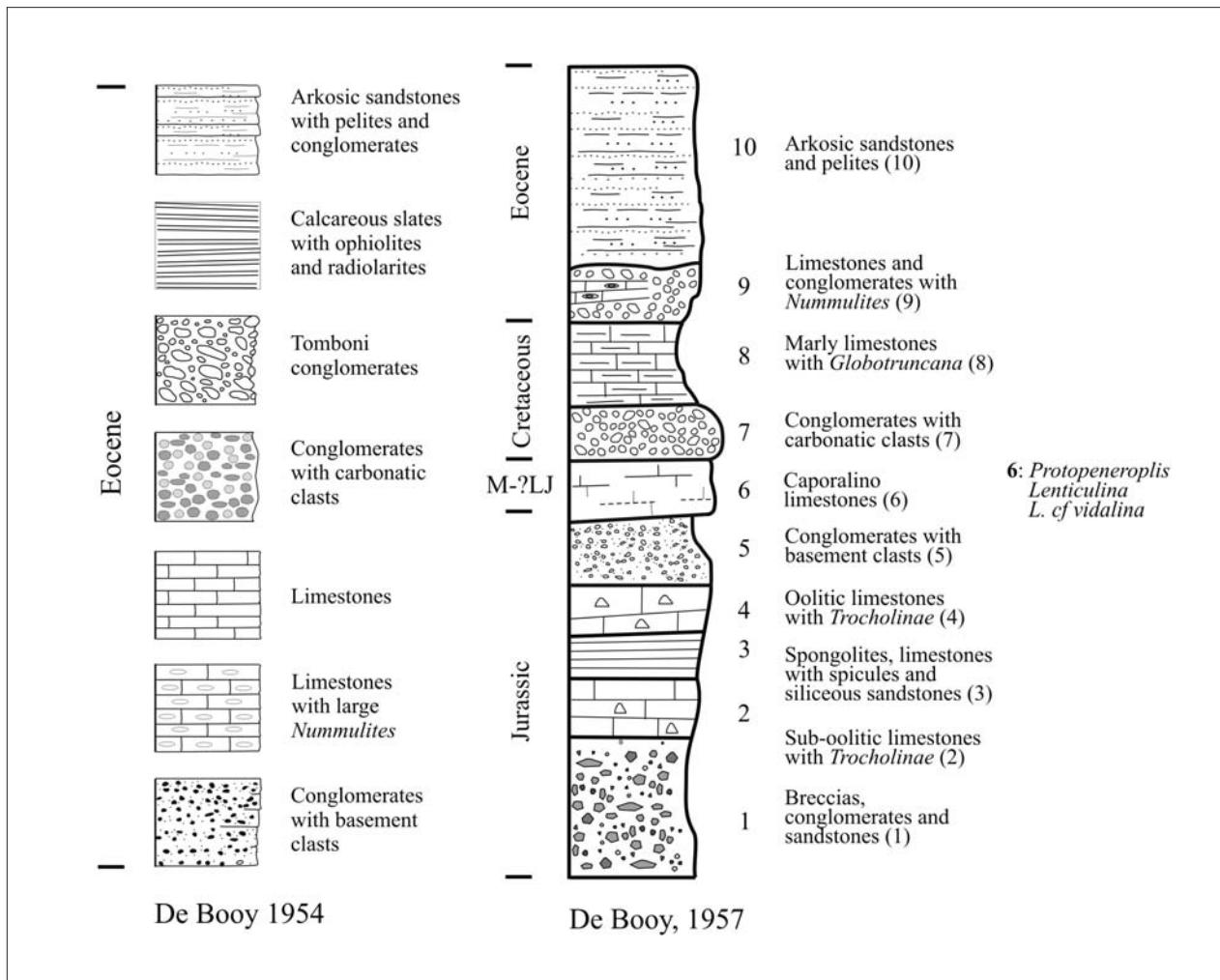


Fig. 3 - Lithostratigraphic sketch of the Caporalino-Sant'Angelo Unit according to De Booy (1954, 1957). M = Middle; L = Late; J = Jurassic.

radiolarites), overlies the Caporalino-Sant'Angelo Unit east of the Cima l'Orzale-Punta Capizzolo alignment. The Miocene marine deposits of the Francardo area seal the nappe pile (Dallan & Puccinelli, 1995).

THE CAPORALINO-SANT'ANGELO UNIT: PREVIOUS STUDIES

Lithostratigraphy

Below is reported a synthesis of the stratigraphic reconstructions proposed over time for the Caporalino-Sant'Angelo Unit, i.e. Sant'Angelo or Caporalino Unit (Figs. 3-10), which corresponds to the upper part of the Caporalino-Pedani unit of Durand-Delga. De Booy (1957) assigned to the Sant'Angelo Unit a Jurassic to Eocene age, although in his previous work (De Booy, 1954) the entire unit was dated to the Eocene due to the presence of *Nummulites* (Fig. 3). Limasset (1958) and Durand-Delga (1975) also claim that the Sant'Angelo

Unit is Jurassic to Eocene in age (Figs. 4, 5). For Mattauer & Proust (1975), the Sant'Angelo Unit is an Eocene coarse clastic succession with huge olistoliths (e.g. Caporalino limestones) not affected by the Alpine metamorphism. According to Limasset (1958) and Durand-Delga (1975), and in contrast with Mattauer & Proust (1975), Amaudric du Chaffaut (1977) assigned to the Caporalino-Sant'Angelo Unit: a Jurassic «lower detritic unit» made of breccias with basement clasts, arenaceous flysch and arenaceous limestones with *Trocholinae*, siliceous limestones and cherts, i.e. *Lydiennes*; the Late Jurassic Caporalino limestones; the Late Cretaceous «upper detritic unit» including conglomerates and clayey limestones with *Globotruncana*; and the Late Eocene arenaceous-pelitic flysch, overlying lens-shaped conglomerates and limestones, both lithologies containing *Nummulites* are also intercalated within the turbidites (Fig. 6). Later, Amaudric du Chaffaut (1980) proposed a more accurate stratigraphy of this unit which includes 13 intervals (a-m), grouped in three formations

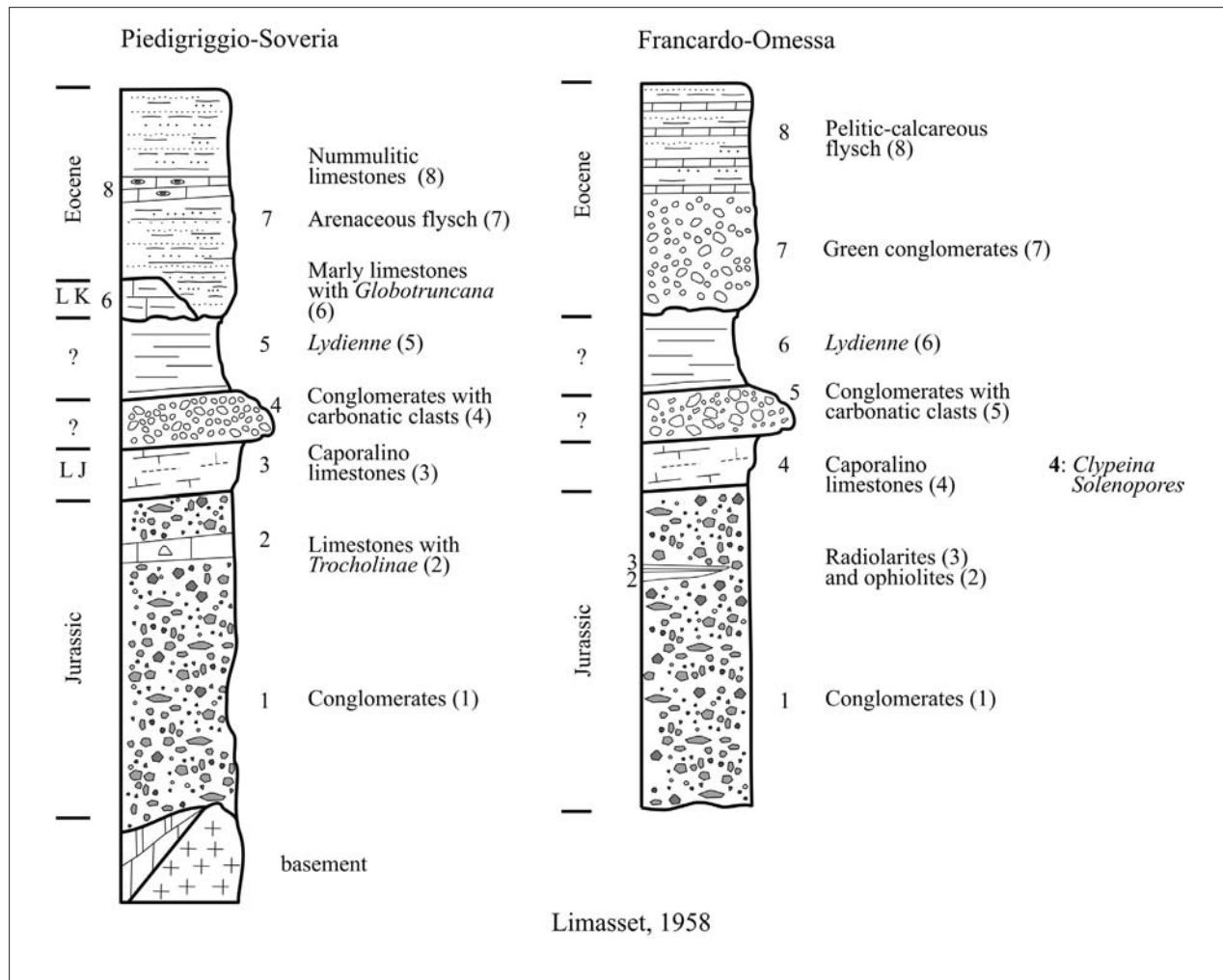


Fig. 4 - Lithostratigraphic sketch of the Caporalino-Sant' Angelo Unit according to Limasset (1958). L = Late; J = Jurassic; K = Cretaceous.

or mega-sequences (Fig. 7). The Middle-Late Jurassic «lower formation» includes: breccias and conglomerates with basement clasts (a), arenaceous flysch (b) and sandstones with breccias (c), micaceous pelites (d), cherts and limestones (e), breccias with basement clasts (f), and the Caporalino limestones (g) covered by Early Cretaceous lenses of siliceous limestones (h). The Late Cretaceous «detritic formation» is composed of polymictic and chaotic breccias with basement and limestones clasts (i), and clayey limestones with *Globotruncana* (j). The basal part of the Early-Middle Eocene «upper formation» is composed of conglomerates (very similar to the interval i) and limestones (k), arenaceous limestones and limestones with conglomeratic intercalations (l); they are overlaid by a thick alternance made of arkosic or carbonatic sandstones with black pelites (m), showing intercalations of conglomerates with *Nummulites*. For Rieuf (1980), the Sant' Angelo Unit comprises: a Middle Jurassic succession with basal breccias and arkoses dominated by basement clasts, a carbonatic to

siliceous alternance, and conglomerates; the Late Jurassic Caporalino limestones overlaid by micritic limestones; the Late Cretaceous conglomerates and marls with *Globotruncana*; the Late Paleocene-Early Eocene lens-shaped conglomerates and limestones; and the Early-Middle Eocene lens-shaped upper portion made of marls and a thick turbiditic sequence which shows a sole of conglomerates and limestones (Fig. 8). According to Durand-Delga (1984), the Middle Jurassic-Middle Eocene upper portion of the Caporalino-Pedani Unit exposed in the Pedani area (Fig. 9a) and Caporalino area (Fig. 9b) corresponds to the Caporalino-Sant' Angelo Unit. It includes: limestones and spongolites (8a), breccias and conglomerates (8b), arkosic flysch (8c), limestones and cherts (8d), the Caporalino limestones (9) with calpionella limestones (9a), lens-shaped conglomerates and marly limestones with *Globotruncana* (10), arenaceous limestones (11), conglomerates (12) and the Tonda flysch (12a) with lens-shaped conglomerate and limestone intercalations. For Rossi *et al.* (1994), the

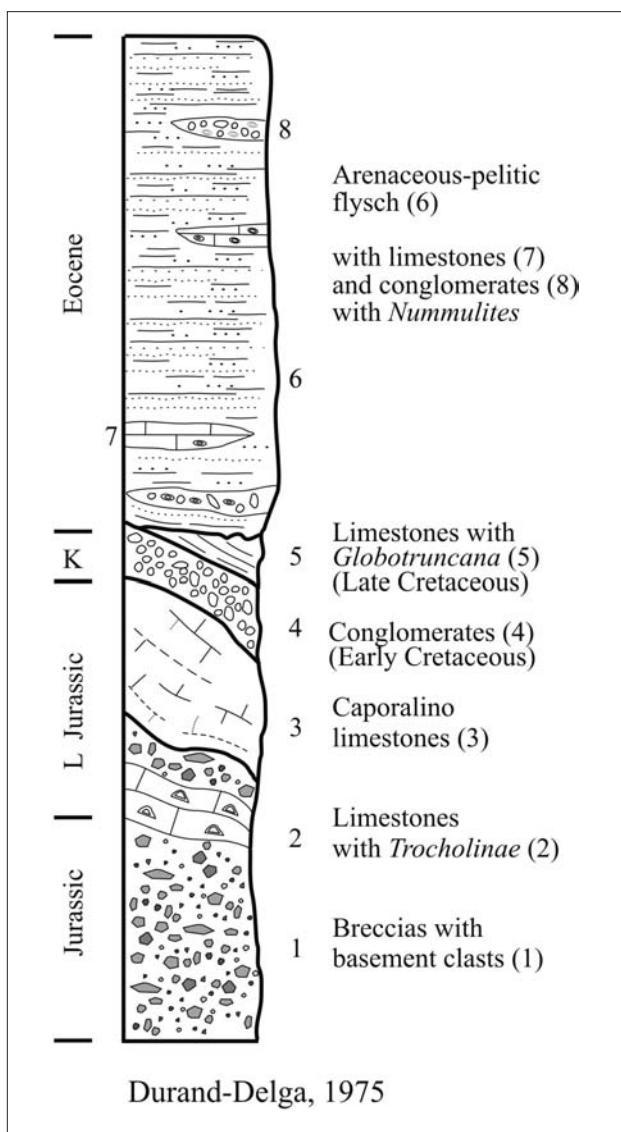


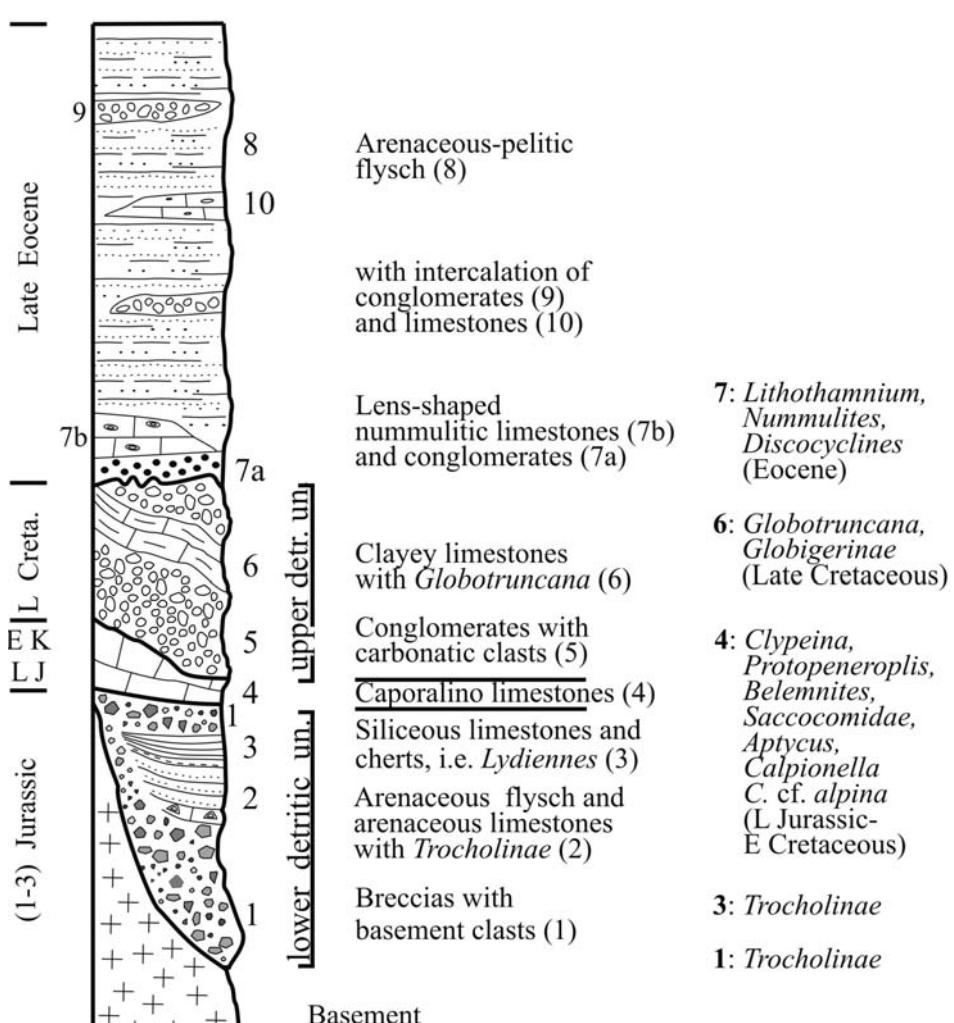
Fig. 5 - Lithostratigraphic sketch of the Caporalino-Sant' Angelo Unit according to Durand-Delga (1975). L = Late; K = Cretaceous.

Middle Jurassic-Late Eocene sedimentary succession exposed in the Caporalino area comprises (Fig. 10): the Francardo breccias (jm4), the Setonia arkoses (jm5), an alternance of limestones and cherts (jm6), the Caporalino limestones (js), conglomerates (cs) and marls with *Globotruncana* (cs1), conglomerates and limestones (ei), and the Eocene siliciclastic Tonda flysch (em-s), with conglomerates and marls in its lower part.

Dating

According to the discontinuous fossil record the previous authors (excluding Mattauer & Proust 1975) assigned the entire Caporalino-Sant' Angelo Unit to the Middle Jurassic-Eocene time interval. The fossil remains reported in literature for the lithological assemblages assigned to the Caporalino-Sant' Angelo Unit (cfr. portion of the Caporalino-Pedani Unit of Durand-

Delga, 1984 and Rossi *et al.*, 1994) are summarized below (Figs. 3-10). The siliciclastic, coarse-grained lower portion of the Caporalino-Sant' Angelo Unit was assigned to the Jurassic or to the Middle Jurassic, due to the presence of *Trocholinae* (De Booy, 1957; Durand-Delga, 1975; Amaudric du Chaffaut, 1977) or of *Trocholinae*, *Protopeneroplis striata* and *Planiinvolutina carinata* (Durand-Delga, 1984). The arkosic flysch was dated to the Jurassic or Middle Jurassic due to the presence of *Trocholinae* (Amaudric du Chaffaut, 1977) or to the Dogger-Early Malm according to the occurrence of *Protopeneroplis striata* (Durand-Delga, 1984). Also the overlying carbonatic and siliceous succession has been assigned to the Jurassic or Middle Jurassic for the presence of *Trocholinae* (De Booy, 1957; Limasset, 1958; Durand-Delga, 1975; Amaudric du Chaffaut, 1977, 1980; Rieuf, 1980) and *Protopeneroplis striata* (Durand-Delga, 1984; Rossi *et al.*, 1994). More rich is the fossil record recovered from the Caporalino limestones which has been dated: to the Middle-?Late Jurassic for the presence of *Protopeneroplis* and *Lenticulina L. cf. vidalina* (De Booy, 1957); to the Late Jurassic according to the occurrence of *Clypeina* and *Solenopores* (Limasset, 1958); to the Dogger-Malm for the presence of *Protopeneroplis*, *Trocholinae*, *Clypeina* and *Favreina* (Durand-Delga, 1984); to the Late Oxfordian based on the corals collected from this unit by Rieuf (1980), which include *Favreina*, *Cladophyllia dichotoma*, *Styliina micromammata*, *Stylohelia coalescens* and *Aplosmilia crassa* (complete list in Beauvais & Rieuf, 1981). The topmost part of the Caporalino limestones has been assigned to latemost Jurassic time interval due to the presence of *Favreina salavensis*, *Protocoprolithus centripetus*, *Helicerina*, *Diceras* and *Protopeneroplis striata* (Rossi *et al.*, 1994) or to the Berriasian due to the presence of *Clypeina*, *Protopeneroplis*, *Belemnites*, *Aptycus*, *Saccocomidae* and *Calpionella cf. alpina* (Amaudric du Chaffaut, 1977, 1980). Early Cretaceous (Berriasian) taxa *Calpionella alpina*, *Tintinnopsella carpatica* and *Crassicollaria cf. parvula* has also been recovered from the clasts of the conglomerates overlying the Caporalino limestones (Durand-Delga, 1984; Rieuf, 1980; Rossi *et al.*, 1994). The marly to calcareous deposits with *Globotruncana* assigned to the Late Cretaceous (De Booy, 1957; Limasset, 1958; Durand-Delga, 1975; Amaudric du Chaffaut, 1977; Durand-Delga, 1984; Rossi *et al.*, 1994) have been better dated by Amaudric du Chaffaut (1980) and Rieuf (1980). Amaudric du Chaffaut (1980) reports a Middle Senonian (?Santonian) assemblages determined by J. Sigal and including *Hedbergella*, *Rotalipora*, *Globigerinae*, *Globotruncana* (*G. gr. sigali*, *G. gr. marginata* and *G. gr. fornicate*). The samples collected by Rieuf (1980) from the marls with *Globotruncana* were assigned to the Late Senonian (Campanian) by J. Magné due to the presence of *Globotruncana* (*G. lapparenti lapparenti*, *G. lapparenti tricarinata*, *G. lapparenti bulloides*, *G. rosetta*, *G. gr. stuartiformis*, *G. elevata*) and *Hedbergella*. The Senonian was confirmed by Magné & Durand-Delga (1983). Part of the conglomerates and limestones overlying the Late Cretaceous marly portion was first assigned to the Late Paleocene (Paleocene-



Amaudric du Chaffaut, 1977

Fig. 6 - Lithostratigraphic sketch of the Caporalino-Sant'Angelo Unit according to Amaudric du Chaffaut (1977). L = Late; J = Jurassic; K = Cretaceous; un. = unit; detr. = detritic.

Eocene boundary) by Rieuf (1980) based on algae and foraminifera; algae include *Distichoplax biserialis* and *Parachaetetes asvapati*, and foraminifera include *Idalina cf. sinjanarica*, *Miscellanea* (?), *Valvulinali*, *Cribogoesella*, *Planorbulina cretacea*, *Coskinolina cf. liburnica*, *Glomalveolina* sp. (and/or *Lacazinella* sp.), *Discocyclina* sp. (common), *Operculina* sp. For Rossi *et al.* (1994) and Durand-Delga (1984) a similar fossil record is Upper Paleocene or Early Eocene in age according to the presence of *Distichoplax biserialis*. The *Nummulites* recovered from the upper portion of the Caporalino-Sant'Angelo Unit have been assigned to the Eocene time interval (De Booy, 1957; Limasset, 1958; Durand-Delga, 1975; Durand-Delga, 1984) or to the Upper Eocene (Amaudric du Chaffaut, 1977). The

dating of this portion was improved by Amaudric du Chaffaut (1980), Rieuf (1980) and Rossi *et al.* (1994). A. Blondeau assigned to the Early Eocene the assemblages containing *Nummulites* (*N. cf. partschi-granifer*, *N. cf. aquitanicus*) and *Assilina* gr. *leyemeirei*, and those containing *Rotalidae*, *Discocyclina Operculina*, and *Nummulites* cf. *partschi-granifer*, both were recovered by Amaudric du Chaffaut (1980) from level k and level 1 respectively. The overlying level m still sampled by Amaudric du Chaffaut (1980) was assigned by A. Blondeau to the Early-Late Lutetian due to the presence of reworked specimens of *Nummulites* (*N. millecaput*, *N. cf. aturicus*, *N. cf. biarritzensis*, *N. cf. sordensis* *a puschi*, *N. cf. bronniarti*), *Assilina* gr. *exponens* and *Discocyclina*. The presence of the Early-Middle Lute-

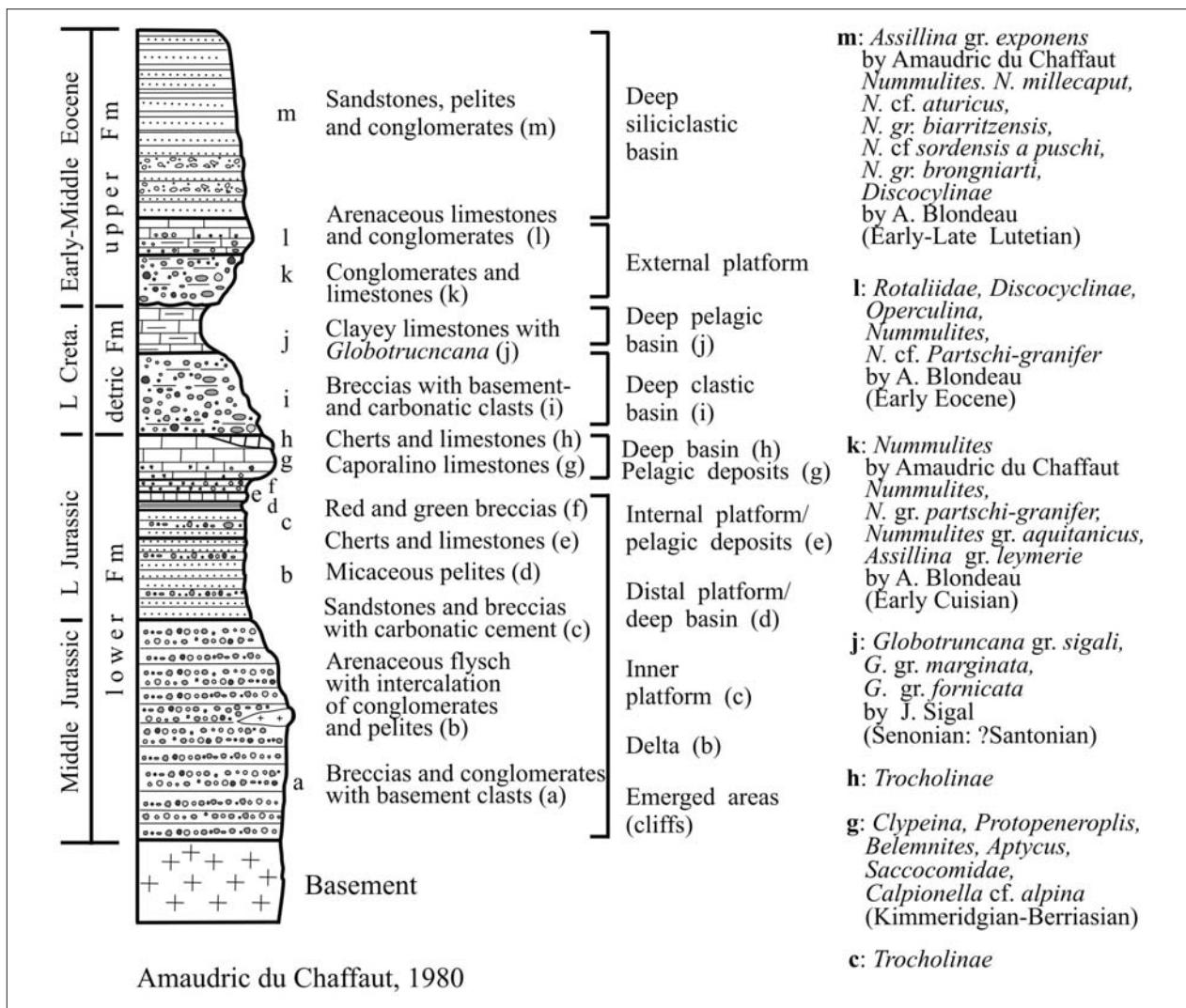


Fig. 7 - Lithostratigraphic sketch of the Caporalino-Sant'Angelo Unit according to Amaudric du Chaffaut (1980). Fm. = Formation; L = Late; Creta. = Cretaceous.

tian was confirmed by Rieuf (1980) due to the occurrence of *Truncorotalia*, *Turborotalia*, *Globorotalia* (*G. cf. centralis*, *G. spinulosa*, *G. cf. bullbrookii*), *Nummulites* (*N. cf. millecaput*, *N. sordensis*, *N. carpenteri*, *N. aturicus*) and *Assillina gr. exponens*, determined by A. Blondeau. These dating were also proved by J. Magné which recognized *Morozovella* (*M. spinulosa*, *M. cf. bulloides tricarinata*), *Turborotalia* (*T. cf. centralis*) and *Nummulites* (*N. cf. millecaput*) in the samples collected by Rossi *et al.* (1994).

LOCATION OF THE STUDIED SECTIONS

In order to improve the stratigraphy of the Caporalino-Sant'Antangelo Unit, we mapped the lithological assemblages outcropping in the Caporalino-Omessa

area at scale 1:10.000 (Fig. 11). The distinguished units are well-exposed in the Cima l'Orzale, the Punta Capizzolo and the Omessa train station sections. The Cima l'Orzale section is located along the slope that goes from the Rocher de Merlongo towards the Cima l'Orzale, i.e. SE of the Francardo village and NE of La Chapelle de Sant'Angelo (1a-1b of Fig. 11). The Punta Capizzolo section lies 1 km south of the Cima l'Orzale section, i.e. SE Francardo village and N of the La Chapelle de Sant'Angelo (2a-2b of Fig. 11). The Omessa train station composite section (3a-3b and 3c-3d of Fig. 11) lies along the railway behind the Omessa train station, and along the road that connects the train station with the Caporalino village. Several samples have been collected from these sections in order to study calcareous nannofossil and foraminifera in smear slides and thin sections, and the results are in Puccinelli *et al.* (in press).

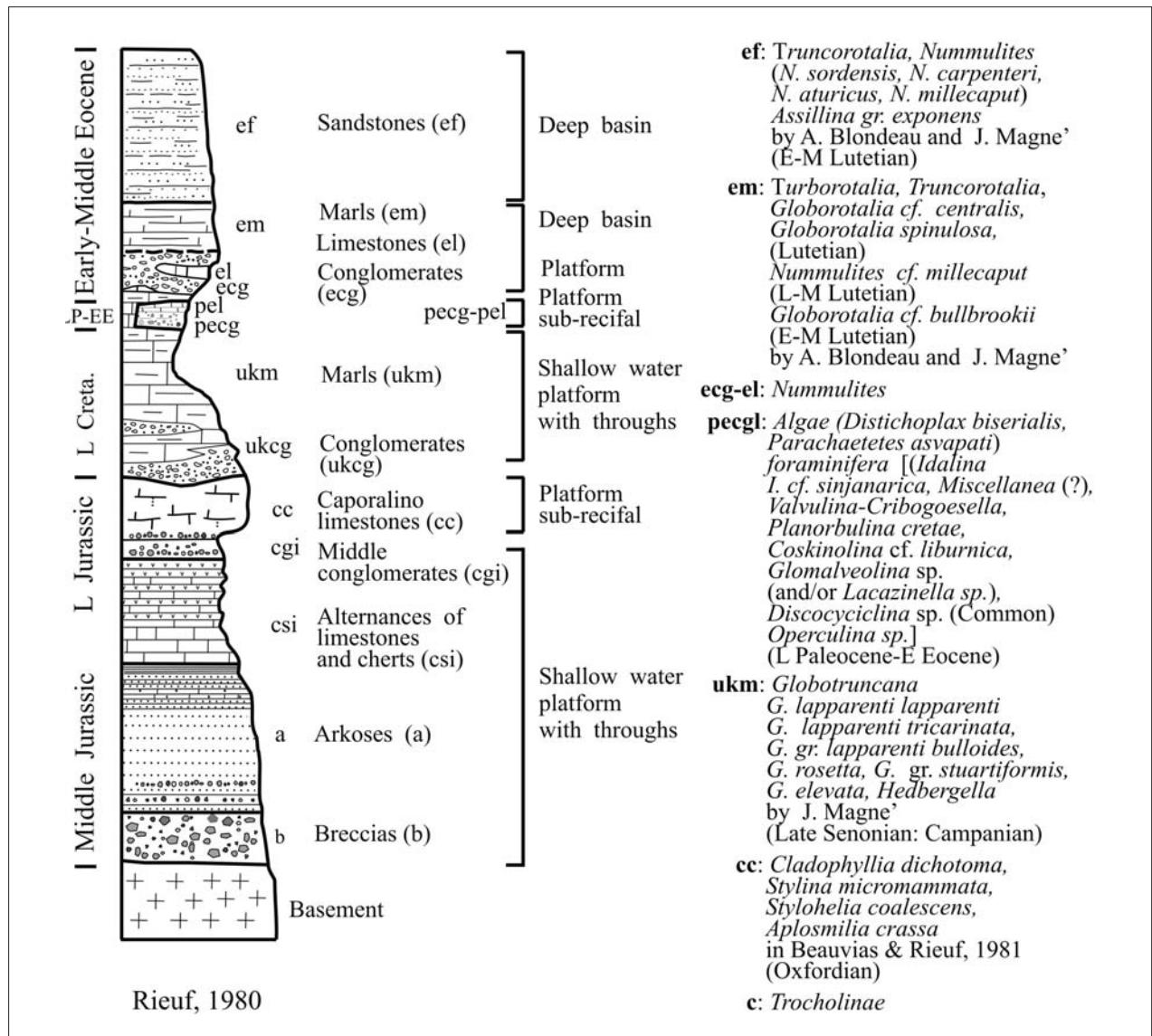


Fig. 8 - Lithostratigraphic sketch of the Caporalino-Sant' Angelo Unit according to Rieuf (1980). L = Late; Creta. = Cretaceous; UP-EE = Late Paleocene-Early Eocene; pecg: Paleocene-Eocene conglomerates, pel: Paleocene-Eocene limestones.

STRATIGRAPHY OF THE CAPORALINO-SANT' ANGELO UNIT: RESULTS

According to the geological map (Fig. 11) and to the refined lithostratigraphy of the mentioned sections (Figs. 12, 13), we recognized four formations grouped in three clastic intervals (Fig. 14). To preserve space the following abbreviations are adopted here: Formation = Fm.; Member = Mb.

Lower clastic interval (up to 500-600 m thick): Merlongo Fm. and Setonia Fm.

Merlongo Fm. – It includes 2 lithofacies: breccias and conglomerates, exposed at Rocher de Merlongo and

between Cima l'Orzale and Punta Capizzolo. The first lithofacies is up to 200-250 m thick and consists of massive or crudely stratified, red and green clast-supported breccias. The second one is 90 to 100 m thick and is composed of clast-supported conglomerates and arkoses with thin intercalations of pelites. The unsorted clasts of breccias and conglomerates are granites, amphibolites, gneiss, rhyolites, quartzarenites and slates. The size of the clasts ranges between 10 and 30 cm, and the fine- to coarse-grained arkosic arenitic matrix of both breccias and conglomerates is scarce and shows the same petrographic composition of the clasts. The transition between breccias and conglomerates is exposed at the Cima l'Orzale, and the contact

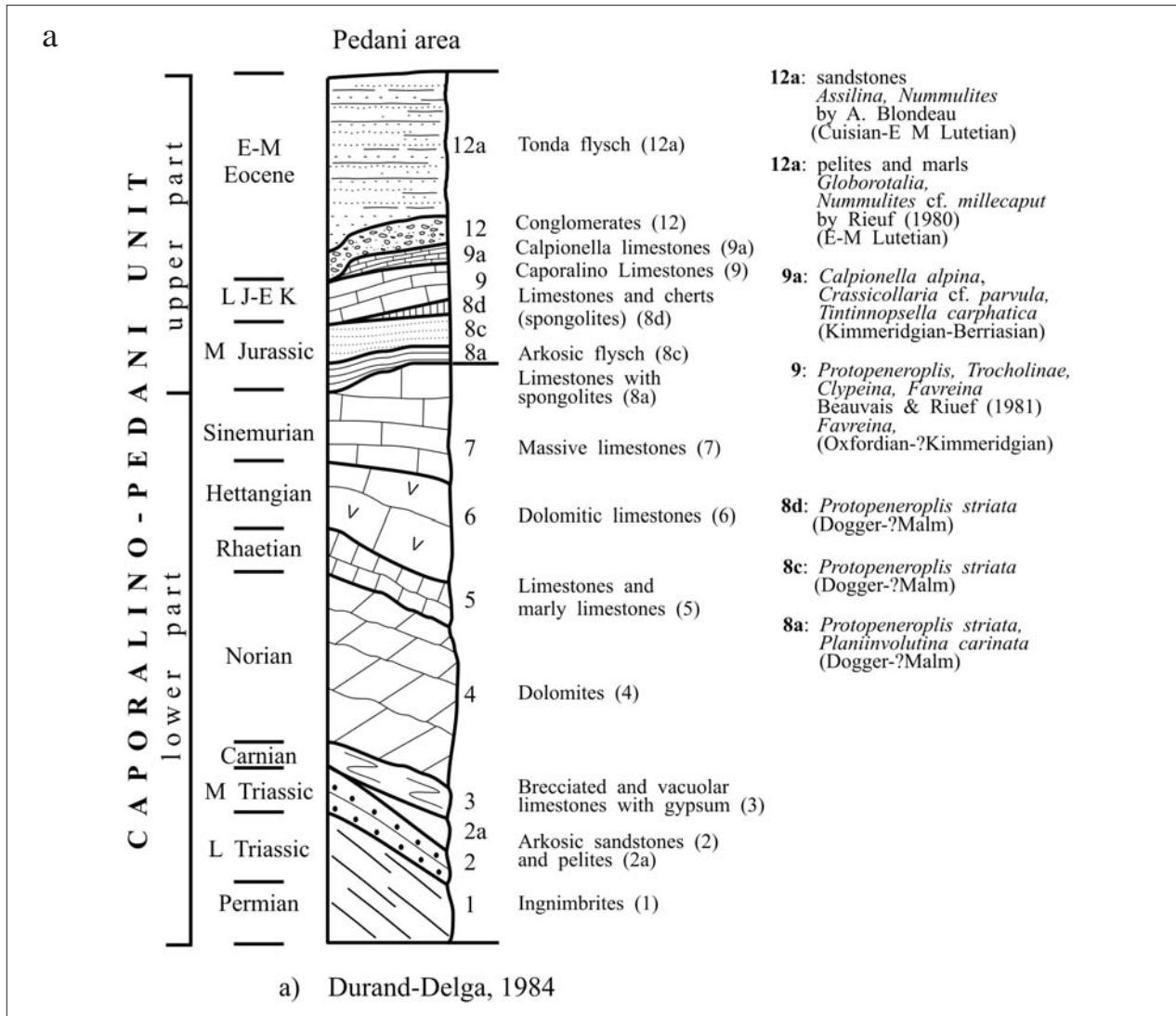


Fig. 9 - Lithostratigraphic sketch of the Caporalino-Pedani Unit in the Pedani (9a) and the Caporalino areas (9b), according to Durand-Delga (1975). L = Late; M = Middle; J = Jurassic; E = Early; K = Cretaceous; P = Paleocene.

with the overlying formation crops out at Punta Capizzolo section.

Setonia sandstones Fm. – This unit up to 200-250 m thick, is exposed between Croix de Setonia and the La Chapelle de Sant' Angelo. It consists of a thinning-upward siliciclastic sequence, made of fine-grained arkosic turbidites with silty interbeds and dark pelites. The crude stratified beds of Setonia sandstones Fm. show gradation, load, and current structures. Intercalations of calcareous sandstones, siliciclastic calcarenites (with ooliths, bioclasts of echinoid, *Trocholinae*, *Protopeneroplis*), coarse-grained sandstones, microconglomerates, and thick beds of breccias and conglomerates are also present. The petrographic composition of the sandstones and the coarse-grained deposits is similar to the

clasts of the Merlongo Fm. The upper portion of Setonia sandstones Fm. consists of fine-grained siliciclastic sandstones with intercalations of breccias, conglomerates, and dark pelites that become predominant in the upper part of unit (north of the Cima l'Orzale). The contact with the overlying Omessa Fm. is exposed at Cima l'Orzale and Punta Capizzolo. According to Puccinelli *et al.* (in press), the silty to silty marls levels belonging to the Setonia sandstones Fm., contain calcareous nannofossil specimens (*Cyclicargolithus floridanus*, *Dictyococcites bisectus*, *Dictyococcites scrippsae*, *Dictyococcites* sp., *Discoaster barbadiensis*, *Sphenolithus* sp. and *Pontosphaera* spp.) which are Middle Eocene in age. The Tertiary age of this level is also supported by the presence of planctonic foraminifera *Globorotalia* spp., that occurs along with reworked specimens and

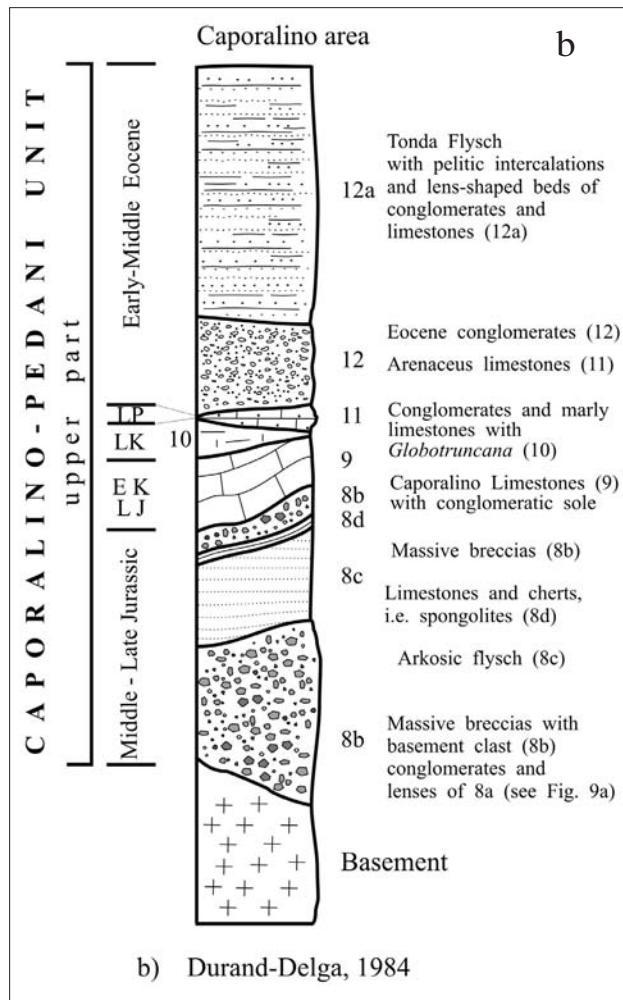


Fig. 9b

fragments of planctonic foraminifera (*Propeneroplis angulata*, *Rotalipora appenninica*, *Globotruncana* spp). and remains of *Rudistes*.

Middle clastic interval (up to 400-500 m thick): Omessa Fm.

Caporalino breccias and conglomerates Mb. – This 100 to 250 m thick member is well-exposed south of Monte Supietra and the Omessa train station (Fig. 13). It is composed of polymictic, unsorted, clast-supported breccias and conglomerates, with clasts mainly represented by amphibolites, granites, rhyolites; clasts of (micritic, bioclastic or oolithic) limestones similar to the Caporalino limestones are rare. The clast diameter ranges from a few centimetres to (> 1) metres and the silty-marly or arkosic matrix is rare. In the upper part of the unit, clasts of amphibolites occur along with sub-rounded to rounded carbonatic clasts similar to the Caporalino limestones. In places, the Caporalino breccias and conglomerates Mb. shows a thick olistolith of amphibolites, and in the upper portion of the unit small

olistoliths of Caporalino limestones are also present. With respect to the Merlongo Fm. the clasts of Caporalino breccias and conglomerates Mb. are relatively more rounded, and towards the top of the member they become smaller and bounded by a carbonatic cement. The Caporalino breccias and conglomerates Mb. could be directly topped by the Punta Capizzolo conglomerates and breccias Mb. because the Caporalino limestones Mb. discontinuously crops out (Fig. 13). The samples of the silty marls collected from the matrix of coarse grained deposits of the Caporalino breccias and conglomerates Mb. furnished scattered and very badly preserved Late Cretaceous calcareous nannofossil specimens of *Watznaueria* spp.

Caporalino limestones Mb. – It consists of lens-shaped olistoliths up to 60–100 m thick, one of which is superbly exposed at Monte Supietra. The Caporalino limestones is composed of fine-grained calcarenites and coarse-grained bioclastic calcirudites, showing a massive to crude stratification. The calcarenites are micritic wack-stone/packstones with peloid and bioclasts, and packstones with pseudo-oids, echinoderm fragments and quartzs (10%). The calcirudites are characterized by bioclast of gastropods, bivalves, bryozoans, rudists, corals, small benthic forams, and echinoderms, which are more abundant in the coarse-grained bottom of the beds. The middle-upper part of the Caporalino limestones, shows nodular reddish to pinkish facies with remains or ghost of belemnites, which could grades to a pelagic succession of cherts and silicified, micritic calcilutites with calpionellids (e.g. La Chapelle de Sant'Angelo), radiolaria and/or fragments of ammonoids (e.g. Cima al Cucco). The uppermost part of the Caporalino limestones also shows fractures filled by clasts of the overlying member. In nearby areas, the olistoliths of Caporalino limestones could overlay the Merlong Fm. or the granites of the Castirla-Piedigriggio Unit.

Punta Capizzolo conglomerates and breccias Mb. – This member is up to 120 m and is nicely exposed at Punta Capizzolo. With respect to the Caporalino breccias and conglomerates, this member shows a higher percentage of large rounded clasts (i.e. bioclastic limestones along with both oolitic and micritic limestones) mainly referable to the Caporalino limestones (e.g. Cima l'Orzale), and a low percentage of angular clasts (i.e. metabasites, granites, rhyolites and filonian quartz). The clast diameter ranges from a few centimetres to a meter or more, and the silty to arkosic (Omessa train station) or shaly (Cima l'Orzale, Punta Capizzolo) matrix is present in a low percentage. At Punta Capizzolo, a decametric-thick olistolith is intercalated in the lowermost part of this level (La Chapelle de Sant'Angelo cherty limestone olistolith, see Fig. 12). It is made up of thin-bedded bioclastic calcarenites, with radiolarian and sponge spicules, along with oolitic limestones showing remains *Trocholinae* and echinoderms, and silty marls with thin cherty intercalations; in the uppermost part of the olistoliths, calcarenites with dark pelitic interbeds are also present. The contact between the Caporalino limestones Mb. and the overlaying member is exposed in the Caporalino Quarry.

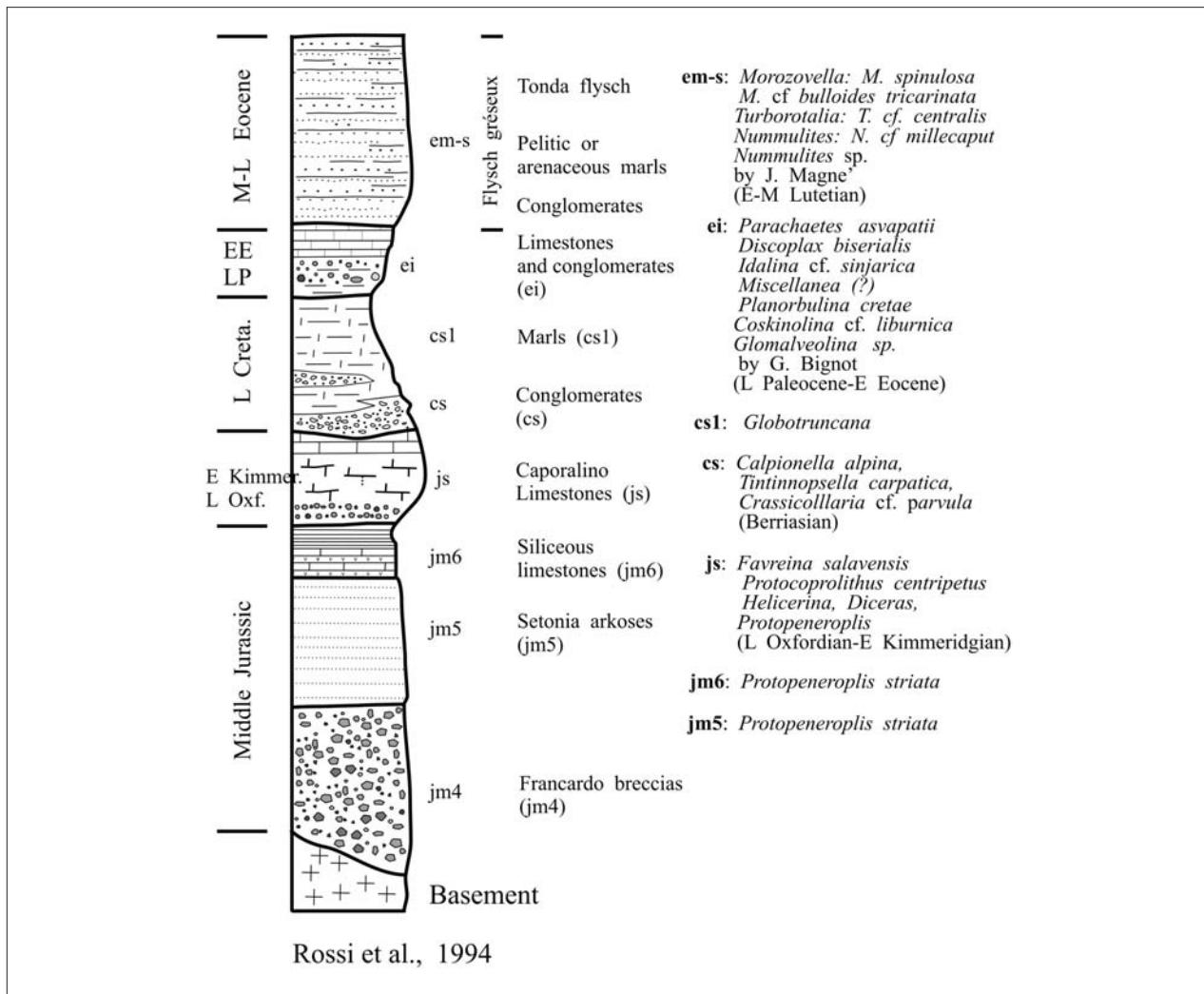


Fig. 10 - Lithostratigraphic sketch of the upper part of the Caporalino-Pedani Unit in the Caporalino area, according to Rossi *et al.* (1994a, 1994b). L = Late; Oxf. Oxfordian; Kimmer. = Kimmeridgian; Creta. = Cretaceous; E = Early.

Caporalino marls Mb. – It is well-exposed along the road that connects the Omessa train station with the Caporalino Village (Fig. 13), and nearby Cima al Cucco (south of La Chapelle de Sant' Angelo). This member is to 30 m thick, and consists of grey-bluish to dark-gray silty or siliceous marls, and siliceous marly limestones, both contain remains of *Globotruncana* (frequent), spicules of sponges, and granules of both quartz and metamorphic rocks. Intercalations of breccias and conglomerates are also present. They are very similar to those of the underlying member, as they are mainly composed of limestone pebbles to blocks referable to the Caporalino limestones, whilst the basement clasts are rare. At Cima al Cucco, the lower part of the Caporalino marls shows lens-shaped debris flows, with a pelitic marly to silty matrix and clasts (block) of limestones mainly referable to the Caporalino limestones. Between the Omessa train station and the Caporalino Village the

topmost part of the Caporalino marls is represented by a 10-15 m thick interval of conglomerates, dominated by rounded clasts of Caporalino limestones along with rare basement clasts and dm-lenses of Caporalino marls Mb. The contact with the overlying formation is visible at Cima al Cucco. The samples collected along the road which connect the Omessa train station with the Caporalino village furnished a poorly preserved fossil record including Cenozoic and (reworked) Late Cretaceous taxa of planctic foraminifera and calcareous nannofossils, the Cenozoic specimens are represented by the genus *Globorotalia* and the species *Coccolithus pelagicus* respectively (Puccinelli *et al.*, in press).

Upper clastic interval (up to 250 m thick): Sant'Angelo sandstones Fm.

Sant'Angelo sandstones Fm. – It is well exposed east of the Cima l'Orzale-Punta Capizzolo alignment. The

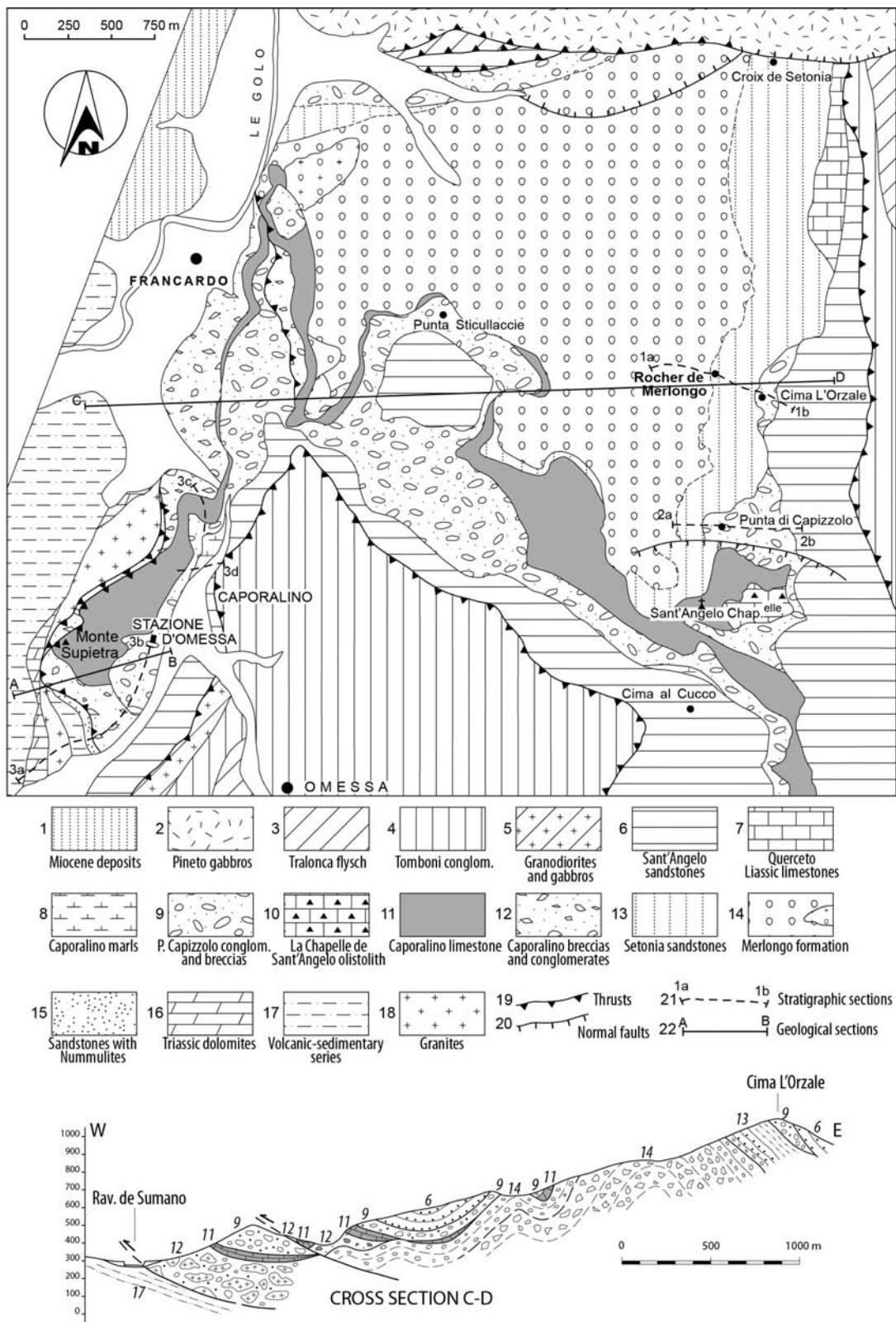


Fig. 11 - Geological map of the Caporalino-Omessa area and distinguished units, geological cross section. Fm. = Formation; Mb. = Member; Thrusts (20); normal faults (21); stratigraphic sections (22); geological section (23).

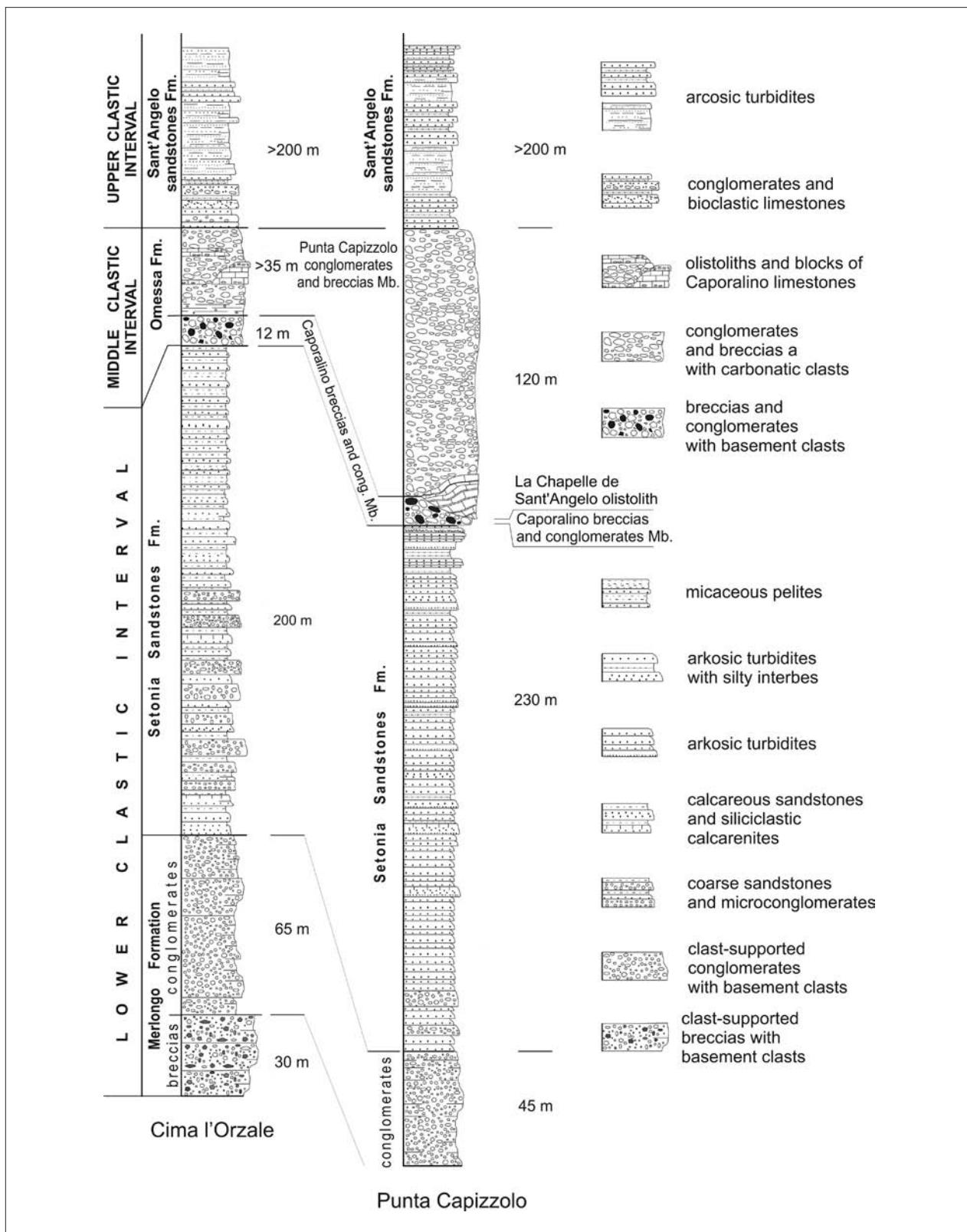


Fig. 12 - Thickness, levels and clastic intervals of the Caporalino-Sant'Angelo Unit exposed at Cima l'Orzale (1a-1b of Fig. 11) and at Punta Capizzolo (2a-2b of Fig. 11); in both sections is represented only the lowermost part of the Sant'Angelo sandstones. Fm. = Formation.

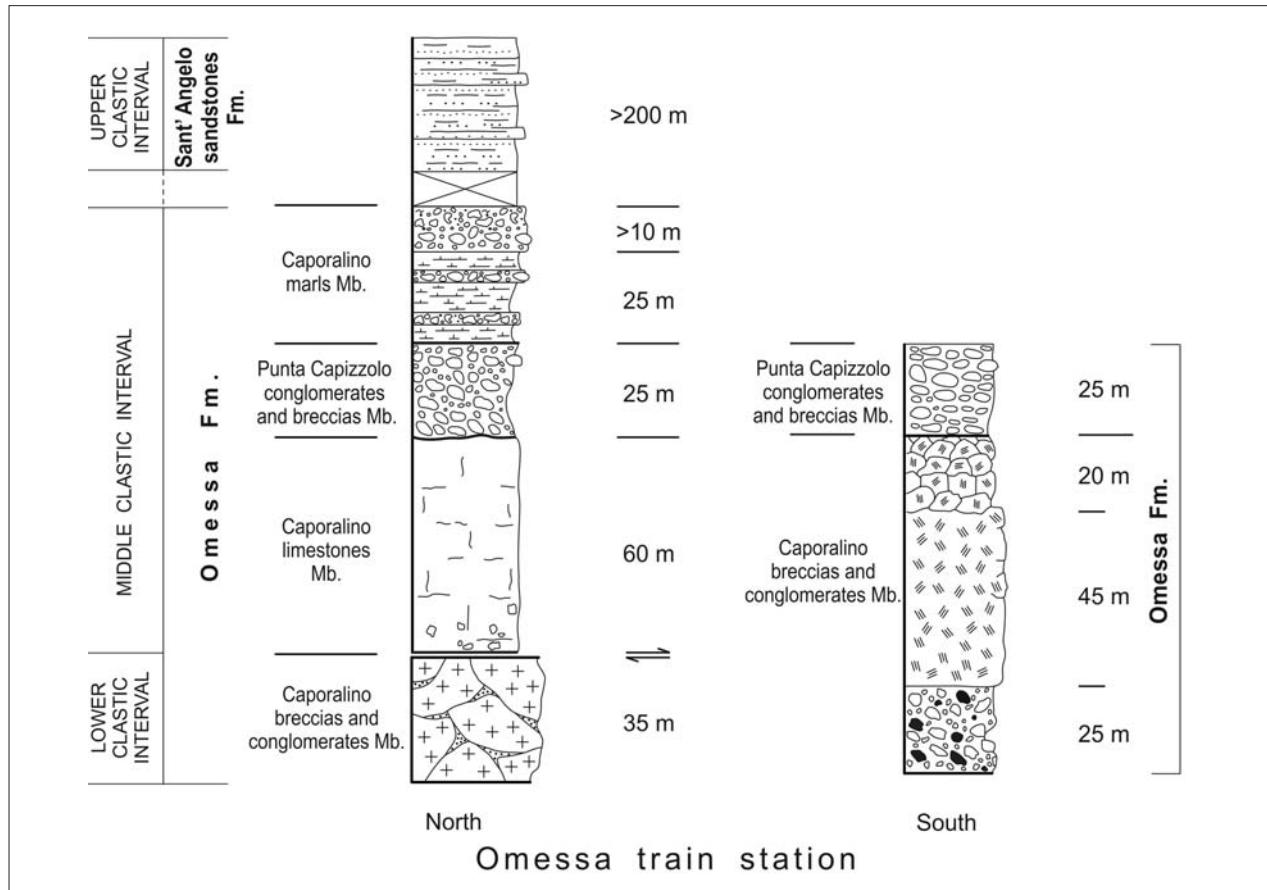


Fig. 13 - Thickness, levels and clastic intervals of the Caporalino-Sant'Angelo Unit exposed north (3c-3d of Fig. 11) and south (3a-3b of Fig. 11) of the Omessa train station; in the first section is represented only the lowermost part of the Sant'Angelo sandstones Fm.

unit consists of a monotonous succession of coarse- to fine-grained stratified, turbiditic arkosic sandstones, with siliceous or (rare) carbonatic cement. The stratified sandstones are intercalated with dark thin pelitic interbeds, more abundant in the upper part of the succession. The granules of the sandstones are granites, rhyolites, metamorphic rocks and limestones, and carbonatic clasts. The thick to very thick (1-5 m) beds show gradation, load casts, ripple marks, convolutions and bioturbations (e.g. Punta Capizzolo and Cima l'Orzale). Conglomerates, coarse-grained bioclastic limestones, and calcareous sandstones are present in the lower portion of the Sant'Angelo sandstones Fm., or are intercalated within the arkosic sandstones. The conglomerates are massive or show a crude stratification, and the clasts are mainly represented by limestones, including clasts of nummulitic limestones. The presence of *Nummulites* within the clasts or within the matrix makes it easy to distinguish between the conglomerates belonging to this formation and the conglomerates of the underlying members, i.e. Caporalino marls or the Punta Capizzolo conglomerates and breccias. The lens-shaped conglomerates intercalated

within the Sant'Angelo sandstones Fm. also show megabeds with nummulitic limestone clasts; the clasts are more angular and smaller than those that characterize the Caporalino marls Mb. From the Sant'Angelo sandstones Fm. sampled at Cima l'Orzale and at Punta Capizzolo sections we recovered remains of the genera *Globorotalia* and *Nummulites*.

DISCUSSION

Based on the superposition of all the recognized lithological assemblages, dated with a discontinuous and scarce fossil record (Figs. 3-10), almost all the previous authors proposed that the Caporalino-Sant'Angelo Unit (i.e. upper part of the Caporalino-Pedani Unit), is a Middle Jurassic-Middle Eocene succession settled in an restricted basin, composed of small platforms characterized by continental to shallow water deposits and narrow troughs characterized by deep sea clastic and pelagic deposits (Amaudric du Chaffaut, 1980; Rieuf, 1980; Durand-Delga, 198a; Rossi *et al.*, 1994). A restricted and irregular small basin was postulated to

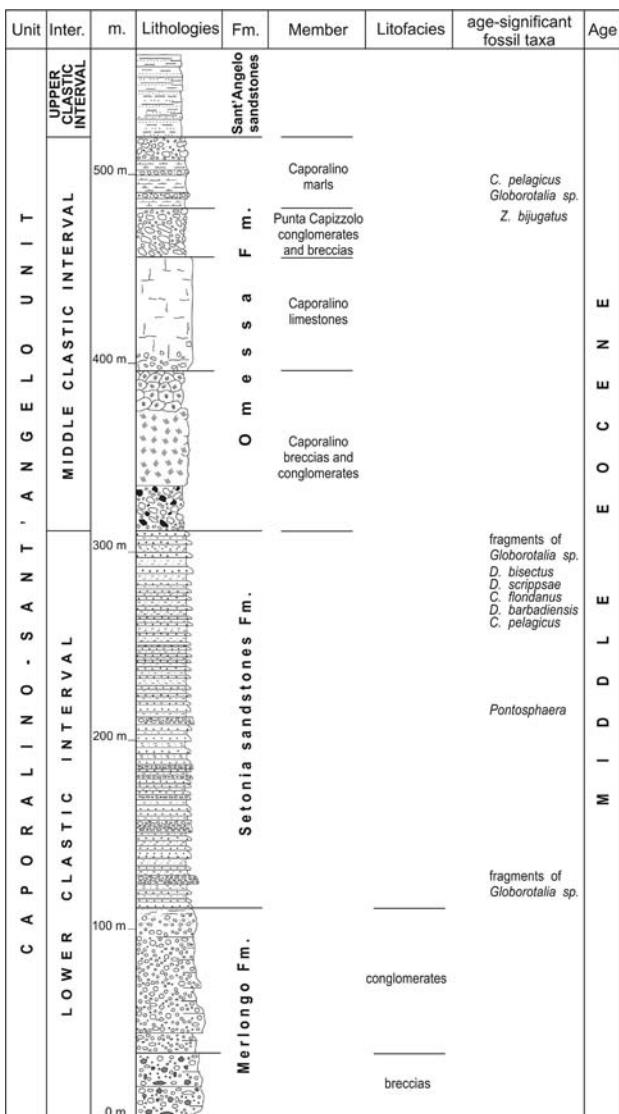


Fig. 14 - Reconstructed lithostratigraphy, microfossil record and age of the Caporalino-Sant'Angelo Unit; in the log is represented only the lowermost part of the Sant'Angelo sandstones Fm. Age significant taxa are from Puccinelli *et al.* (submitted).

explain (1) the remarkable differences of the lithological assemblages and their thickness variation even on a short distance, (2) the presence of reworked fossil remains and (3) the juxtaposition of shallow-water and pelagic facies. However this long-lived basin does not explain (1) why all the described lithological assemblages are never superimposed on the same vertical, (2) why there are very long time intervals without sedimentation, (3) why the «Middle Jurassic coarse to fine grained siliciclastic succession» is missing in other Tethyan successions, (4) why the sedimentary succession of the Caporalino-Sant'Angelo Unit outcrops only in a limited area, and (5) why the correlations with «similar» Alpine successions, sedimented on the

distensive European continental margin are weak and (in our opinion) biased. As reported in Amaudric du Chaffaut (1980) and Rieuf (1980) we confirm that the Caporalino-Sant'Angelo Unit (cfr. upper part of the Caporalino-Pedani Unit of Durand-Delga 1984 and Rossi *et al.* 1994) includes a lower and upper thick siliciclastic intervals, corresponding to the Merlongo and Setonia sandstones Fms. and the Sant'Angelo sandstones Fm. respectively. In contrast with these authors, between the lower and the upper clastic intervals there is another clastic interval, i.e. the Omessa Fm., rich of carbonatic clasts up to huge olistoliths (e.g. Caporalino limestones). Furthermore the Caporalino-Sant'Angelo Unit is a fake Middle Jurassic-Middle Eocene because a Middle Eocene calcareous nannofossil assemblage has been recovered from the lower siliciclastic interval (Puccinelli *et al.*, in press). In particular the Caporalino-Sant'Angelo Unit is a clastic wedge not older than Bartonian as *Dictyococcites bisectus* first appears in the Zone MNP16 of Fornaciari *et al.* (2001), and sedimented in a compressive basin during the final stages of the underthrusting and the subduction of the continental crust (Molli, 2008).

CONCLUSIVE REMARKS

The new geological mapping of the Caporalino-Omessa area and the refined lithostratigraphy including the composition of the coarse grained deposits allowed us to recognize within the Caporalino-Sant'Angelo Unit three clastic intervals and four formations which are Middle Eocene in age. Our data hence allow us to reject the hypothesis that considers the Caporalino-Sant'Angelo Unit as a Middle Jurassic-Middle Eocene sedimentary succession, settled in a distensive basin on the European continental margin (Amaudric du Chaffaut, 1980; Rieuf, 1980), and to archive the existence of the Permian- Middle Eocene Caporalino-Pedani Unit (Durand-Delga, 1984, 1986; Rossi *et al.* 1994). Based on the achieved results, the Caporalino-Sant'Angelo Unit is composed of an upwards fine grained lower siliciclastic interval, i.e. Merlongo and Setonia sandstones Fms. made of basement clasts, which are also the main clastic fraction of the Omessa Fm. lower portion, i.e. Caporalino breccias and conglomerates Mb. The middle-upper part of the Omessa Fm. is characterized by huge carbonatic olistoliths, i.e. the Caporalino limestones Mb., and coarse clastic deposits rich of carbonatic clasts similar to the Caporalino limestones, i.e. Punta Capizzolo conglomerates and breccias Mb., which are also present in the conglomerates associated with the Caporalino marls Mb. The fine-grained upper siliciclastic interval with basement and carbonatic clasts and remains of *Nummulites* is made of arkosic turbidites with conglomerates and limestones. In summary, the Middle Eocene Caporalino-Sant'Angelo Unit is a thick clastic wedge mainly composed of a siliciclastic fraction fed by the «Hercynian» Corsica basement. The siliciclastic input was temporarily integrated or replaced by a clastic fraction, represented by carbonatic clasts or olistoliths. These carbonates which mainly

characterized the middle clastic interval are remnants of a totally eroded and/or subducted sedimentary cover because these similar lithologies are missing in nearby outcropping successions belonging to the «Hercynian» and «Alpine» Corsica units. Therefore our results permit to partly recover the hypothesis that considers the Caporalino-Sant'Angelo Unit as coarse-grained Eocene deposits with huge olistoliths, but in contrast with this hypothesis, in our opinion the Caporalino-Sant'Angelo Unit accumulated during the Bartonian, in a compressive basin, located between the (external) European continental margin and the (internal) deforming «Corsica» accretionary wedge.

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