The Jurassic pelagic carbonate platform of the Cornicolani Mts. (Central Apennines)

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ABSTRACT

This study presents the geological mapping of an intrabasinal Jurassic high affected by pelagic sedimentation (i.e. Pelagic Carbonate Platform, PCP).
Areas characterised by Jurassic PCP are widespread all over the southern Neotethyan continental realm, from the Southalpine area (to the north) to Sicily (to the south), across the PCP of the northern, central and southern Apennine Arcs.
In the Cornicolani Mts., about 40 km NE of Rome, the transition from a PCP to the surrounding pelagic basin (PB) is well exposed. The palaeoscarp that marks this transition is evidenced by the silicification of the Calcare massiccio Fm. and shows a general NW-SE trend.
The structural analysis performed on the neptunean dykes affecting the Calcare massiccio Fm. points mainly to a NNW-SSE conjugate system, sub-parallel to the recognized strip of silicified limestone that marks the palaeoscarp.

AIMS

- To propose a number of features which should be mapped in a Jurassic PCP area and relative methodologies.
- To show the stratigraphic relationship between PCP and PC deposits.
- To stress the significance of the silicified zone in the Calcare massiccio Fm. in recognizing the PCP palaeoscarp.
- To note the importance of analysing neptunean dykes in the reconstruction of the geometry of PCP margins.
- To focus the main microfacies of the PCP deposits.
- To reconstruct a 3D geological representation of the Cornicolani Mts. PCP.

KEY WORDS

Pelagic Carbonate Platform, Jurassic, central Apennines, epi-escarpment deposits, nodular limestones, neptunean dykes, microfacies, 3D geology.

RIASSUNTO

Questo contributo riguarda la cartografia geologica degli alti morfo-strutturali giurassici intrabacinali, interessati da sedimentazione pelagica (Piattaforme Carbonatiche Pelagiche, PCP). Le aree caratterizzate da PCP sono diffuse su tutto il margine continentale meridionale della Neotetide, dal Sudalpino fino alla Sicilia, passando attraverso le PCP dell'arco appenninico marchigiano-umbro-sabino e dell'Appennino meridionale.
Nei Monti Cornicolani, circa 40 km a NE di Roma, è ben esposta la transizione di una PCP verso l'antistante bacino pelagico (PB).
La paleoscarpata che marca questa transizione è evidenziata da una fascia di silicizzazione del Calcare massiccio, che mostra un andamento generale NW-SE.
L'analisi strutturale effettuata sui filoni sedimentari che interessano il Calcare massiccio mostra principalmente un sistema coniugato orientato NNW-SSE, subparallelo alla fascia di silicizzazione che individua la paleoscarpata.

GEOLOGICAL MAP OF THE EASTERN CORNICOLANI MTS.

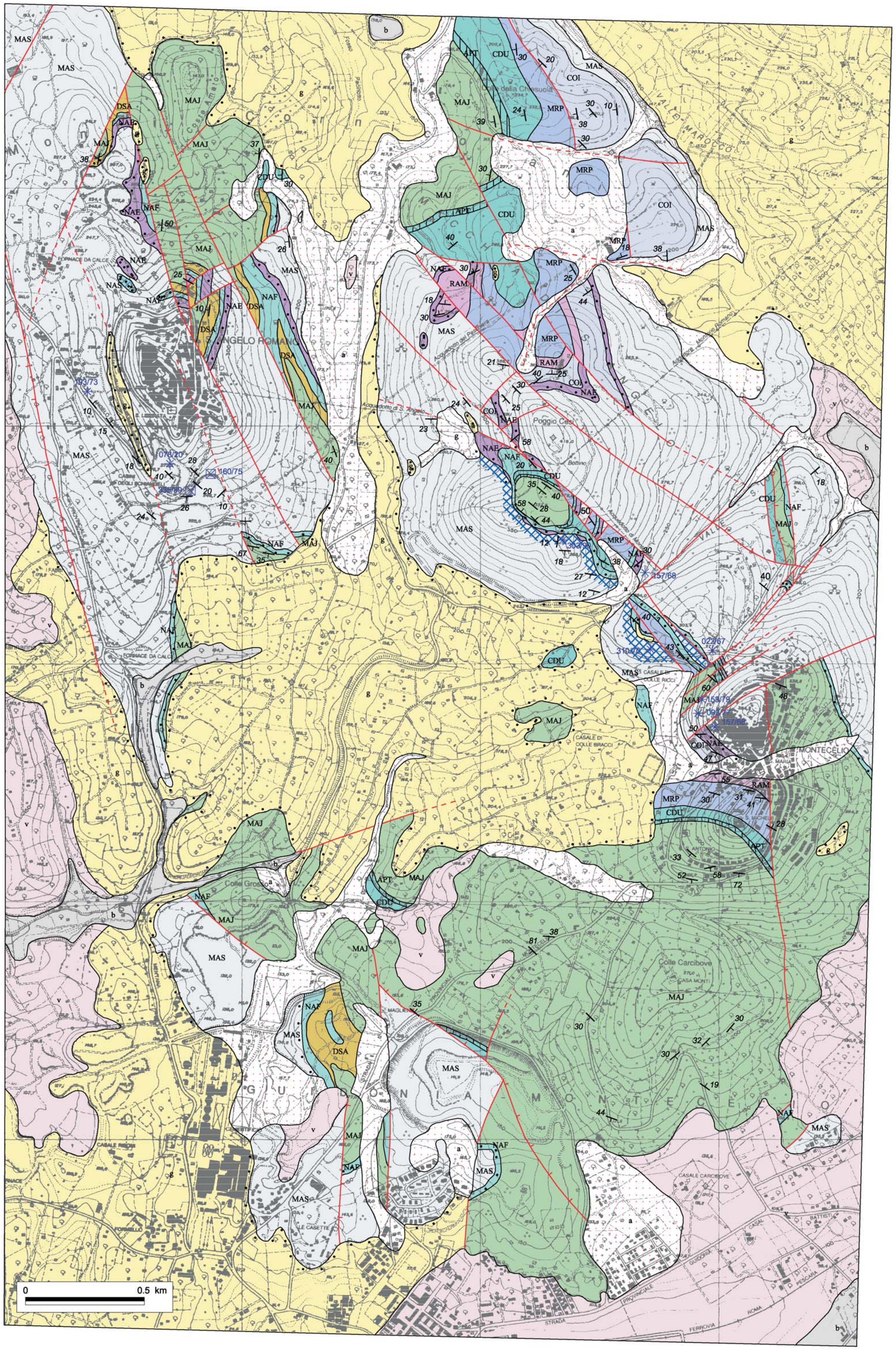


Fig. 1- *Geological map of the eastern Cornicolani Mts. In this area the transition of a Pelagic Carbonate Platform (PCP) to the surrounding pelagic basin(PB) is well exposed. PCP deposits, referable to epi-escarpment palaeoenvironment, outcrop at Montecelio, Poggio Cesi and S. Angelo Romano. PB deposits are detectable both in the northern and in the southern part of the map. PCP epi-escarpment deposits (NAS, NAF and NAE) rest unconformably on lower Liassic peritidal limestone (Calcare massiccio Fm., MAS) of the Apennine Carbonate Palaeoplatform (ACP). Neptunean dykes and silicification processes, affecting the Calcare massiccio Fm. at Montecelio, Poggio Cesi and S. Angelo Romano, are useful features to recognize both the location and the geometry of the PCP palaeoscarp.*

GEOLOGICAL SETTING

The Cornicolani Mts. belong to the central Apennine fold-and-thrust belt, characterised by a pile of nappes derived from the Neogene deformations of the Adria Meso-Cenozoic sedimentary cover (Fig. 2).

The deformed Meso-Cenozoic successions are related to platform-basin systems mainly consisting of shallow-water marine carbonates (Latium-Abruzzi Carbonate Platform domain) and deeper-water limestones with lime resediments (Umbro-Marchean Pelagic Basin and Sabina-Gran Sasso-Mainarde Basin-to-Platform domains). These platform-basin systems developed during the Middle Liassic as a consequence of the break-up of the Late Triassic-Early Jurassic Apennine palaeoplatform domain.

During this extensional event, linked to the Early Jurassic spreading of the Neotethyan Ocean, the down-faulted blocks, which were characterised by pelagic sedimentation, experienced different displacements and subsidence rates. Thus both Pelagic Basins (PB) and Pelagic Carbonate Platforms (PCP), as well as Carbonate Platform domains (up-faulted blocks), developed in the Jurassic Neotethyan Ocean.

The Cornicolani Mts. belong to a Jurassic pelagic domain where PCP conditions developed from the Pliensbachian (Middle Liassic) up to the Tithonian (Late Malm). Later on, with the sedimentation of the Maiolica Fm. (calpionellids-bearing limestone), PB conditions prevailed over the previous PCPs domains. Sedimentary processes of pre-orogenic character continued in the area until the Middle Miocene.

Starting from the Late Tortonian, the pre-orogenic successions of the area were involved in the building-up of the Apennine chain. At that time, an eastward migrating Foreland Basin System (*sensu* De Celles & Giles, 1996) developed in the western area (Tyrrhenian side) of the central Apennines. During the Early Pliocene, following the forelandward migration of the compressional tectonics, the leading edge of the Central Apennines reached the Adriatic side of the chain.

Finally, starting from the Late Pliocene, the Tyrrhenian extensional tectonics reached the present western side of the central Apennines and gave rise to the transgression of the Gelasian-Santernian Tyrrhenian Sea. In the Cornicolani Mts. (Fig. 3), this transgressive cycle is testified by the presence of both shallow-water marine clastic deposits and traces of the Gelasian coast line (*Lithophaga* pierced limestones).

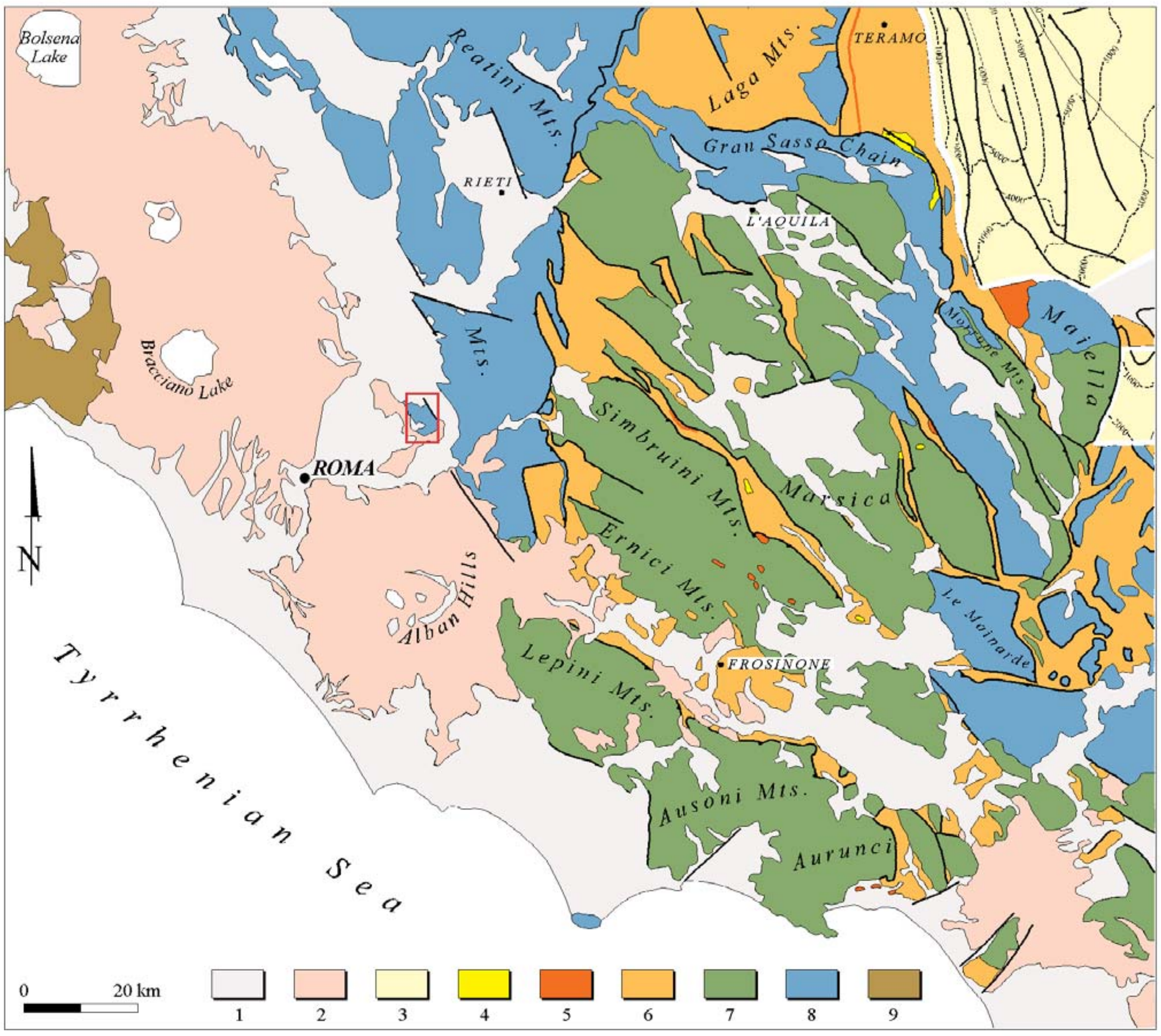


Fig. 2 - *Geological sketch of the central Apennines with location of the Cornicolani Mts.* (red rectangle).
1) *Plio-Quaternary clastic deposits;* 2) *Middle-Upper Pleistocene volcanics;* 3) *buried Pliocene deposits;* 4) *Messinian Lago-Mare/Lower Pliocene thrust-top deposits;* 5) *Messinian evaporites;* 6) *Upper Miocene foredeep deposits;* 7) *Meso-Cenozoic shallow-water limestones;* 8) *Meso-Cenozoic deep-water limestones;* 9) *Upper Cretaceous-Oligocene allochthonous Sub-Ligurian Units.*

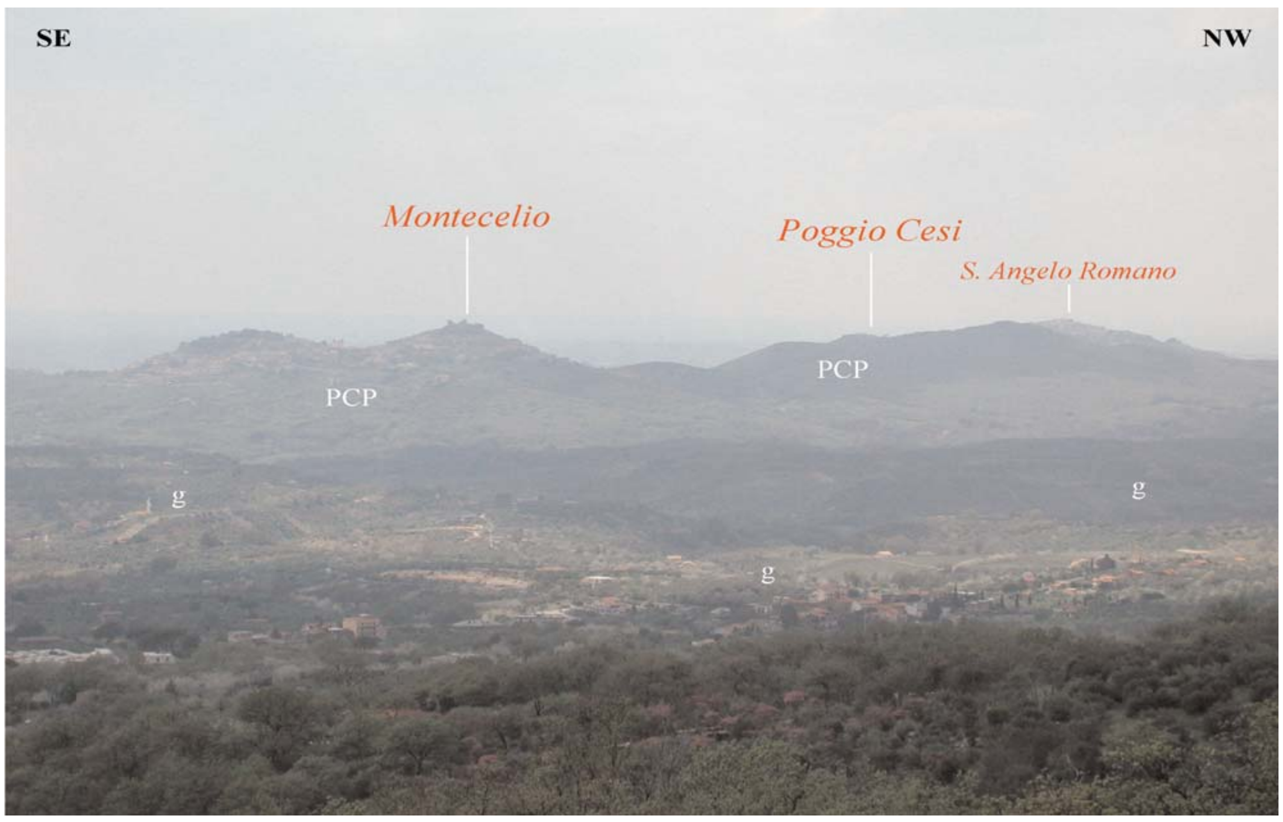


Fig. 3 - *Panoramic view from NE of the eastern Cornicolani Mts. Montecelio, Poggio Cesi and S. Angelo Romano are characterised by Jurassic* PCP *settings. The hills in the foreground* (g) *consist of marine clastic deposits of the post-orogenic Plio-Pleistocene cycle (see Fig. 1). In places, at the base of the carbonate reliefs, a strip of Lithophaga pierced limestones defines the Gelasian coast line of the Tyrrhenian Sea.*

STRATIGRAPHICAL AND SEDIMENTOLOGICAL OUTLINE OF PELAGIC CARBONATE PLATFORMS (PCP) AND PELAGIC BASINS (PB)

Following the break-up of the Late Triassic-Early Liassic palaeoplatform domain, Jurassic platform-basin systems developed on the Neotethyan continental margins. In the pelagic domain, owing to differences in the amount of tectonic displacement, both complete (PB) and reduced (PCP) Jurassic pelagic successions deposited above the faulted-palaeoplatform-blocks.

The stratigraphy of a PB is characterised by a normal-thickness succession of pelagic limestones with occasional grain-flow and debris-flow lime resediments. From the Middle Liassic up to the Neocomian, a typical PB succession contains: Corniola Fm., Rosso ammonitico Fm., Calcari e marne a Posidonia Fm., Calcari diasprini Fm., Calcari con Saccocoma ed Aptici Fm. and, finally, Maiolica Fm. Generally, this pelagic succession bears nodules, lenses and horizons of mainly radiolarian-chert. Conversely, the stratigraphy of the less downthrown palaeoplatform blocks is characterized by a reduced-thickness succession of pelagic limestone, containing no chert (PCP) (Fig. 4). Pelagic Carbonate Platforms (PCPs) are widespread in the Neotethyan continental realm. In the western part of the southern Neotethyan margin, PCPs are present from the Southalpine area (to the north) to Sicily (to the south). Several PCPs in the Central Apennines have been studied in detail by various authors (Chiocchini *et alii*, 1975; Cosentino *et alii*, 1982; Galdenzi, 1990; Santantonio, 1993;

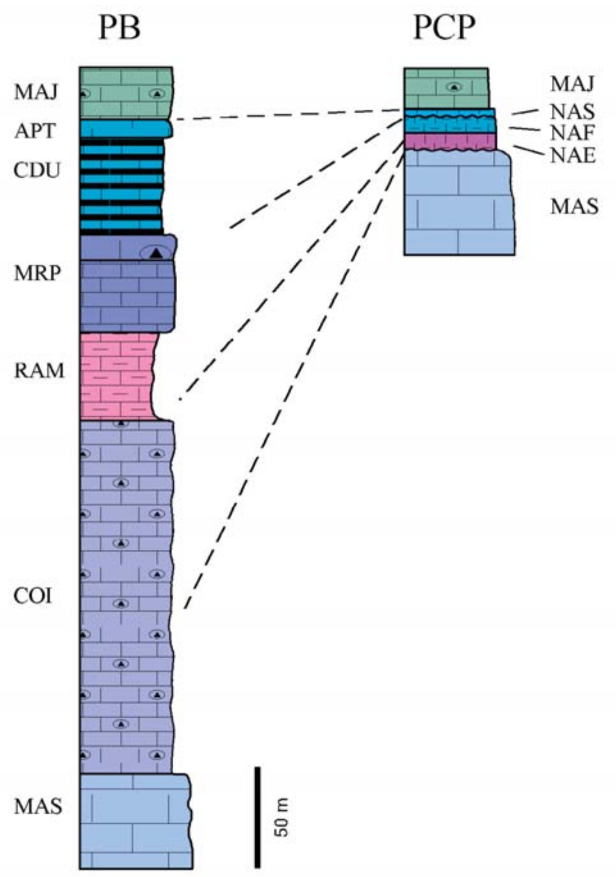


Fig. 4 - *End-members of pelagic basin* (PB) *and pelagic carbonate platform* (PCP) *stratigraphic correlation. Generally, in the* PCP-PB *transition (palaeoscarp) dolomitization processes can affect both* PCP *and* PB *successions. In the Cornicolani Mts. other stratigraphic features allow us to characterize the transition between* PCP *and* PB *domains.*

1994; DI BUCCI *et alii*, 1994; GALLUZZO & SANTANTONIO, 1994; SANTANTONIO *et alii*, 1996; GALLUZZO & SANTANTONIO, 2002). As these authors have shown, certain common features characterize the stratigraphy of PCPs: 1) a highly reduced thickness of the Jurassic deposits between the Calcare massiccio Fm. (Hettangian-Sinemurian) and the Maiolica Fm. (Tithonian p.p.-Barremian) (just a few tens of meters), with a PCP/PB thickness ratio of less than 1/10; 2) the presence of several stratigraphic gaps in the PCP deposits; 3) the presence of neptunean dykes, mainly within the Calcare massiccio Fm.; and 4) silicification processes in the Calcare massiccio of the PCP palaeoscarp.

HOW TO DISTINGUISH A JURASSIC PB FROM A PCP: MATERIAL AND METHODS FROM THE CORNICOLANI MTS.

In order to distinguish PB from PCP successions, we basically need to perform a highly detailed geological survey to recognize and map the different features that characterize these pelagic domains. Due to the reduced thickness of PCP successions, geological mapping must be carried out at a scale of at least 1:10,000 or more.

First of all, palaeoplatform facies (Calcare massiccio Fm.) have to be distinguished during the field work, and the kind of stratigraphic successions that rest above them detected. Palaeoplatform facies consist mainly of Lower Liassic peritidal limestones, with a grainstone texture, containing coated-grains and dasycladaceous algae (Fig. 9H). Minor subtidal facies, with prevalent micrite matrix, are also present. Generally, the Calcare massiccio Fm. crops out in poorly stratified massive beds (Fig. 5). Above the Lower Liassic palaeoplatform facies, Jurassic PB successions are characterised by well-stratified pelagic limestones with frequent, normal-thickness, lime resediments, nodules, lenses and horizons of chert (Fig. 6). Generally speaking, Jurassic PB facies reach several hundreds of metres in thickness, varying depending on the amount of lime resediments present. Conversely, a few tens of metres of nodular pelagic limestones, which rest above the Calcare massiccio Fm., characterise the Jurassic succession of a PCP (Fig. 7). In contrast with PB deposits, the absence of chert in the nodular limestones that characterize a PCP succession should be noted.

Once these primary stratigraphic characters have been distinguished, structural and microfacies analyses can be performed to detect and measure the tectono-sedimentary features typical of a PCP domain. On the field, where PCP deposits crop out it is possible to recognize different kinds of nodular limestones, as well as the presence of both neptunean dykes and silicified processes within the Lower Liassic palaeoplatform facies (Calcare massiccio Fm.).

Moreover, biostratigraphic analyses of the thickness-reduced Jurassic succession allow improved definition of the differences between the field-identified nodular limestones and the recognition of the presence of stratigraphic gaps within the PCP deposits.

The occurrence of both silicified processes and strong angular unconformity between the Lower Liassic peritidal limestone and the overlying Jurassic nodular deposits, as well as a highly reduced thickness, allow us to refer the PCP features recognized in the Cornicolani Mts. to an epi-escarpment sub-environment.

PCP PALAEOSCARPS: MAIN TECTONO-SEDIMENTARY FEATURES FROM THE CORNICOLANI MTS.

PCP palaeoscarps are characterised by the occurrence of a few tectono-sedimentary features that allow us to distinguish them from both PB successions and the top of PCP domains. On the palaeoscarp, the epi-escarpment Jurassic deposits, which unconformably rest on the Lower Liassic peritidal limestone, are characterised by very thin (a few decimetres thick) nodular limestone (Fig. 7). The contact between the nodular limestone and the underlying Calcare massiccio Fm. is defined by an unconformable boundary, with an angular unconformity in places of about 60° (Poggio Cesi). A useful feature which enables the recognition of the PCP palaeoscarp is the occurrence of silicification processes in the Lower Liassic peritidal limestone (Fig. 8). In the Poggio Cesi area, epi-escarpment deposits rest above a surface of strongly silicified Calcare massiccio Fm.

In this area, the Calcare massiccio silicified facies crops out along a 1.5 km continuous NW-SE-oriented strip.

Another feature that particularly characterizes the edge of a PCP is the occurrence of neptunean dykes, mainly within the Calcare massiccio Fm.

Epi-escarpment deposits

The epi-escarpment deposits of the Cornicolani Mts. are characterised by discontinuous, nodular limestones, a few decimetres thick, resting unconformably on a surface of silicified Calcare massiccio Fm.

Fig. 5 - *Poorly-stratified beds of Calcare massiccio Fm.* (MAS) *from a quarry to the west of S. Angelo Romano. These Lower Liassic massive limestones pertain to the Apennine Carbonate Platform* (ACP) *and constitute the substratum for the* PCP *Jurassic deposits of the Cornicolani Mts.*

Fig. 6 - *Well-stratified limestones* (CDU) *outcropping north of Poggio Cesi. The presence of lenses and horizons of chert* (c) *means these can be considered as being sedimented in a pelagic basin* (PB).

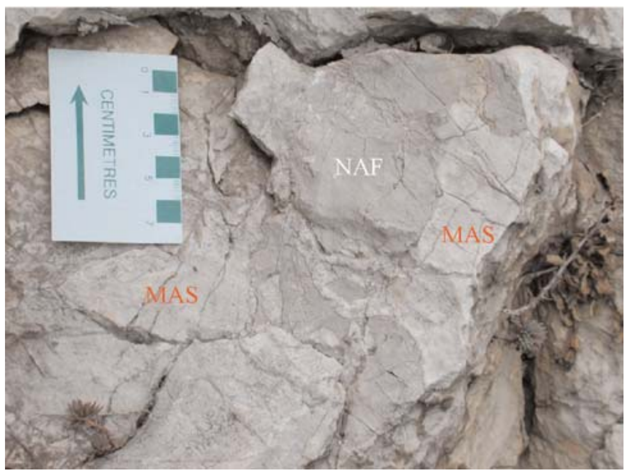
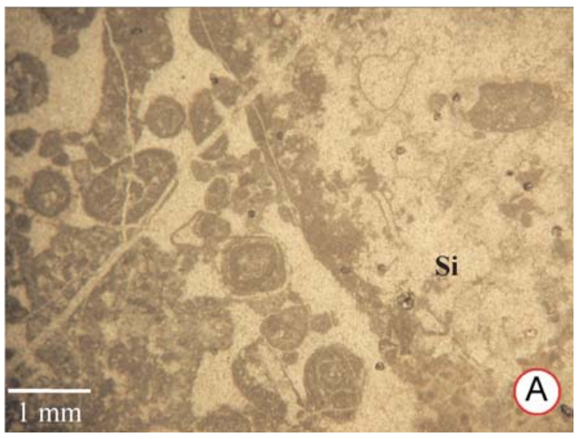
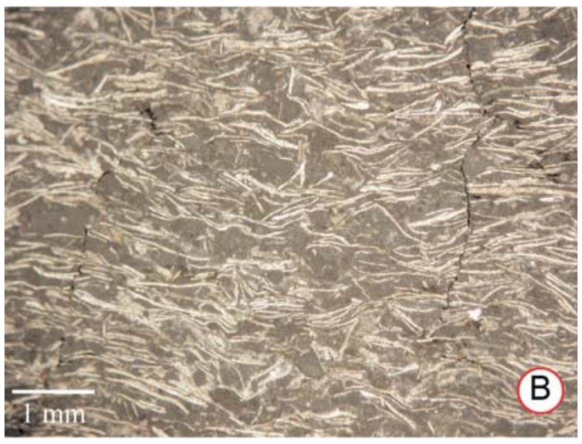


Fig. 7 - *Unconformable boundary between nodular limestones, rich in pelagic pelecypods* (NAF), *and the underlying Lower Liassic peritidal limestones (Calcare massiccio Fm.,* MAS*).*

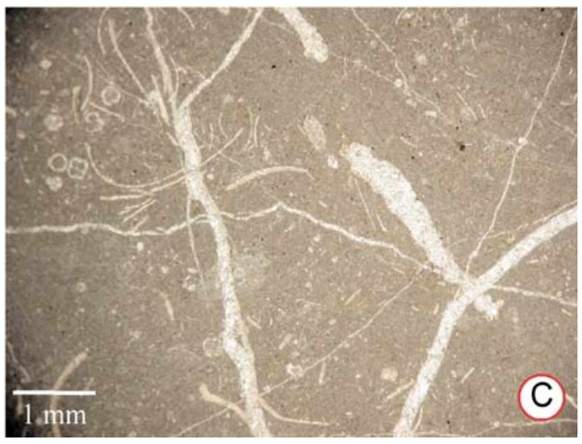
Fig. 8 - *Silicified surface on the Lower Liassic peritidal limestones of the* ACP. *The occurrence of silicified Calcare massiccio Fm. is one of the most useful features enabling to recognize the* PCP *palaeoscarp. Generally speaking, silicified Lower Liassic peritidal limestone is overlain by epi-escarpment nodular deposits* (NAE, NAF *and* NAS).



Thin-section microphotograph, in transmitted light, of partially silicified (Si) *peritidal limestone (Calcare massiccio Fm.,* MAS*). The occurrence of silicification processes in the Lower Liassic shallow-water limestones is a useful tool to recognize the* PCP *palaeoscarp.*



Thin-section microphotograph, in transmitted light, of Calcari nodulari a filaments (NAF)*. The abundant occurrence of iso-oriented pelagic pelecypods (*Posidonia *sp.) is a signature of condensation in the sedimentary record.*



Thin-section microphotograph, in transmitted light, of Calcari nodulari a filaments (NAF)*. Sometimes,* NAF*, besides pelagic pelecypod remains, can also contain Globuligerina sp. (left-up corner), the oldest planktonic foraminifers that are present in basinal successions.*

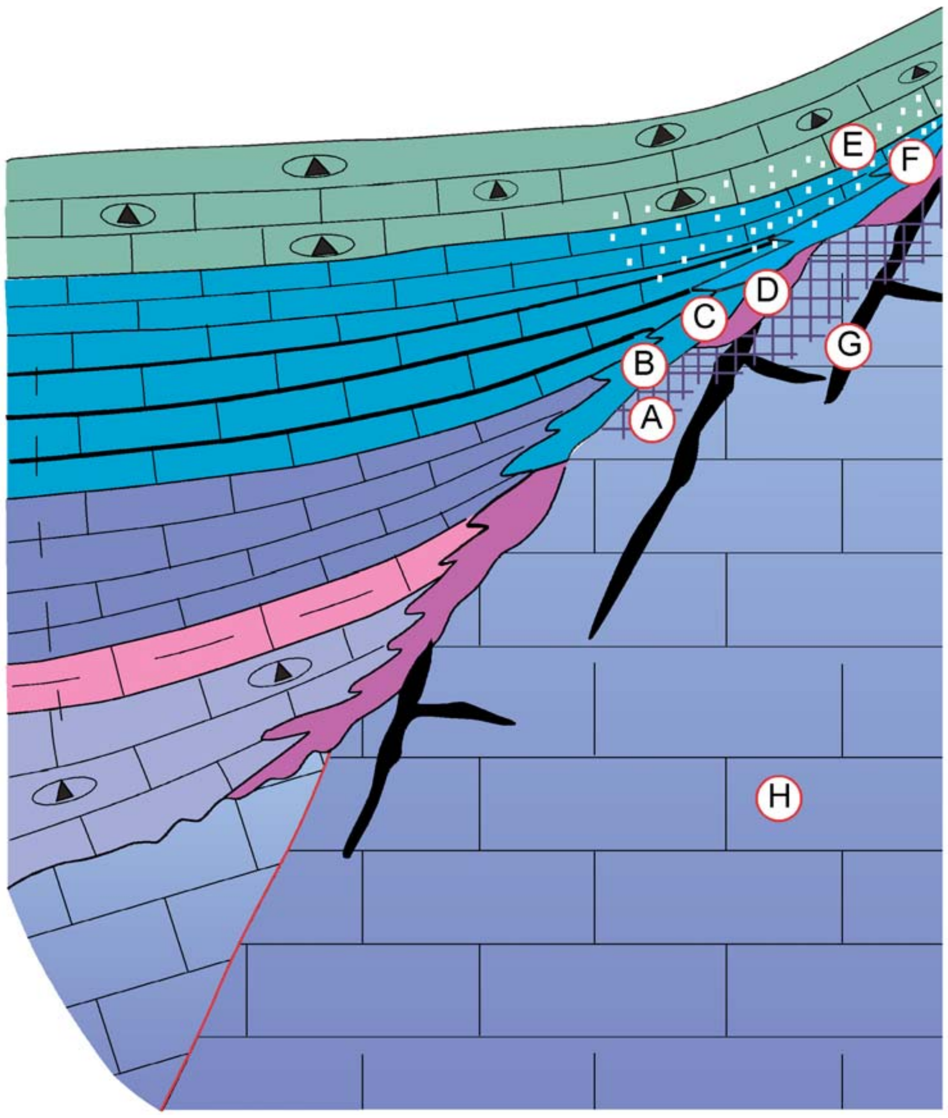
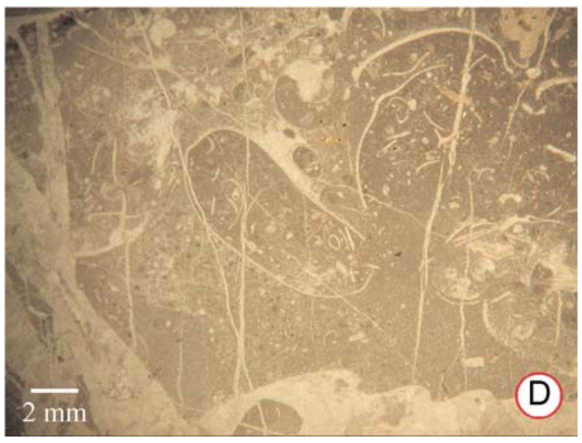
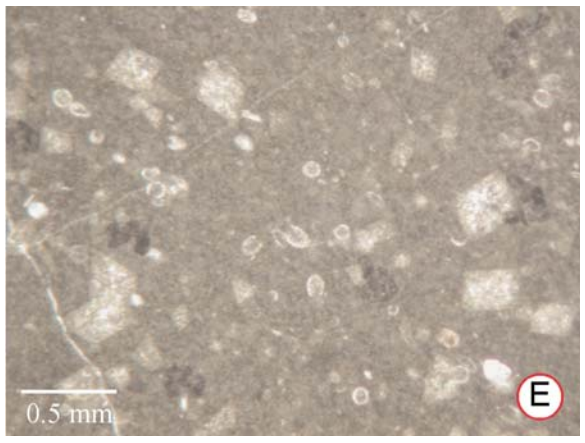


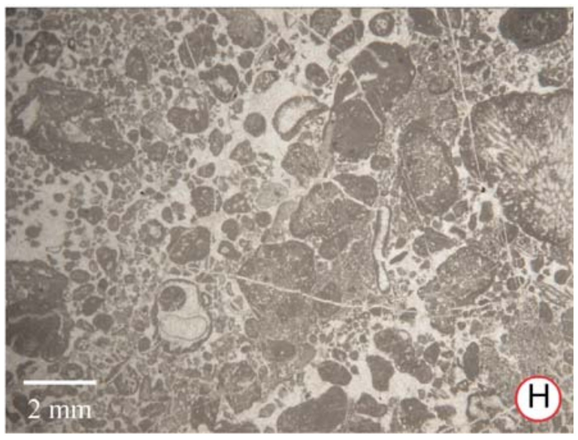
Fig. 9 - *Conceptual stratigraphical model (not to scale) of the* PCP *epi-escarpment deposits of the Cornicolani Mts. The main microfacies occurring in a* PCP *palaeoscarp environment are shown in the* A-H *microphotographs. In particular,* A *and* H *microphotographs have been taken from the peritidal limestones of the* ACP*, which is the substratum of the epi-escarpment deposits of the Cornicolani Mts.* D, B-C *and* F *represent the microfacies of* NAE, NAF *and* NAS *respectively. Microphotograph* E *shows dolomitization processes commonly occurring both at the top of* PCP *and at the* PCP-PB *transition. Finally,* G *represents the microfacies of a neptunean dyke from Mt. S. Angelo Romano area.*



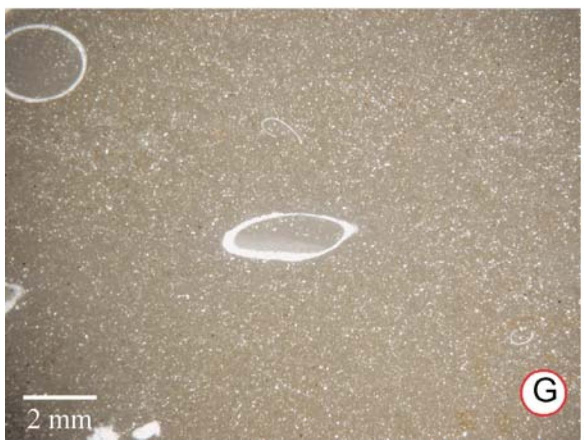
Thin-section microphotograph, in transmitted light, of Calcari nodulari inferiori (NAE)*.* NAE *consists of ammonite-bearing nodular limestone, with benthic foraminifers, spicules of siliceous sponges, crinoids, gastropods, brachiopods and ostracods.*



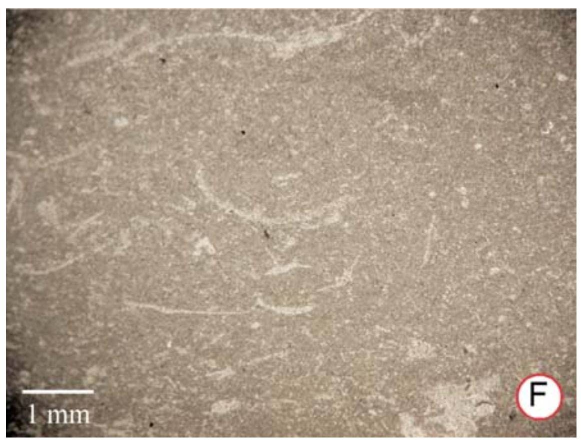
Thin-section microphotograph, in transmitted light, of dolomitized (dolomite rhombs) Calpionella limestone (Maiolica Fm., MAJ*). Dolomitization processes could affect both the epi-escarpment deposits and the overlying basinal facies.*



Thin-section microphotograph, in transmitted light, of Lower Liassic peritidal limestone (Calcare massiccio Fm., MAS*).*
This microfacies characterises the Early Jurassic Apennine Carbonate Palaeoplatform (ACP).



Thin-section microphotograph, in transmitted light, of a neptunean dyke (S. Angelo Romano area). The neptunean dykes found in the Cornicolani Mts. are generally filled with unfossiliferous mudstone/wackestone. In this case, some anellid shells characterize the fossiliferous content of the neptunean dyke.



Thin-section microphotograph, in transmitted light, of Calcari nodulari a Saccocoma ed Aptici (NAS)*. This wackstone with Saccocoma remains (pelagic crinoid) come from one isolated outcrop, to the north of S. Angelo Romano, which directly overlies the Calcare massiccio Fm.*

By means of microfacies and biostratigraphic analyses, these epi-escarpment deposits have been distinguished in Calcari nodulari inferiori (NAE, Pliensbachian p.p.), Calcari nodulari a filaments (NAF, Toarcian p.p.-Lower Bajocian) and Calcari nodulari a Saccocoma ed Aptici (NAS, Kimmeridgian p.p.-Tithonian).

NAE consists of light-brown nodular limestone with benthic foraminifers, spicules of siliceous sponges, crinoids, gastropods, brachiopods, ostracods and ammonite (Fig. 9D). South of Poggio Cesi, NAE crops out discontinuously and rests unconformably on the Hettangian-Sinemurian p.p. peritidal limestone. North of Poggio Cesi and in the Montecelio area, NAE rests paraconformably on the Calcare massiccio Fm. and is covered by the Corniola Fm. Both south of Poggio Cesi and north and east of S. Angelo Romano, NAE passes upwards to the Calcari nodulari a filaments (NAF).

NAF consists of filament-bearing grey and light-brown nodular limestone (Fig. 9B), with radiolarian spicules of siliceous sponges and ostracodes. SE of Poggio Cesi, NAF also contains protoglobigerinids (Fig. 9C). Many of the epi-escarpment deposits recognized in the Cornicolani Mts. belong to NAF.

NAS consists of grey-greenish and light-brown nodular limestones with Saccocoma, radiolarians and aptichi (Fig. 9F). In the area analysed, NAS has been found in one isolated outcrop north of S. Angelo Romano, resting unconformably on the Calcare massiccio Fm.

In the stratigraphy of the Cornicolani Mts., it is worth to note the occurrence of dolomitization processes that affect both the epi-escarpment deposits and the overlying basinal facies (Calcari diasprini Fm., Calcari con Saccocoma ed Aptici Fm. and Maiolica Fm.) (Fig. 9E).

Silicified Calcare massiccio Fm.

Silicified Lower Liassic peritidal limestone has been also detected in PCPs of the Umbria-Marche Apennines (DI BUCCI *et alii*, 1994; SANTANTONIO *et alii*, 1996; GALDENZI & MENICHETTI, 1999). SANTANTONIO *et alii* (1996) interpreted the occurrence of chert in the Calcare massiccio Fm. as the result of inflow of silica-rich diagenetic fluids through the still porous peritidal limestone of the PCP Jurassic escarpment (Fig. 9A).

In the Cornicolani Mts., silicification processes affected the Lower Liassic limestone of the Jurassic palaeoscarp just for a few decimeters from the escarpment surface (Fig. 9A).

Silicification in the Calcare massiccio Fm. is revealed by the occurrence of small nodules of white chert (mainly less than 1 cm in diameter) distributed on an irregular surface of peritidal limestone (Fig. 8). SE of Poggio Cesi, chert occurs in small neptunean dykes within the Calcare massiccio Fm.

Neptunean dykes

The occurrence of neptunean dykes mainly within the Lower Liassic peritidal limestone (Calcare massiccio Fm.) of the central Apennine PCPs has been reported by several authors (FARINACCI, 1967; COSENTINO *et alii*, 1982; GALDENZI, 1990; SANTANTONIO, 1993; GALLUZZO & SANTANTONIO, 1994; SANTANTONIO *et alii*, 1996).

In the area studied, 29 neptunean dykes have been observed within the Calcare massiccio Fm. (Fig. 10). On the field, they have been found either as single dykes or as clusters of dykes. These tectono-sedimentary features have a thickness which ranges from 2 meters to a few centimetres. The neptunean dykes found in the Cornicolani Mts. are generally filled with unfossiliferous light-brown or white wakestones (Figs. 11 and 9G). In the S. Angelo Romano area, the occurrence of brecciated wakestone on the walls of some neptunean dykes allow us to infer a multiple filling process, probably due to a late reactivation of the structure.

The attitude of the neptunean dykes found in the area has been measured and then plotted on an equal area stereo net (lower hemisphere) (Fig. 12). Most of the dykes show a general NW-SE trend. The pattern of the neptunean dykes found in the S. Angelo Romano quarry is referable to an extensional conjugate system. This system is characterised by a NNW-SSE mean orientation of the dykes and by a WSW-ENE extensional axis. The analysis of the neptunean dykes allows us to define the orientation of the Jurassic stress field that drove the onset of the PCPs and their later tectono-sedimentary evolution. It is worth noting that the orientation of the PCP palaeoscarp recognized in the Cornicolani Mts. is quite similar to the distribution of the main neptunean dyke system. Therefore, the genesis of the Jurassic palaeoscarp in the Cornicolani Mts. must be related to the activity of an extensional stress field with a WSW-ENE extensional axis (present coordinates).

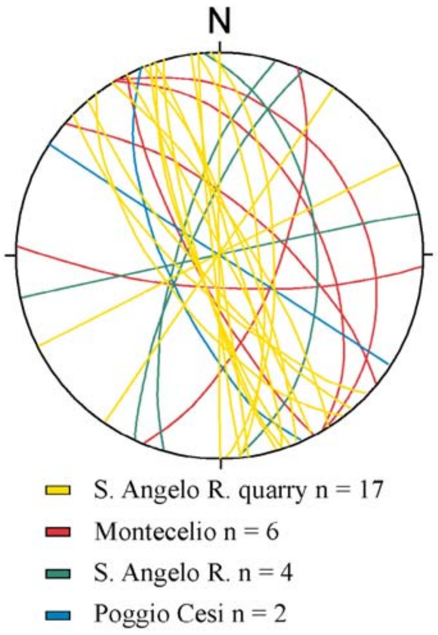


Fig. 12 - *Stereonet (Schmidt projection, lower hemisphere) showing the pattern of the neptunian dykes measured in the Cornicolani Mts.*

Fig. 10 - *Panoramic view of S. Angelo Romano quarry (south of S. Angelo Romano village). The massive Lower Jurassic peritidal limestone of the* ACP *(Calcare massiccio Fm.) is cut by NNW-SSE neptunean dykes* (D).
In the same quarry, this PCP *feature has been found either as single dyke or as cluster of dykes. Generally speaking neptunean dykes shown the same geometry of the* PCP *palaeoscarp.*

Fig. 11 - *Detail of a neptunean dyke cutting across the whitish Lower Jurassic peritidal limestone (Calcare massiccio Fm.) of the S. Angelo Romano quarry. In this case, unfossiliferous light-brown wakestone characterises the dyke filling.*

MAPPING A PCP AREA

As mentioned, the main features that characterise the geology of a PCP are: 1) widespread outcrops of Early Liassic peritidal limestones (Calcare massiccio Fm.); 2) reduced-thickness of Jurassic deposits; 3) presence of Jurassic nodular pelagic limestones, containing no chert; 4) silicified processes within the Calcare massiccio Fm.; and 5) neptunean dykes in the Early Liassic peritidal limestone.

A map showing the geology of a PCP area should report all these features using appropriate symbols. Depending on map scale, and due to their reduced thickness, the different nodular pelagic limestones that characterize a PCP area could be represented separately, in different colours, or jointly by the same legend unit. The map distribution of the nodular pelagic limestones, as well as their stratigraphic relationship with the underlying peritidal limestones, could suggest the extent of the PCP area and related sub-environments.

When mapping silicified peritidal limestones, the geometry of the PCP epi-escarpment can be shown directly on the map. In the Cornicolani Mts. PCP map, the silicified Calcare massiccio Fm. is shown by a blue net halftone-screen. This kind of representation allows us to highlight the geometrical trend of the PCP epi-escarpment palaeoenvironment. As shown in the geological map, the PCP outcropping in the Cornicolani Mts. has a NNW-SSE-striking palaeoscarp.

Finally, in a PCP geological map it is useful to represent the neptunean dykes cutting the Calcare massiccio Fm. Generally, neptunean dykes occur as single dykes and/or as clusters of dykes. A cluster of dykes is defined as several dykes having the same attitude and occurring over a relatively small area. We suggest that both of these be shown, so as to provide a more complete picture of the orientation of the PCP palaeoscarp.

The neptunean dykes that affect the Calcare massiccio Fm. are generally too thin to be mapped, so they can be represented using graphic symbols showing both their occurrence and their attitude.

3D GEOLOGY OF THE CORNICOLANI MTS. PCP

Having a three-dimensional view is one of the most important requirements for geologists, and representing the third dimension (depth) of a geological feature has always been a goal for prospecting geology. Cross-sections, fence-diagrams and block-diagrams are routinely used to depth-extrapolate geological surface data, but up to now 3D geological reconstructions have been rough estimates and generally calculated by hand. Today, advances in computing techniques providing the possibility to process vast quantities of data have resulted in the development of a wide range of tools to record and represent the location and characteristics of natural features (GIS).

For the production of a 3D geological model of the Cornicolani Mts., ERDAS Imagine 8.3.1 was first used to create a georeferenced geological database. Autocad Map 2000 was used for the vectorization of two basic linear themes (stratigraphic boundaries and tectonic lines). The vectorial-files (.dwg) thus obtained were imported in Arcview GIS 3.2 and converted into shape-files (.shp). A polygon data structure was created to describe the topological properties of areas representing the different mapped units. Using Arcview GIS 3.2, the polygonal dataset was combined with the DEM (mesh 20 m x 20 m) to provide a gridded database. With the DEM surface as reference, and using ArcGis 8.1, the 3D views of the Cornicolani Mts. PCP were then obtained (Figs. 13A and B).

We realized two block diagrams from different views (from the SE in Fig. 13A and from the NW in Fig. 13B) in order to illustrate the depth-extrapolated geology on all four sides of the 3D view. In Figs. 13A and 13B, both the PB and the PCP Jurassic successions crop out in the Cornicolani Mts. In the NE sector of the study area (Fig. 13B), the outcropping succession is referable to a north-eastward deepening PB.

Taking into account the surface geology of Montecelio and of the surrounding areas, the south-eastward extension of a PB has been inferred below the Neogene-Quaternary post-orogenic covers (Fig. 13A).

Generally speaking, moving westwards from the PB, Jurassic PCP epi-escarpment features crop out all over the study area. Therefore, the Jurassic PCP must be supposed to extend in the central-western Cornicolani Mts., probably as a part of, or connected with, the Sabina Plateau (GALLUZZO & SANTANTONIO, 2002).

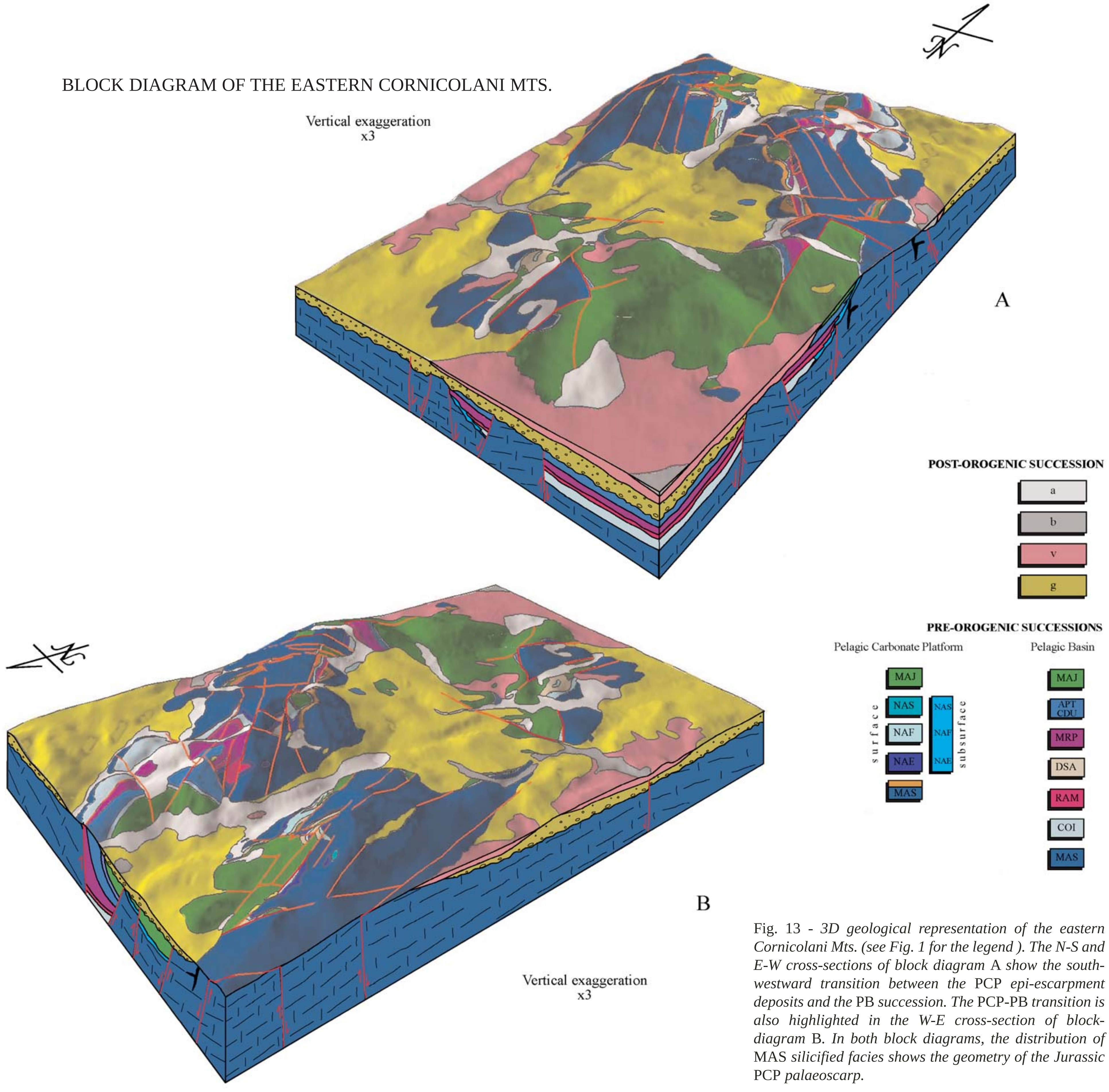


Fig. 13 - *3D geological representation of the eastern Cornicolani Mts. (see Fig. 1 for the legend). The N-S and E-W cross-sections of block diagram* A *show the south-westward transition between the* PCP *epi-escarpment deposits and the* PB *succession. The* PCP-PB *transition is also highlighted in the W-E cross-section of block-diagram* B*. In both block diagrams, the distribution of* MAS *silicified facies shows the geometry of the Jurassic* PCP *palaeoscarp.*

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