Carbonate buildups and associated facies in the Monte Facito Formation (southern Apennines)

CIARAPICA, Gloria, et al.

Abstract

In this paper the buildups and the associated facies belonging to the Upper part of the Monte Facito Formation are described. They show a first stage of colonization by encrusting organisms; the growth of the carbonate complex was locally interrupted by terrigenous deposition. The drowning of the buildups was caused by an increase of subsidence with the deposition of Ammonitico Rosso facies and then of radiolarite marls. The upper part of the Mt. Facito Formation is referred to the Ladinian on the basis of foraminifers, brachiopods, calcareous sponges, dasycladacean algae, palynomorphs and ammonites.

Reference

CARBONATE BUILDUPS AND ASSOCIATED FACIES
IN THE MONTE FACITO FORMATION (SOUTHERN APENNINES)

Nota dei Soci GLORIA CIARAPICA (*), SIMONETTA CIRILLI (**) , ROSSANA MARTINI (**), ROBERTO RECTORI (*) & LOUISETTE ZANINETTI (***) e di GIOVANNA SALVINI-BONNARD (****)

ABSTRACT

In this paper the buildups and the associated facies belonging to the Upper part of the Monte Facito Formation are described.

They show a first stage of colonization by encrusting organisms; the growth of the carbonate complex was locally interrupted by terrigenous deposition.

The drowning of the buildups was caused by an increase of subsidence with the deposition of Ammonitico Rosso facies and then of radiolarite marls.

The upper part of the Mt. Facito Formation is referred to the Ladinian on the basis of foraminifers, brachiopods, calcareous sponges, dasycladacean algae, polynyms and ammonites.

KEY WORDS: Triassic, Biostratigraphy, Sedimentology, Southern Apennines.

RIASSUNTO

Vengono descritti i buildups e le facies associate appartenenti alla porzione superiore della Formazione di Monte Facito (Appennino meridionale). È stato riconosciuto uno stadio iniziale di colonizzazione da parte di organismi incrostanti, seguito poi dal pieno sviluppo dei corpi biocstruiti la cui crescita veniva localmente interrotta dall'avvento di materiale silicoclastico fine.

Il definitivo annegamento del complesso carbonatico è attribuito ad una ripresa della subsidenza con conseguente deposizione di facies tipo Ammonitico Rosso prima e marnoso radiolaritico successivamente.

In base alle associazioni a foraminiferi, brachiopodi, alghe dasycladacee, spugne calcaree, palinomorfi ed ammoniti la porzione superiore della Formazione di Monte Facito è stata riferita al Ladinico.

TERMINI CHIAVE: Trias, Biostratigrafia, Sedimentologia, Appennino meridionale.

The Mt. Facito Formation (Early Triassic - Ladinian) is the lowermost portion of the Lagonegro sequences; in the Basilicata region it mainly crops out in the Moliterno (southward) and Brienza (northward) area.

The Mt. Facito Formation upwards makes transition to the Late Triassic Cherty Limestones (Monte Sirino Formation) whose base is referred to as the Late Ladinian for the presence of conodonts (Mietto & Panzanelli Fratoni, 1990). The contact between these two formations is often tectonized.

The Monte Facito Fm. was formerly divided in two members (Scandone, 1965); recent studies have pointed out the necessity of a formal revision and have suggested a provisional subdivision in four members (Ciarapica et al., 1988; 1990). Topic of this paper is the member “C”, in the upper portion of the Mt. Facito Formation (fig. 1).

The most characteristic elements in the upper portion of the Monte Facito Formation are the carbonate organic buildups which show up in the landscape. The origin, the position of the buildups and their connections with the other lithofacies were the topic of many discussions and doubts in the past: buildups or olistoliths? (Scandone, 1972; Wood, 1981).

The Cerchiara area, east of Brienza, provides good exposures of sequences made of flat-lenticular massive carbonate bodies separated
In thin section these limestones reveal microfacies mainly composed of boundstone and, subordinately, of wackestone, packstone and grainstone.

The boundstone is mainly made of several encrusting organisms (cyanobacteria, foraminifers and Incertae sedis), green algae (Dasycaledales) and calcisponges (Sphinctozoa). The prevalent type of boundstone is that resulting by trapping and stabilization (bindstone and subordinately bafflestone) (fig. 2). True calcisponge framestones were just seldom found.

The activity of the encrusting organisms produced dark, densely linked masses with small irregular cavities. Many generations of isopach, fibrous and dirty cements often form thick coatings around the various organisms (fig. 3); they can also fill intrastructural cavities of different sizes. The origin of these cements is probably due to cyanobacteria activity which aided the processes of calcium carbonate precipitation and thus the early cementation which caused the rigidity of the buildups.

Boundstones made of green algae (Dasycaledales) have often been found, but these organisms are more frequent as bioclasts because of their frail structures.

The following species have been recognized:

-Diplopora annulata (Schaffault, 1863) (fig. 8);
-Teutoporella herculi (Stoppani, 1857);
-T. nodosa (Schaffault, 1863) (fig. 2, B).

The Sphinctozoa are frequent, in small sizes (max 4 - 5 cm); they can build colonies about 20 cm high. The main recognized species are:

-Colospongia catenulata Ott, 1967 (fig. 2, A);
-Dicycoela manon manon (Munster, 1841);
-Folicatena cautica Ott, 1967 (fig. 2, A);
-Paravaesicocaulis sp.;
-Uvamella irregularis Ott, 1967.

Foraminifers are also frequent and various. During the last two years new genera and species have been recorded together with other species already known in the Mt. Facito Formation but never recorded in other localities. The foraminifer content of the massive grey limestones consists of the following forms:

-Abriolina mediterranea Luperto, 1963 (fig. 4: H);
-Ammobaculites sp.;
-Astacolus sp.;
-Austrocolonia sp. (fig. 5: B);
-Bigenerina sp.;
-Endothyra spp. (fig. 5: D);

by intervals of marls or radiolarites. One of them passes, upwards, to Ammonitico Rosso facies which grades into reddish radiolarite marls. At the base of some carbonate bodies it is possible to recognize a horizon of black limestone.

The same field relationships among the different lithologic types have been found in other areas, even if much more discontinuously.

**MASSIVE GREY LIMESTONES**

They form lenticular massive buildups 80 to 100 m thick. On the weathered surface “embroidery-like” structures can be found. They are due to a framework of small and irregular cavities without any main direction.
Fig. 2 - A) Boundstone with Colospongia catenulata (left) and Follicatena cautica (neg. print) (x 5.5, RF-P): note the amounts of fibrous cements among the grains and the two cavities filled by micrite; B) Teuitlorella nodosa (x 5.5, SR-G); C) Boundstone with Cayeuxia (neg. print) (x 10, CE 53).
Fig. 3 - A-E) Fibrous dirty cements in the boundstone: they fill small cavities and coat various organisms leaving cavities filled by micritic sediments (D) (x 100); F chain of fungal spores (x 1500).

*Endothyrannela pentacamerata* Salmi, 1967;
*E. robusta* Salmi, 1978;
*E. virzi* (Koehl-Zaninetti, 1968) (fig. 5: E);
*Endothyrannela* sp.;
“Gentinza” sp. (fig. 5: A);
*Lamelliconus multispirus* (Oberhauser, 1957) (fig. 4: G);

*Lenticulina* sp.;
*Nodosaria* sp.;
*Nodosinella libera* Trifonova, 1967;
*Nubecularia* sp.;
*Ophthalmidium abriolense* (Luperto, 1965) (fig. 4: E);
*Ophthalmidium* spp.;
Fig. 4: A) Palaeolituonella meridionalis (x 108, SR 2-1); B, C) Turriglomina magna (x 108, ORG 5); D) T. scandonei (x 108, CE 8-3); E) Ophthalmidium abriolense (x 158, CE 18 s 5); F) Oberhauserellidae (x 158, CE 9 s 3); G) Lamelliconus multispirus (x 64, CE 37); H) Abriolina mediterranea (x 158, SR 2-1).

“Pachyphoia” sp. (fig. 5: C);
Palaeolituonella meridionalis (Luperto, 1965) (fig. 4: A);
Paraphthalmidium aff. P. carpathicum Salaj & Borza, 1981;
Reophax spp. (fig. 5: F);
Textularia sp.;
“Tetrataxis” sp.;
Turriglomina magna (Urosevic, 1981) (fig. 4: B, C);
Fig. 5 - A) "Geinitzina" sp. (x 108, CE 1-3); B) Austrocolomia sp. (x 108, CE 15 s 1); C) "Pachiphloia" sp. (x 108, CE 8-6); D) Endothyra sp. (x 108, CE 23 s 2); E) Endothyraenella wirzi (x 54, CE 22 s 3); F) Reophax sp. (x 30, ORG 1 s 5).

*T. mesotriasica* (Koehn-Zaninetti, 1968);
*T. scandonei* Zaninetti, Ciarpica, Martini, Salvini-Bonnard & Rettori, 1987 (fig. 4: D);
*Turrispirillina* sp.;
*Ammodiscidae*;
*Ataxophoramidae*;
*Duostominidae*;
*Oberhauserellidae* (fig. 4: F);

*Trochamminidae*;
*?Spriamphorellinae* (fig. 6: A, B).

*Incertae sedis* organisms are frequent and important in the boundstone. The main species are:
*Baccanella floriformis* (Pantic, 1971) (fig. 7: C);
*Bacinella irregularis* (Radocic, 1959) (fig. 7: D);
Earlandia amplimuralis (Pantic, 1972) (fig. 6: D); E. gracilis (Pantic, 1972) (fig. 6: C); G. minuta Borza & Misevic, 1975; Microtubus communis Flügel, 1964 (fig. 7: A); Muranella sphaerica Borza, 1975; Tubiphytes obscurus (Maslov, 1956) (fig. 7: B).

Small colonies of corals have been rarely found.

Within the buildups it is easy to find pockets or levels of packstone and/or grainstone containing the same organisms present in the boundstone (fig. 8).

Some levels are made of packstones with echinoderms and, sporadically, of lumachellas with undeterminable ammonites.

Oncoids are scarce and ooids are absent.

The described facies can be referred to as buildups of a low to moderately high energy environment. The true builders are the encrusting organisms, but the cyanobacteria played a very important role; in fact, they allowed the stabi-
lization of the mounds through early cementation processes (Monty, 1982). All the other recorded organisms can be considered as "companion" organisms.

This kind of buildups can be considered as "spar-cemented organically bound skeletal-debris reef" according to Heckel's classification (Heckel, 1974).

**BLACK LIMESTONES**

This lithologic type is well distinguishable from the above described massive limestones mainly because of the marly content which makes it easily weathered. The black limestones generally lie at the base of the buildups of which they would represent the first stage of growth, that is bottom colonization by «pioneer» encrusting organisms (fig. 11).

This vertical zoned trend was already recognized in other Ladinian and Late Triassic reefs (Schäfer & Senowbari-Daryan, 1981; Flugel, 1982; Fois, 1982).

In thin section these limestones often shows a boundstone texture with micrite. The recognized encrusting organisms are the only builders; they are abundant, but represented by few species, such as:

*Poripheritubus buseri* Senowbari-Daryan, 1984 (fig. 8);
*Tubiphytes obscurus* (Maslov, 1956) (fig. 7: B);
*Tabulozoa*;
they are often in association with *Eurandella amplimuralis* (Pantic, 1972) (fig. 6: D).

The micrite, often pseudospar, contains very small abundant tubes, probably referable to as cyanobacteria; they can be well observed on the fibrous cements which border and fill the cavities. Levels and pockets of wackestone and
Fig. 8 - Top: Grainstone with Dasycladales (*Diplopora annulata*) and other bioclasts (neg. print) (x 5,5, ORG 1); bottom: boundstone with *Poriferitubus buseri* (negative print) (x 5,5, PM 33).
packstone are frequent; they locally show mottled structures mainly due to bioturbation or to compaction and fluid escape.

The paleontologic content presents an oligotypic character: the porcellaneous (Ophthalmidium spp.) and the calcareous-hyaline (Nodosariidae) foraminifers are rather common, whereas those with microgranular test are

---

Fig. 9 - A) ?Striatoabietes aytugii (x970, CE 209); B) ?Cucullispora cuneata (x1370, CE 234); C) Vitreisporites pallidus (x1500, CE 209); D) Anapiculatisporites sp. (x1800, CE 25); E) Triadispora modesta (x1800, CE 234); F) Platysaccus sp. (x1500, CE 234); G) Protodiploxypinus gracilis (x1500, CE 234); H) Triadispora sp. (x1370, CE 234); I) Micrhystidium sp. (x1800, CE 234); L) Aratriiosporites sp. (x1800, CE 234).
scarce (*Endothyranella* spp., *Endothyra* spp.).

The black limestones associated with marls at Pietra Maura and in the Cerchiara area are rich in brachiopods. The specimens of Pietra Maura have been already studied by Taddei Ruggieri (1968) who recognized an association mainly composed of:

*Anisactinella* cfr. *stoppanii* (Salomon, 1985);
*Punctospirella fragilis* (Schlotheim, 1814).

Other specimens of brachiopods coming from the black limestones of Pietra Maura and Cerchiara area are now being studied.

**RED AND YELLOW MARLS**

These beds are associated with the gray massive and black limestones; sometimes they contain levels with *Daonella*.

In the Cerchiara sequence a palynological assemblage was recorded; the palynomorphs are not well preserved, because of oxidation and tectonics. The following forms have been recognized:

*Alisporites* sp.;
*Anapiculatisporites* sp. (fig. 9: D);
*Atratrisporites* sp. (fig. 9: L);
? *Cucullispora cuneata* Scheuring, 1970 (fig. 9: B);
"Lueckisporites" cf. *singhii* Balme, 1970;
*Platysaccus* sp. (fig. 9: F);
*Protodiploxypinus gracilis* Scheuring, 1970 (fig. 9: G);
? *Striatoabietes* ayugii Visscher, 1966 (fig. 9: A);
*Todisporites* sp.;
*Triadispora modesta* Scheuring, 1970 (fig. 9: E);
*T. stabilis* Scheuring, 1970;
*Triadispora* sp. (fig. 9: H);
*Vitreisporites pallidus* (Reissinger) Nilsson, 1958 (fig. 9: C);

Scarce badly preserved specimens of:
*Brachysaccus* sp.;
*Ovalipollis* sp.;
*Protodiploxypinus* sp.

Badly preserved Triassic *Bactryllium* and *Nodosariidae* have also been found in these marls.

In the Cerchiara area, where a well exposed sequence can be observed, the marls overlying the buildups represent the sudden deposition of fine grained terrigenous sediments; the terrigenous influx produced the pollution of the depositional environment and locally caused temporary crisis in the buildup development.

**AMMONITICO ROSSO FACIES**

They consist of massive or nodular pink limestones and generally directly overlie the buildups.

The massive facies of the Ammonitico Rosso sometimes fills the infrastructural primary and, more seldom, the dissolution cavities of the buildups.

Porcellaneous (Ophthalmidium abriolense) and calcareous-hyaline foraminifers are present in the wackestones:

*Abriolina mediterranea* Luperto, 1965 (fig. 4: H);
"Pachyphloia" sp. (fig. 5: C);
"Getnirzina" sp. (fig. 5: A);
*Lenticulina* sp.;
*Astacolus* sp.;
*Austrocolomia* sp. (fig. 5: B);
*Oberhauserellidae* (fig. 4: F).

The massive Ammonitico Rosso facies contains also brachiopods and undeterminable ammonites.

The nodular Ammonitico Rosso facies is made up by pink, micritic nodules separated by a red matrix; the nodules and the matrix are rich in filaments and radiolarians (fig. 10). Calcareous-hyaline and porcellaneous foraminifers can be found in the nodules.

The Ammonitico Rosso facies represent the drowning of the buildups.

![Fig. 10 - Wackestone from the Ammonitico Rosso with radiolarians, filaments and brachiopod shells. In the center a longitudinal section of ammonite (neg. print) (x4, CE 9 s 3).](image-url)
Fig. 11 - Paleoenvironmental evolution during the Middle Triassic: 1) shallow water areas with clastic sedimentation; 2) stage of colonization of the bottom by encrusting "pioneer" organisms, in oligotypic associations, which built small and flat mud mounds; 3) growth of the buildups by the combined activity of different and more diversified organisms; 4) drowning of the buildup complex and spreading of Ammonitico Rosso facies and radiolarites.

STRATIGRAPHIC CONSIDERATIONS

The rich paleontologic content of the upper part of the Mt. Facito Formation (foraminifers, brachiopods, pelecypods and palynomorphs) indicates, at least, the Ladinian, but some species of each group have a stratigraphic range extending from the Anisian to the Carnian. Further problems for the exact stratigraphic position of each lithotype derive from the absence
of a perfect calibration among the different biostratigraphic scales.

The conodonts recently studied (Mietto & Panzanelli Fratoni, 1990) have given precious informations:

— the base of the cherty limestones (Mt. Si-rino Fm.) is assigned to the Late Longobardian, therefore the sedimentation of Mt. Facito Fm. ended inside the Ladinian, and the Carnian age can be excluded;

— the Ammonitico Rosso facies directly overlying the buildups are everywhere referable to as the Late Fassanian.

The brachiopods of the black limestones at Pietra Maura seem to indicate the Late Anisian; the fossil assemblage which is being studied (ammonites and brachiopods) could provide new elements for dating the beginning of the buildups development.

ENVIRONMENTAL EVOLUTION

A preserved sequence of the Cerchiara area shows some of the original relations among the different lithologic units of the buildups member. Five carbonate bodies crop out in vertical bedding and N-S strike. The lowermost two are buildups, separated by marls; the third is actually a tectonic doubling of the second one and it is overlaid by Ammonitico Rosso facies and by radiolarites; the uppermost two are embedded in the radiolarites and respectively could be a carbonate slide and a calcarenite bank.

— The lowermost buildup (100 m thick) shows a vertical zonation with black limestones at the base;

— this buildup is followed upwards by yellow and red marls which contain a thick level of black limestones with brachiopods, ammonites and crinoids;

— the second buildup, which can be followed northwards, underlies Ammonitico Rosso facies and laterally passes to carbonate breccias in a red marly matrix;

— the Ammonitico Rosso make transition upwards to radiolarites.

This sequence suggest the former existence of shallow water areas locally colonized by pioneer encrusting organisms. These small areas could have represented the necessary hard bottom for the further development of the buildups by several and more differentiated organisms.

Temporary fine terrigenous influx could have locally interrupted the growth of the buildups, causing the necessity of a new phase of colonization.

The drowning of the buildups (Ammonitico Rosso facies) is mainly due to the increase in the subsidence rate connected with block-faulting. These same tectonic events could have caused the split of some buildups producing carbonate clasts of different sizes embedded within a pelagic radiolarite matrix (fig. 11).

The definitive drowning of the carbonate platform complex is documented by the radiolarites and radiolaritic marls of the uppermost part of Monte Facito Fm.

ACKNOWLEDGEMENTS

The authors wish to thank Prof. Leonsevero Passeri for his support during each stage of the research, Prof. Vittorio De Zanche and Paolo Mietto for the interesting discussions on the field. Thanks are also expressed to Prof. Claude Monty who enriched our knowledge about cyanobacteria and their effects in carbonate rocks during two days of discussion and Prof. James L. Wilson who supported our studies on the buildups with many examples of other situations and stimulating discussions. We wish also to remember Dr. Pompeo Limongi and Dr. Roberto Panzanelli Fratoni who, first among us, studied the Mt. Facito Fm.

Manoscritto consegnato il 31 gennaio 1989
Testo accettato per la stampa il 26 giugno 1989
Ultime bozze restituite il 27 marzo 1990

REFERENCES


