R.C.M.N.S. Interim Colloquium

MARCH 2011 - SCONTRONE (L'AQUILA), ITALY

Field Guide to the Post-Conference Excursions (Scontrone, Palena and Montagna della Majella)

4 – 5 March 2011

Edited by

Giorgio CARNEVALE*, Etta PATACCA** & Paolo SCANDONE**

**Dipartimento di Scienze della Terra, Università degli Studi di Torino*

***Dipartimento di Scienze della Terra, Università di Pisa*

Excursion 1: Scontrone, 4th March 2011.

THE MIOCENE DEPOSITS OF SCONTRONE

Etta PATACCA* & Paolo SCANDONE* & Giorgio CARNEVALE**

*Dipartimento di Scienze della Terra. Università di Pisa
**Dipartimento di Scienze della Terra. Università degli Studi di Torino

The Scontrone vertebrate remains are contained in the transgressive basal portion of the *Lithothamnium* Limestone Formation (Scontrone Member of the *Lithothamnium* Limestone in Patacca et al., 2008) which overlies in unconformity different terms of the Cretaceous-Paleocene sequence with a temporal gap spanning between 45 and 80 Ma north-west of Scontrone and reaching at least 120 Ma south-east of the village (see geological map in foldout 1, columnar sections in foldout 2, and their geographic location in Fig.1). A complete section of the Scontrone Member crops out in the Sangro Gorge on top of upper Paleocene calcirudites characterized

Figure 1. *Panoramic view on Scontrone showing the location of the stratigraphic sections described in the text and illustrated as columnar sections in foldout 2.*

Sangro Gorge on top of upper Paleocene calcirudites characterized by huge clasts of *Polystrata alba* and *Archeolithothamnium* boundstones (Coral-algal Limestone). The Thanetian age of these deposits is indicated by the presence of *Planomalina cretae*, *Miscellanea* sp., *Cuvillierina* sp., *Discocyclina* sp. and rare *Morozovella* sp. recovered in the matrix of the breccias. In the Scontrone North and Scontrone Fossil Site sections the Scontrone Member overlies in disconformity upper Albian-Turonian skeletal debrites and redeposited litho-bioclastic calcarenites rich in echinodermal plates, fragments of corals, well-rounded fragments of rudists (requienids) and oversized calcareous lithoclasts (Rudist-bearing Calcarenite; Fig. 2.1). These resediments have obviously derived from penecontemporaneous high-energy shoals connected with rudist banks. In the lower/middle part of the Rudist-bearing Calcarenite the dominant lithologies are represented by bioclastic packstones with orbitolinids and fragments of caprinids. Sporadic intercalations of hemipelagic foraminiferal wackestones document the late Albian *Rotalipora ticinensis* Zone (*Hedbergella, Ticinella* and *Globigerinelloides* associated with *Rotalipora ticinensis, Ticinella roberti, Biticinella breggiensis* and *Planomalina buxtorfi*). The fossil content in the upper portion of the Rudist-bearing Calcarenite is mostly represented by fragmented radiolitids, *Pithonella*-like calcisphaerulids and echinodermal plates associated with sporadic planktonic foraminifers (*Praeglobotruncana gibba* and *Dicarinella imbricata*) attesting the Cenomanian-Turonian (*Whiteinella archeocretacea* and *Helvetotruncana helvetica* Zones). In the Scontrone Fossil Site area the first occurrence of *Marginotruncana pseudolinneiana* and *M. coronata* in the uppermost portion of the Rudist-bearing Calcarenite documents the middle/late Turonian. In the Scontrone South section the Scontrone Member lies above the Neocomian-Barremian platform-edge carbonates of the Terratta Formation represented by reefal boundstones with a rich and extremely diversified fossil assemblage including stromatoporoids, crinoidal plates, calcareous sponge, *Tubiphytes morronensis*, *Cayeuxia* and *Bacinella irregularis/Lithocodium aggregatum* (Fig. 2.2) locally associated with *Nautiloculina* spp., *Trocholina* spp. and *Protopeneroplis ultragranulata*.

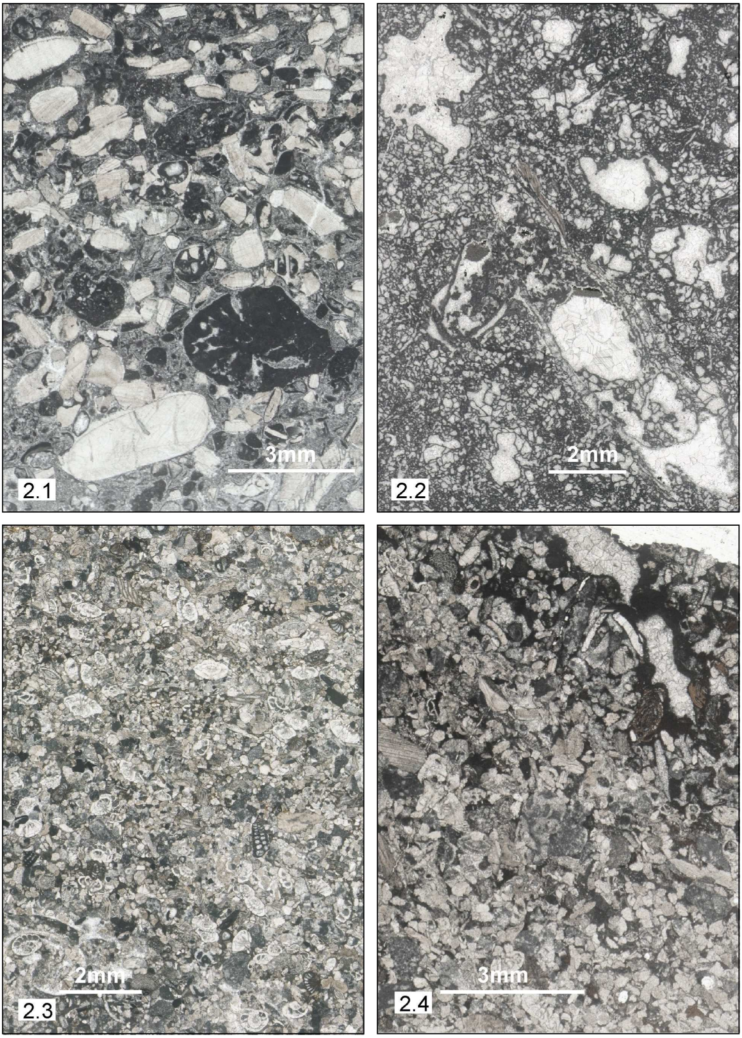

Figure 2.1. *Scontrone Cemetery section. Litho-bioclastic packstone with very well-rounded fragments of rudists (requienids) and oversized*

calcareous lithoclasts. In the lower-right side, intensively bored lithoclast. Upper Albian-Turonian Rudist-bearing Calcarenite. **2.2**. *Scontrone South section. Bacinella irregularis/Lithocodium aggregatum boundstone. Neocomian-Barremian Terratta Formation.* **2.3**. *Scontrone North section. Lithobioclastic grainstone/packstone with numerous thick-shelled Ammonia and porcellanaceous benthic forams. Scontrone Member of the Lithothamnium Limestone, interval* ***a***. **2.4**. *Sangro Gorge section. Bioclastic packstone with Ammonia and Elphidium. The bifurcating, thinning downward large tubular structure coated by a thick dense micrite is a rhizolith structure. Scontrone Member of the Lithothamnium Limestone, upper portion of the* ***a*** *interval.*

The Scontrone Member of the *Lithothamnium* Limestone (Patacca et al., 2008) represents a fortuitous relic of paralic deposits escaped from the erosive ravinement usually accompanying the shallow-marine Tortonian transgression. In the outskirts of Scontrone these paralic deposits display rapid facies variations within a quite small area (see columnar sections in foldout 2). The complex lateral variations and stratal architecture, which made difficult correlations from one site to the other, required detailed stratigraphic and sedimentological analyses. In this guidebook the Scontrone Member has been divided into four intervals featuring two major parasequences. The lower parasequence, ranging in thickness from 8 metres in the Sangro Gorge section to 3 metres in the Scontrone Fossil Site and Scontrone South-West sections and characterised by an overall shallowing and thinning-up stratal architecture, has been referred to a storm-dominated coastal environment. The overlying thicker parasequence, which directly onlaps the Neocomian platform margin in the Scontrone South area, is characterized as a whole by a shallowing and coarsening-up stratal architecture. The deposition of this parasequence took place in a wave-dominated barrier-lagoon coastal setting. The second parasequence of the Scontrone Member is truncated at the top by a ravinement surface developed at the base of the high-energy shallow-marine carbonates forming the lower portion of the Lithothamnium Limestone Formation in the bulk of the Central Apennines where the Scontrone Member is lacking.

The transgressive tract of the lower parasequence, representative of high-energy coastal bars (interval **a** in the columnar sections of foldout 2), consists of 2.5 metres of buff to off-white mottled calcarenites locally showing a faint large-scale and low-angle cross stratification. In thin section these calcarenites are represented by litho-bioclastic grainstone/packstones with abundant large-sized *Ammonia* and frequent *Elphidium crispum* together with relatively abundant porcellanaceous benthic foraminifers (Fig. 2.3). The *Ammonia*-and-*Elphidium* association indicates a nearshore environment with clean-hard substrate. The lithoclasts, all very well rounded and often bored, have derived from older well-lithified lithologies. In addition, the presence of abraded specimens of isolated late Cretaceous globotruncanids and of micritized Paleogene-early Miocene large foraminifers indicates strong subaerial erosion and severe physical reworking and winnowing of the eroded material. Near the top, the bio-lithoclastic calcarenites show vertically-elongated root traces with their micritic coating, as well as strong bioturbation (Fig. 2.4). A thin layer (20-25 centimetres) of pervasively rooted, yellow-to-pink very-fine-grained calcarenite (Fig. 3.1) lies on top of the shallow-water calcareous sand bars. This calcarenite is characterized by very well-rounded mostly biogenic carbonate grains set in a reddish FeO-stained dense micrite matrix of pedogenic origin. The calcarenite layer has been interpreted as a supratidal wind-driven deposit marking the beginning of the

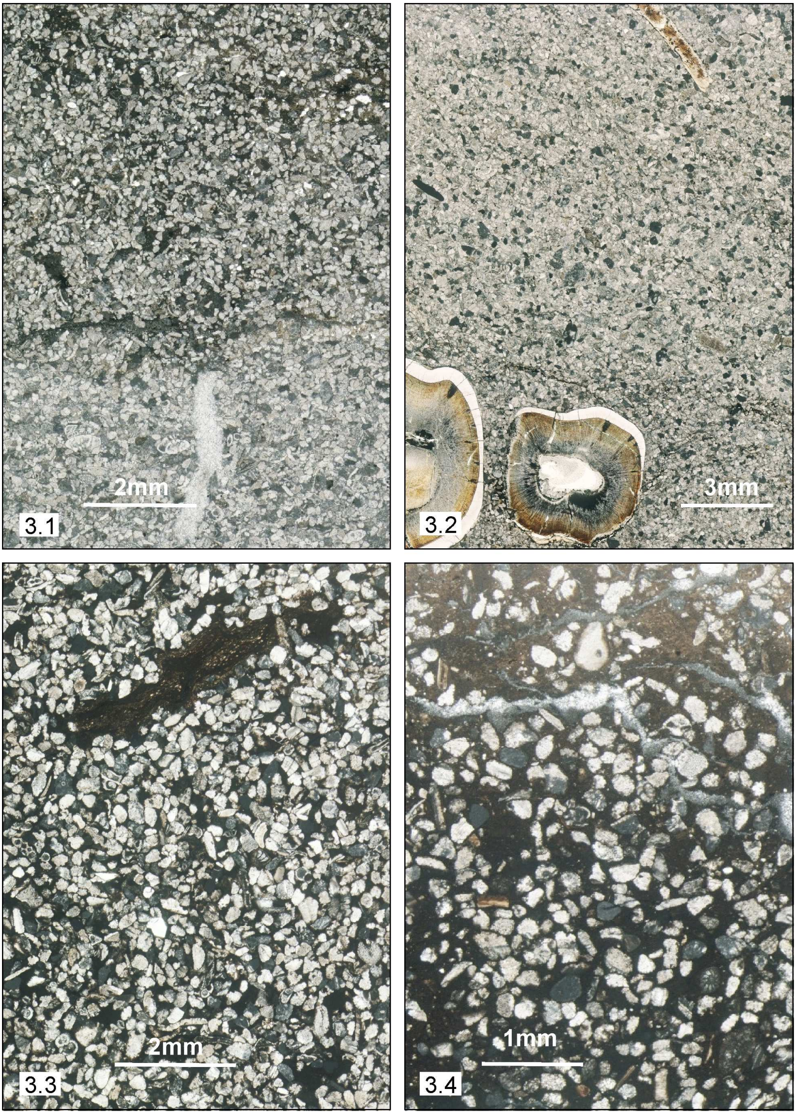

***Figure 3.1**. Scontrone Fossil Site section. Bioclastic packstone with large specimens of Ammonia (lower side) crossed by a vertical bifurcating spar-*

*filled root mould. A dark irregular string marks the contact with the overlying eolian carbonate. Scontrone Member of the Lithothamnium Limestone, top of the **a** interval. **3.2**. Scontrone Fossil Site section. Well-sorted litho-bioclastic packstone with well preserved vertebrate teeth (lower-left side) showing the characteristic brownish dentine surrounded by a thick rim of colourless enamel. In the upper-right side a vertebrate bone fragment is present. Scontrone Member of the Lithothamnium Limestone, top of the **a** interval. **3.3**. Scontrone South-West section. Wind-blown marine biogenic detritus sparse in a dense pedogenic micrite matrix. Presence of sparse planktonic forams landward transported during storm events. A large dark-brown root (upper-central part) still retaining a perfectly preserved cellular structure at very high magnification. Scontrone Member of the Lithothamnium Limestone, top of the **a** interval. **3.4**. Scontrone South-West section. Wind-blown biodetritus associated with small rounded micrite grains set in a rubified pedogenic micrite. In the upper part of the picture, net of root traces and geopetally-filled syneresis cracks. Scontrone Member of the Lithothamnium Limestone, top of the **a** interval.*

regressive moment of the parasequence. The bulk of the Scontrone vertebrate remains have been recovered from this horizon (Fig. 3.2). The subaerial origin of the rubified calcarenite veneer is proven by the occurrence of large rhizoliths (Fig. 3.3) and by the presence of a close network of root traces (Fig. 3.4). A subaerial origin is also indicated by the abundance of medium to fine-sand-sized calcareous extraclasts associated with reworked and broken tests of planktonic and benthic foraminifers plus unidentified bioclasts. The presence of allochthonous material, the fauna derivation from different realms and the general conditions of the tests unequivocally attest eolian deposits accumulated by deflation processes on marine-derived materials. In conclusion, the results of the performed petrographic analysis show that the deposit yielding the Scontrone vertebrates is a wind-driven calcarenite draping the top of subtidal sand bars. Modern eolian carbonates are common along arid to semiarid wind-exposed coastlines located in wide carbonate-ramp settings with abundant calcareous-sand production.

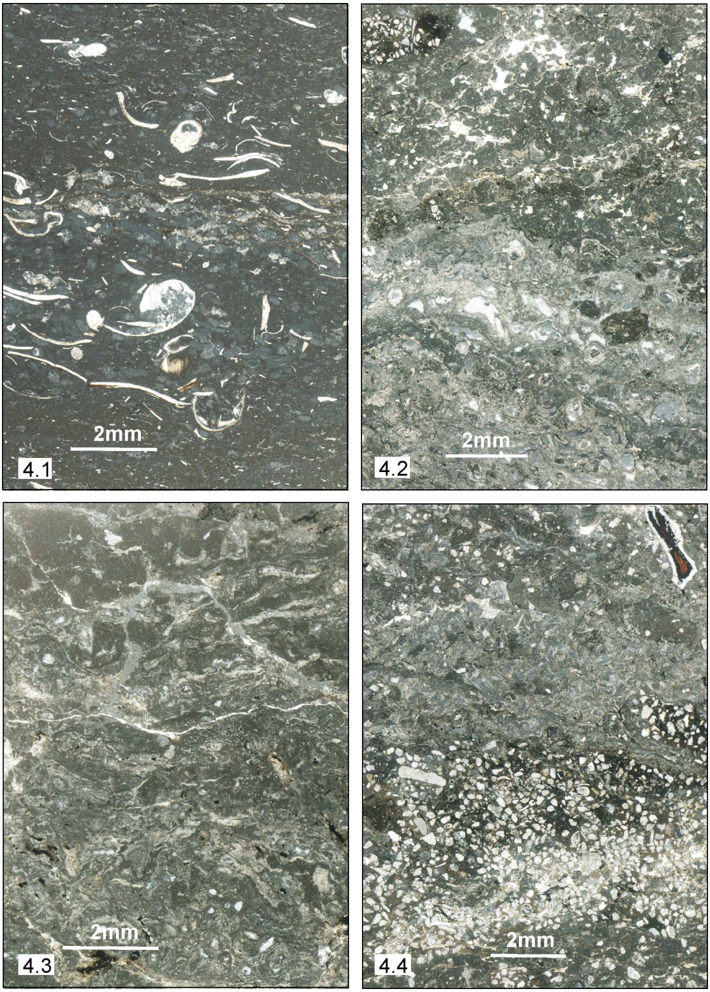

Figure 4.1. *Scontrone South-West section. Wackestone with ostracods and hydrobiids associated with small micritized rounded grains mainly*

*represented by coprolites (recognizable at high magnification). In the centre of the picture, lamina of coprolite-rich packstone. Scontrone Member of the Lithothamnium Limestone, marsh deposit of the **b** interval. **4.2**. Scontrone Fossil Site section. Dark-brown to pale yellow mottled mudstone affected by intense pedogenic process. Circumgranular cracks (upper part of the picture) and calcified thick root mat with transverse and oblique sections of spar-filled root moulds (circular white hollows with grey micrite or microsparite centre). Scontrone Member of the Lithothamnium Limestone, marsh deposit of the **b** interval. **4.3**. Scontrone South-West section. Dark-brown to pale yellow mottled mudstone affected by intense root activity and syneresis processes. Scontrone Member of the Lithothamnium Limestone, marsh deposit of the **b** interval. **4.4**. Scontrone Fossil Site section. Colour mottled mudstone with flakes of rubified rooted eolianite crust. The groundmass is represented by a dense network of calcified root mat. At the upper right corner, worn fragment of vertebrate. Scontrone Member of the Lithothamnium Limestone, marsh deposit of the **b** interval.*

The described eolian carbonates are overlain by grey-green to yellowish muddy deposits (interval **b** in the columnar sections) testifying to a sudden change in the environmental conditions with the establishment of intermittently flooded mudflats. These deposits are principally represented by Wackestones rich in small hydrobiids and dreissenids, ostracods and thick-walled *Ammonia* frequently associated with coprolites and charophyte gyrogonites (Fig. 4.1). The mudstones show a crude lamination and a grey-green to yellowish-green mottled appearance. The microscopic analysis shows that the vague, irregular lamination is related to the discontinuous presence of crinkled microbial laminae disrupted by root activity. The mottled appearance is related to the presence of yellowish to pinkish flakes of eolianite removed from the early-lithified wind-exposed substrate and to the presence of syneresis cracks, well preserved calcified roots and small planar fenestrae (Figs. 4.2-4.4). Such features point to an intermittent exposure of the muddy sediment associated with intense pedogenesis. Interval **b** displays quite relevant changes in facies and thickness within a relatively small area and a rapid lateral pinch-out towards the east (Scontrone Fossil Site) and south (Scontrone South-West and Scontrone South sections). In the Sangro Gorge and Scontrone North sections, where the **b** interval reaches the maximum thickness (5 and 3 metres, respectively), the mudstones contain channelized pebbly deposits with lithoclasts derived from the substratum (Sangro Gorge) as well as brackish-water shell lag accumulations. The lowest shell bank, present in both sections, is characterized by winnowed, disarticulated and deeply bored oyster thick valves (Fig. 5.1). Cerithiids and potamidids dominate the lumachella layers in the upper portion of the **b** interval (Fig. 5.2). Desiccation cracks systematically affecting the top of the single lumachella layers (Figs. 5.3 and 5.4) and deep root penetration testify to short episodes of subaerial exposure. The facies analysis of the **b** interval indicates a muddy intertidal flat incised by ephemeral channels or small creeks in which lumachella lags and sporadic conglomerates were accumulated by strong tidal currents. The deeply rooted thin muddy deposits of the Scontrone Fossil Site and Scontrone South-West sections give evidence of well vegetated mud flats and marshes flanking the tidal creeks. In both sections the marsh muddy deposits contain scarce and badly preserved bone fragments (Figs. 4.2 and 4.4). In conclusion, the bulk of the Scontrone vertebrate remains are embedded in a rooted wind-blown calcarenite sealed by tidal-marsh muddy deposits containing rare and scattered bone fragments.

The upper parasequence is characterized by an upward increase in the sand/mud ratio associated with an increase in the thickness of the beds. The lower transgressive portion (interval **c**) consists of tan foetid marls and shaly marls with thin intercalations of brackish-water lumachella beds made up of flattened complete shells of potamidids and cerithiids with a high percentage of thick-walled *Ammonia*, ostracods and sparse *Elphidium* (Fig. 6.1).

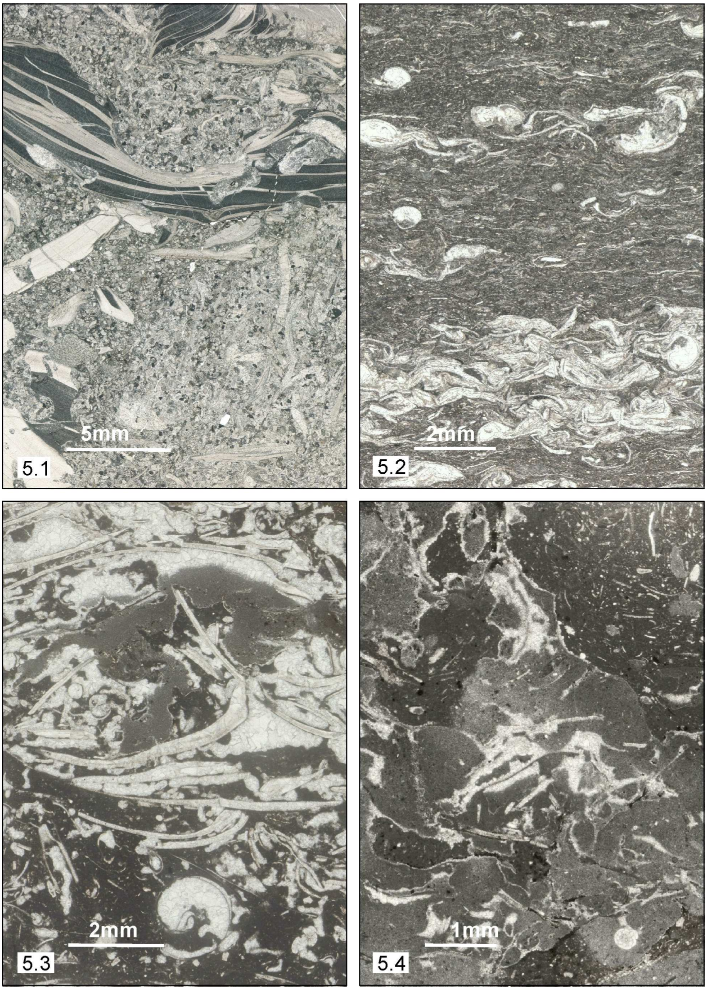

Figure 5.1*. Scontrone North section. Fine-grained bioclastic packstone with fragmented and deeply bored oyster shells. Scontrone Member of the*

*Lithothamnium Limestone, lower portion of the **b** interval. **5.2**. Scontrone North section. Densely packed gastropod-rich lumachella layer with flattened and crushed shells of hydrobiids. The background sediment is represented by a packstone with thin-walled disarticulated ostracods. Scontrone Member of the Lithothamnium Limestone, Bioclastic accumulation of a subtidal marsh deposit. **5.3**. and **5.4**. Sangro Gorge section Lumachella layer showing large geopetally-filled vugs and cracks. Scontrone Member of the Lithothamnium Limestone, desiccated and brecciated top of the gastropod-rich lumachella layer.*

These mud-dominated transgressive deposits include fine to medium-grained grey litho-bioclastic calcarenites characterized by ripple laminations within medium-scale trough sets which have been interpreted as storm layers accumulated in a coastal lagoon. These bio-lithoclastic calcarenites, composed of a fine-grained biodetritus (echinoid spines, serpulid and barnacle debris associated with *Ammonia* and *Elphidium*), show frequent lag accumulations of fragmented cerithiids and sparse disarticulated oyster shells. Small fragments of vertebrates have been found in the lowest channelled calcarenite. Interval **c** reaches the maximum thickness in the Sangro Gorge and Scontrone North sections (around 2.50 metres) and rapidly thins moving towards the east and the south. In the Scontrone South-West section it is represented by 1.5 metres of thinly laminated tan foetid marls and shaly marls the lower portion of which is rich in *Dreissena*, *Melanopsis* and hydrobiids testifying to hypohaline water conditions. In thin section the marls show calcisphaerulid-rich laminae (Fig. 6.2) probably representing blooms of calcareous resting cysts of algae or calcitized sporomorphs. In the Sangro Gorge the uppermost portion of the **c** interval is represented by more open lagoon deposits as indicated by the presence of sparse cardiids together with the cerithiids. A change into slightly saltier waters, up to mesohaline conditions is also suggested by the occurrence of oyster shell lags accumulated in shallow tidal channels near the top of the interval (see Scontrone Fossil Site).

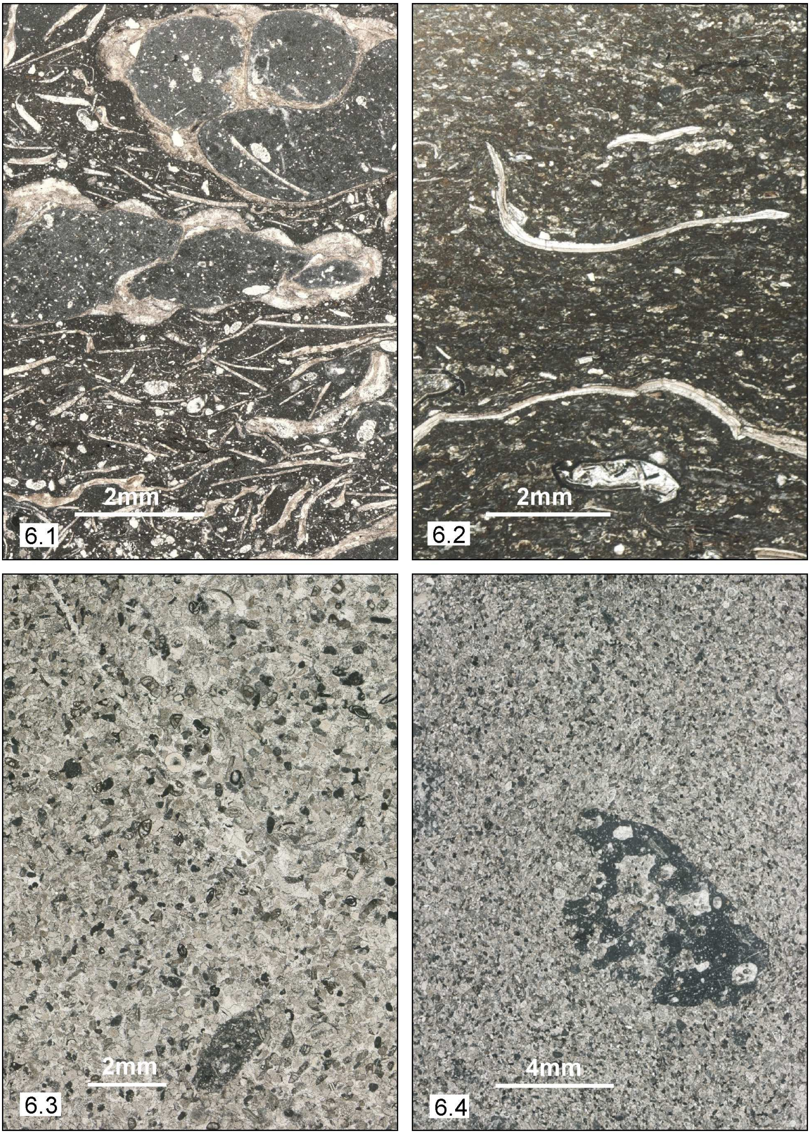

Figure 6.1. *Scontrone North section. Bioclastic wackestone/packstone with crushed cerithiids, large-sized Ammonia and ostracods. Scontrone Member of the Lithothamnium Limestone,* ***c*** *interval, storm accumulation in a brackish-water lagoon.* ***6.2***. *Scontrone South-West section. Very fine-grained bioclastic packstone with calcisphaerulid-rich laminae (white spots mainly concentrated in the upper part of the picture). Disarticulated valves of dreissenids. Scontrone Member of the Lithothamnium Limestone,* ***c*** *interval, inner-lagoon deposit with oligohaline to hypohaline water.* ***6.3*** *and* ***6.4***. *Scontrone North section (6.3) and Scontrone South section (6.4.). Very well-sorted fine-grained bio-lithoclastic grainstone with oversized well-rounded calcareous clasts. Scontrone Member of the Lithothamnium Limestone, tidal bar deposit of the* ***d*** *interval.*

The **d** interval, well exposed in the Sangro Gorge and Scontrone South sections, is principally composed of off-white medium-grained litho-bioclastic calcarenites (Fig. 6.3) with a biogenic content characterized by euryhaline and stenohaline fossil associations. These calcarenites consist of well sorted bioclastic grainstones with sparse oversized, very well rounded and locally bored calcareous clasts (Figs. 6.3 and 6.4) and with thick-walled gastropods. Low-angle cross stratification is locally present, but usually it has been shaded by the intense bioturbation. Discontinuous layers of thick-walled oysters occur at the base of the calcarenite beds.

These deposits, making the bulk of the **d** interval, have been interpreted as thick sand-bar accumulations in proximity to higher-energy settings and more open coastal environments.

In the Scontrone South section the top of the interval is marked by a thin layer of extensively rooted fine-grained calcarenite in which vertically elongated root tubules have been filled with dark organic material. The high-energy sand-bar deposits are overlain by 1.5 metres of lagoon deposits mainly represented by thinly laminated foetid marls and shaly marls rich in potamidids and cerithiids (Fig. 7.2). In the Scontrone South section the lagoon deposits overlying the rooted dark surface of the sandbar calcarenite are represented by dark shaly marls and limey marls containing scattered micritized bioclasts, crushed potamidids, cerithiids and dreissenids together with plant remains and numerous tick-walled ostracods.

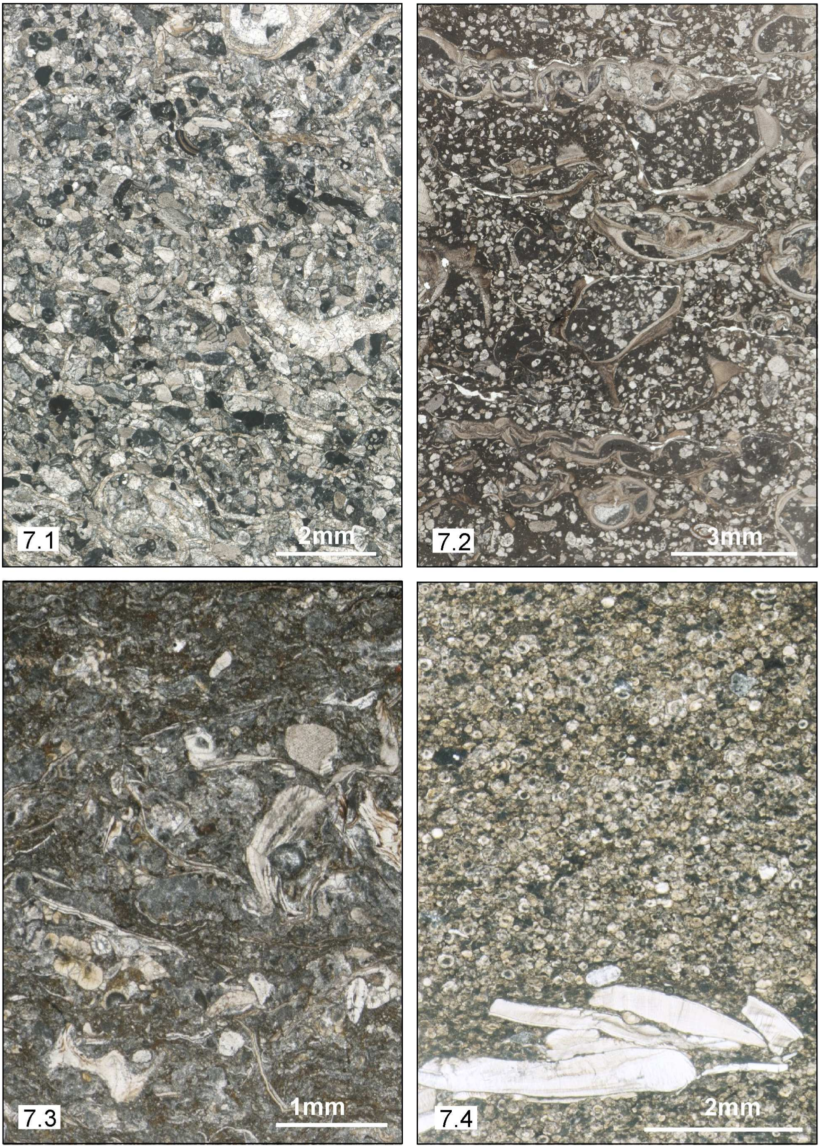
7.1
2mm
7.2
3mm
7.3
1mm
7.4
2mm

Figure 7.1. *Scontrone South-West section. Bio-lithoclastic packstone with well-rounded biogenic and lithic grains. In the left side, transversal section of spar-filled thick-walled gastropods. Scontrone Member of the Lithothamnium Limestone, tidal bar deposit of the **d** interval.* ***7.2***. *Crushed cerithiids preserving their original aragonite shell in a fine-grained bioclastic wackestone/packstone rich in Ammonia. Sangro Gorge section. Scontrone Member of the Lithothamnium Limestone, top of the **d** interval, storm layer accumulated in a coastal lagoon.* ***7.3***. *Scontrone South section. Bioclastic packstone with fragmented shells. In the lower-left side of the picture, yellow cluster of calcareous resting cysts of algae or calcitized sporomorphs. Immediately above the yellow cluster, well-preserved white dehisced cysts. Scontrone Member of the Lithothamnium Limestone, top of the **d** interval, restricted inner part of a coastal lagoon.* ***7.4***. *Scontrone South section. Densely packed calcisphaerulid packstone with crushed shell fragments of cerithiids. The exceptional abundance of these spherical calcareous bodies may be related to a phytoplankton bloom in waters with high level of eutrophication. Scontrone Member of the Lithothamnium Limestone, top of the **d** interval, restricted coastal lagoon.*

At high magnification the shaly marls reveal the presence of numerous sphaerical to ovoidal calcareous bodies (Fig. 6.3.) likely representing intact or partly dehisced calcareous resting cysts of algae or calcitized sporomorphs. A thin bed (30 centimetres) of foetid dark-brown calcisiltite with a characteristic microscopic fabric (Fig. 7.4) is present at about 20 cm from the base of the muddy lagoon deposits. In thin section the calcisiltites appear as a dense aggregate of calcareous microspheres representing an unusual in situ accumulation of algal cysts or calcitized sporomorphs in the protected innermost part of the lagoon. The return to protected lagoon conditions after the high-energy sand-bar deposition attests the shoaling-up facies architecture of the second parasequence.

In the Scontrone South section the second parasequence is clearly truncated by the erosional surface at the base of the shallow-marine offshore bars. The basal portion of the high-energy sandbars consists everywhere of medium to coarse-grained litho-bioclastic calcarenites with a grain-supported fabric and a fossil association characterized by abundant stenohaline organisms (echinoid spines, fragmented barnacles, scattered coralline algal rhodoids and *Ammonia,* together with large sized *Elphidium* and fragmented *Heterostegina* probably displaced by storms).

<u>**Stop illustration**</u>

<u>**Stop 1. Sangro Gorge**</u>

See figures 8 and 9 and foldout 2

Figure 8. *Panoramic view on the Sangro Gorge stratigraphic section.*

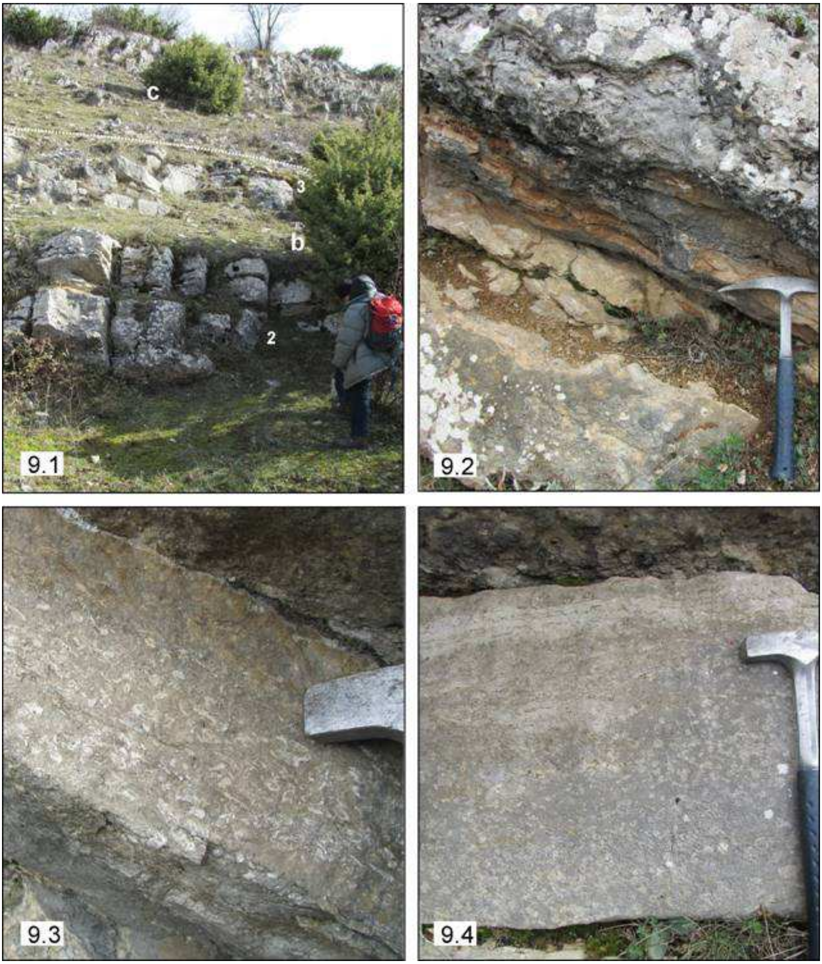

__Figure 9__. Sangro Gorge section. Tidal channel deposit in the regressive tract of the lower parasequence of the Scontrone Member (interval __b__). __9.1__. Channelized beds (2 and 3 in the picture overlain by lagoon deposits of the c interval. Note the evident concave-up lower surface of the channel deposit 2. __9.2__. Enlarged view of the upper part of the channel deposit 2 with a very thick oyster shell-bed. __9.3__. Enlarged view of the cerithiid shell lag

*accumulation in correspondence to the tidal channel 3. **9.4**. Tidal channel topped (above the head of the hammer) by a mudstone with evident desiccation structures.*

Stop 2. Scontrone Fossil Site

See figure10 and foldout 2

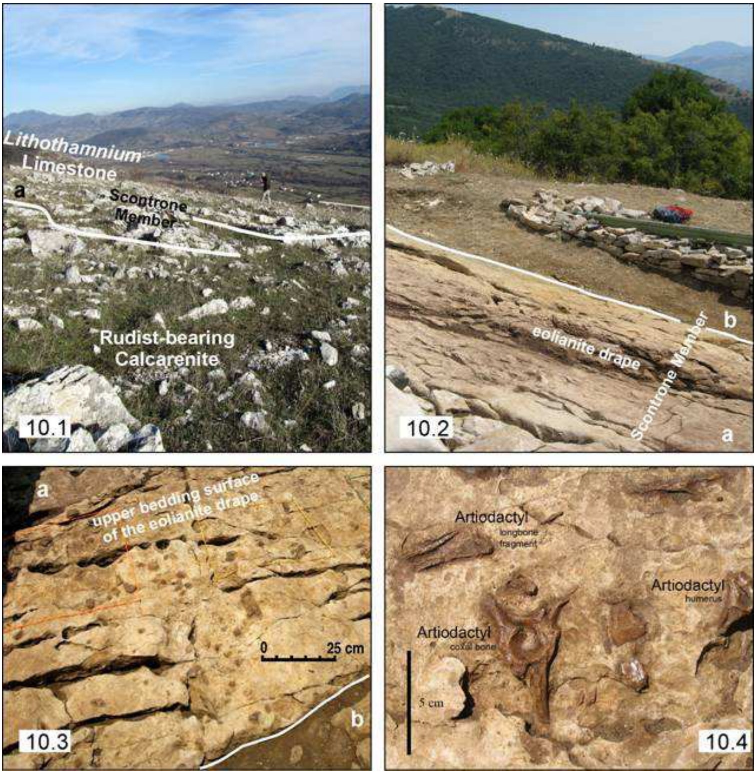

***Figure 10**. Scontrone Fossil Site. **10.1**. Panoramic view of the contact between the Albian-Turonian basinal Rudist-bearing Calcarenite and the*

*Tortonian ramp carbonates of the Scontrone Member of the Lithothamnium Limestone. **10.2**. Eolian calcarenite drape (top of the lower parasequence) containing the bulk of the vertebrate remains (top of the **a** interval) and contact with the overlying muddy marsh deposit. **10.3** and **10.4**. Upper surface of the eolianite deposits with vertebrate remains.*

<u>Stop 3. Scontrone South</u>

See figures 11 and 12 and foldout 2

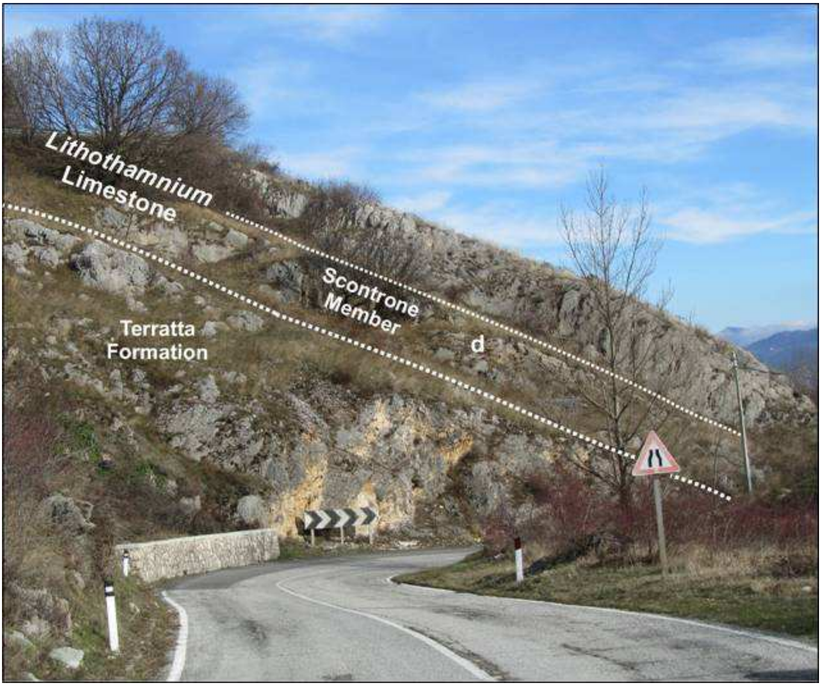

***Figure 11**. Scontrone South section. Second parasequence of the Scontrone Member (**d** and **e** intervals) directly overlying the Neocomian-Barremian platform-edge deposits of the Terratta Formation.*

Figure 12. *Details of the Scontrone South section.* ***12.1***. *Tidal bar calcarenite (**d**) belonging to the transgressive tract of the second parasequence of the Scontrone Member unconformably overlying the Terratta Formation.* ***12.2***. *Lagoon deposits belonging to the regressive tract of the second parasequence overlain by shallow-marine calcarenites. The*

contact corresponds to an erosional surface. ***12.3***. *Top of the tidal-bar calcarenite showing large-scale and low-angle cross stratification. Transgressive tract of the second parasequence (interval* ***d***). ***12.4***. *Close-up view of the intensively rooted upper surface of the tidal-bar calcarenite of figure 12.3 displaying thin vertical tubules filled with dark organic materials.*

Stop 4. Scontrone Cemetery

See figure 13 and foldout 2

Figure 13. *Scontrone Cemetery section. Unconformable contact between the Lithothamnium Limestone and the Rudist-bearing Calcarenite.*