The Sedimentary Structures of the Lowville Limestone, Ingham Mills, New York

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Introduction

Ingham Mills is located along East Canada Creek in the Little Falls 7.5' quadrangle. The outcrop is located directly beneath a dam and is approximately 20 meters in height and a tenth of a kilometer in area. The outcrop is kept clear of almost all vegetation by seasonal flooding of the dam, thus giving geologists a rather large window into the middle Ordovician.

The outcrop consists of formations from the Cambrian and Ordovician, the Black River, and the Trenton Groups. The Black River Group is represented by the Lowville Limestone, which at this locality is approximately 9 meters thick. The Trenton Group is represented by the Napanee and King's Falls Formations and the Sugar River Limestone. The Little Falls Dolomite (Cambrian) occurs briefly at the extreme bottom of the outcrop and is overlain unconformably by the Lowville Limestone (Curran & White, 1991)

The Lowville Limestone in this area represents and ancient carbonate tidal flat environment with two areas of intertidal and supratidal environments and one area of shallow subtidal environment. The outcrop as a whole clearly shows a transgressive sequence. There are numerous examples of sedimentary structures which show subaerial exposure throughout the outcrop and two sets of beds which contain evidence that there was tidal channel activity.

Data

Field work preformed in the area during June 1991 consisted of the researching of a detailed stratigraphic section, cataloging and analysis of mudcracks, channels and nodular layers within the section, and sampling of those beds which were associated with sedimentary structures. 38 thin sections were cut and analyzed for lithology and fossils.

The formation was divided into 24 distinct beds (Fig. 1). Mudcracks were divided into three different size classes: small, <10 cm across, medium, 10-20 cm across, and large, >20 cm across. It was also observed if mudcracks were visible at all points on a bed exposure, or only faintly visible on limited areas of a bed. All mudcracks were of a complete, orthogonal nature. (Allen, 1982, p.545) Channels were identified as having been cut into beds below beds 11 and 19, though the channels in one bed did not appear to be similar to those in another. Nodular layers were associated with bed 11 and to a lesser extent with bed 22.

Discussion

Mudcracks

Mudcracks of varying size and definition occur in beds 1, 2, 4-9, 14, 15/16, 20a, 23, and 24 (Fig. 1). Mudcracks are associated with both the intertidal and supratidal zones and are a result of desiccation due to subaerial exposure (Allen, 1982). Therefore, with the exception of isolated instances in and areas of beds 1-9, the environments were generally high intertidal to supratidal. The major subtidal or lower intertidal episode occurred during the deposition of beds 15-16 through most of bed 23.

Channels

The layer of channels associated with bed 11 is complex and contains peculiar structures in the beds below. Not all of the channel-like structures associated with this bed are actual channels. The channels associated with bed 19 are different than those of bed 11 and were formed under different conditions.

The complexity of the bed 11 channels is due to three factors. First, not all of the channel-shaped structures display cutting of the beds below bed 11 and, therefore, are not channels (Figs. 4 & 5). Second, the beds beneath all of the channel-shaped structures display topographically higher regions beneath those structures (Figs. 2-5). Finally, the topographic rises which begin with bed 8 display a dendritic drainage pattern when viewed in plane view (Fig. 6).

Figure 1

Stratigraphic Section of the Lowville Limestone at Ingham Mills, NY

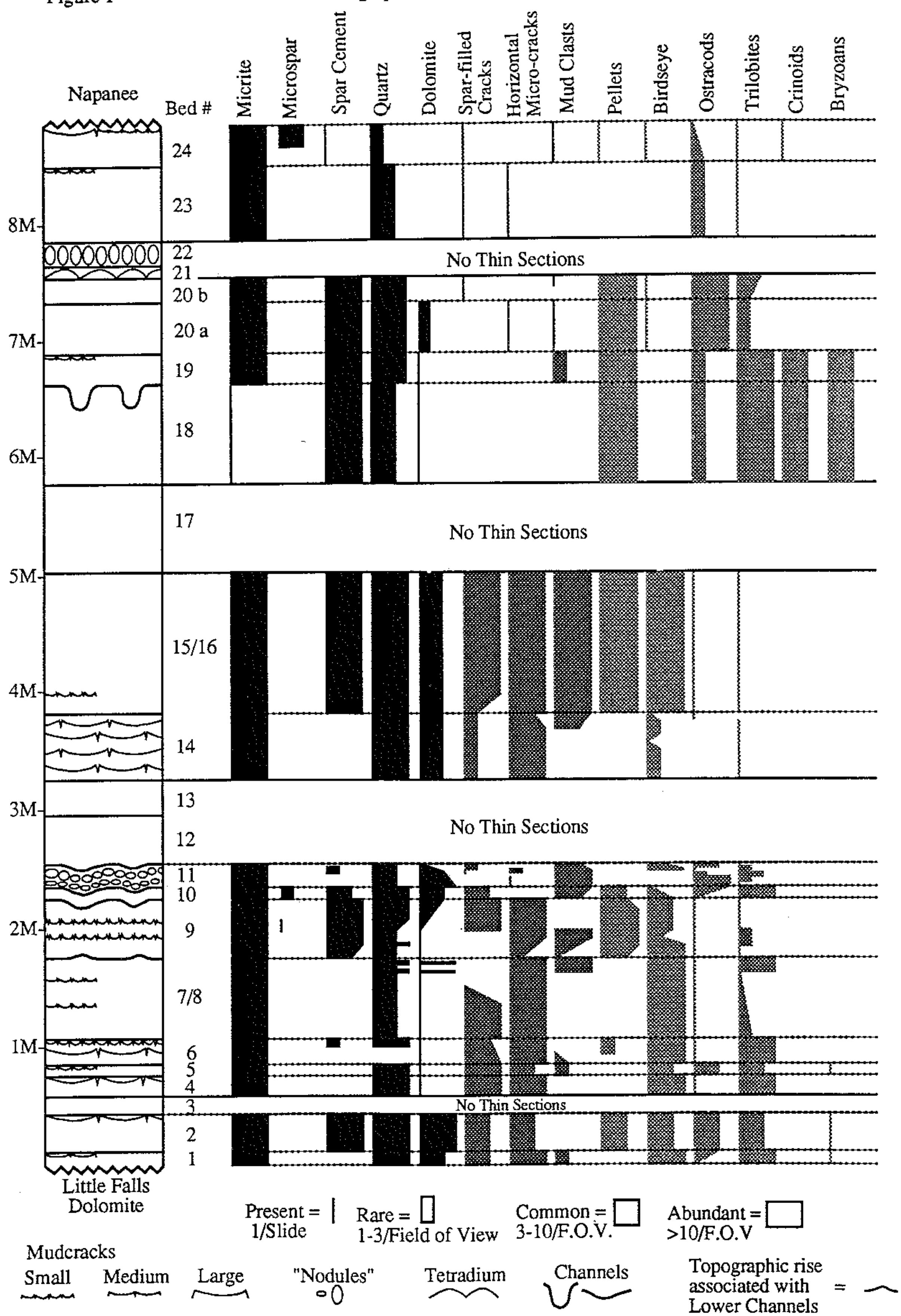


Figure 2

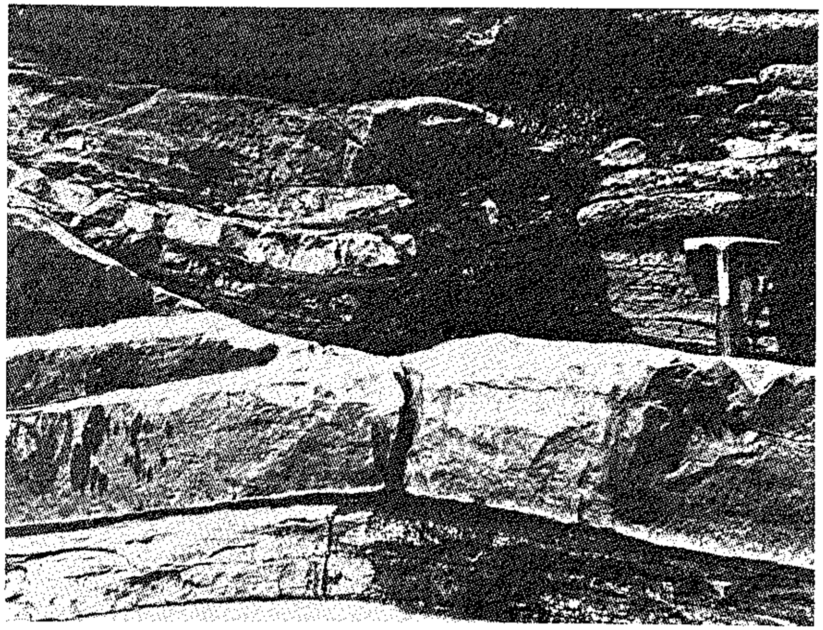


Figure 4

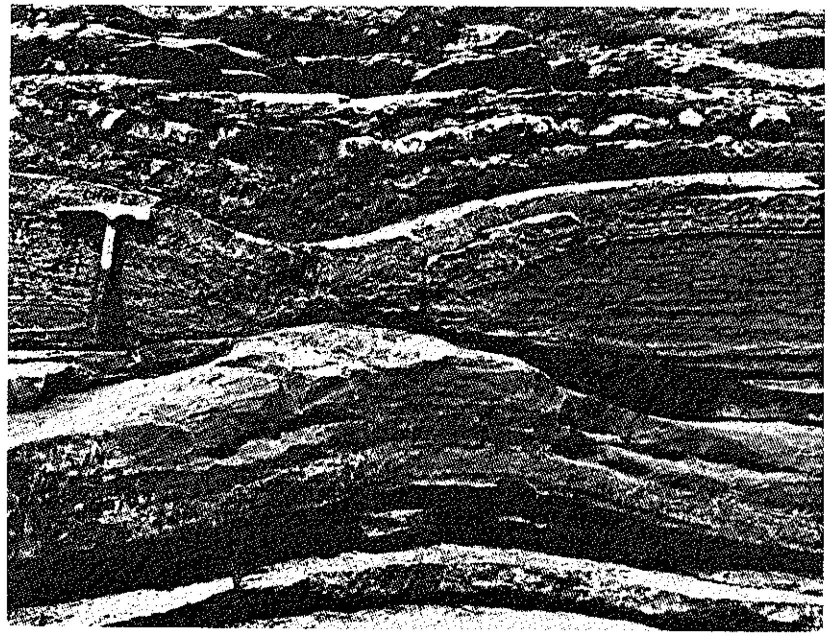
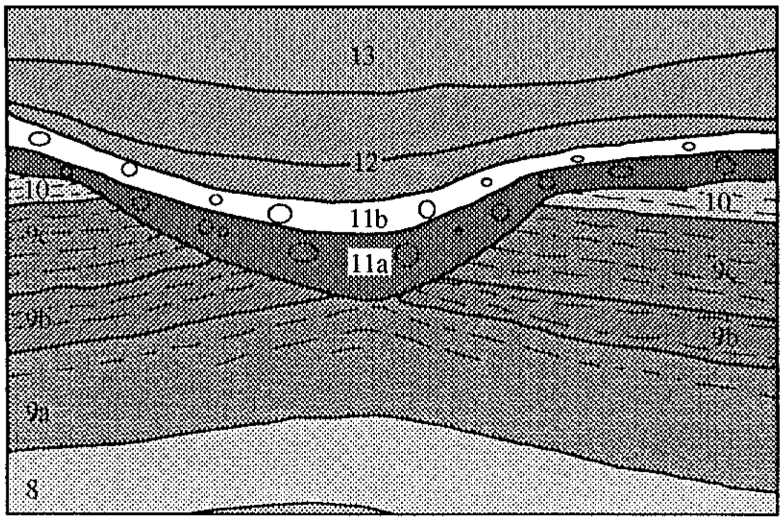
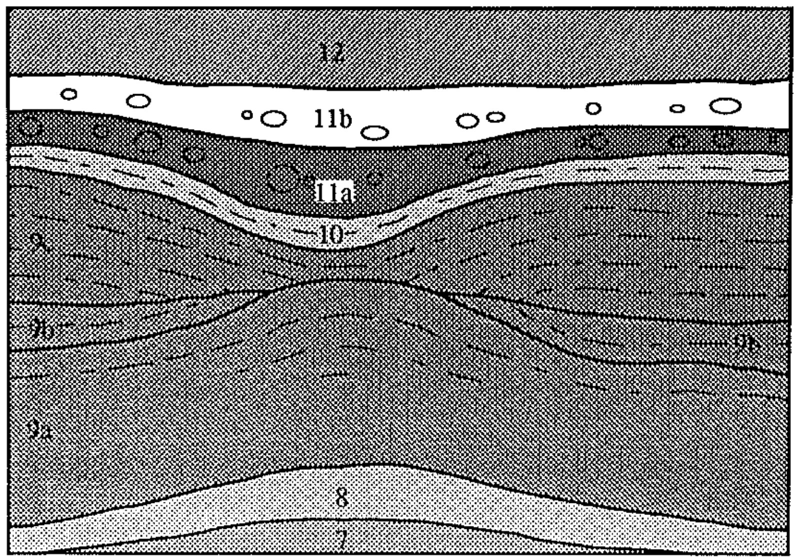


Figure 3



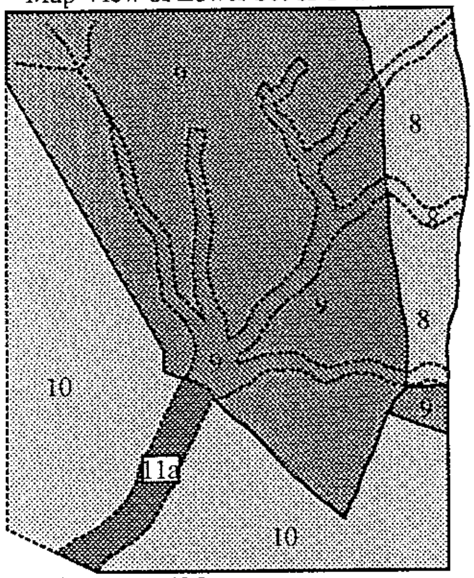
Channel # 7

Figure 5



Channel # 6

Figure 6
Map View of Lower Set of Channels



Scale: 1cm = 1M

There is a genetic relationship between the channel-shaped structures and the topographically higher regions below them. Those structures which display cutting of the surrounding beds would not have been initially channeled when these areas were topographically higher than the surrounding areas, as they are now. A peculiar series of events occurred between the deposition of beds 8 and 11 to form these structures.

The channels which are filled in by bed 19 appear to be of radically different origin than those filled by bed 11. There are thirteen upper level channels which occur in three different clusters. The channels are generally small and usually not deeper than 0.5 M nor wider than 0.5 M at the top. There is scant evidence of cross bedding, although it is possible that most of the traces of this were erased by bioturbation. There is evidence of fault-block rotational slumping as well as some cross bedding in the largest of the channels, which is approximately 0.7 M deep and 1 M across.

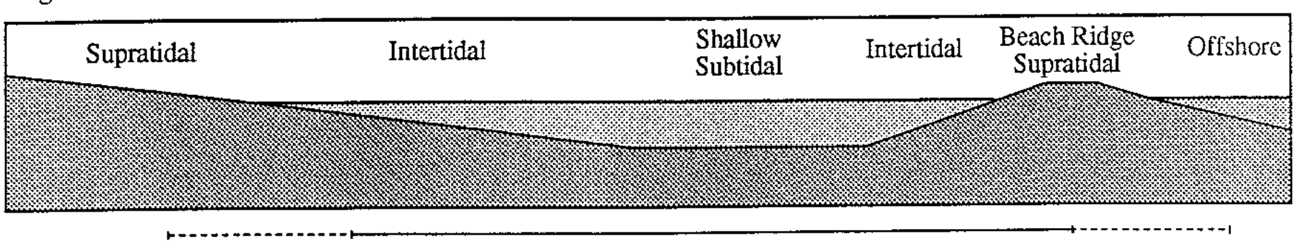
Paleocycles

Figure 7 is a possible cross section which, when combined with a gradual rise in local sea level, could have resulted in the sequence of beds which exist at Ingham Mills in the Lowville Limestone. Hardie, et al. (1977, pp.35, 121) describe one area of the Three Creeks area of Andros Island which progresses from a shoreline supratidal zone through the intertidal and into the shallow subtidal zone of a tidal pond. From the bottom of the pond the environments progress up through the intertidal to the supratidal, as elevation rises up the back slope of a barrier beach ridge, before finally falling away through the intertidal and into the deeper subtidal environment of the carbonate shelf.

Were such a situation to have existed, two levels of intertidal and supratidal environments would occur in the section before the area would have been submerged more permanently in the deeper subtidal zone. One would occur when the water began to rise up along the land and another as the beach ridge, which protects the pond or lagoonal area, moved steadily to the east while shoreline continued to retreat. Exactly where the Lowville Limestone beds would fall into a situation similar to that described above is not wholly clear. The sedimentary structures, mudcracks and channels, indicate intertidal and supratidal environments from approximately beds 1-11 or 14 and then again from approximately beds 18-24. The dominance of micrite as a matrix in all but bed 18 of those for which thin sections were prepared suggest a protected, low-energy environment. The large numbers of trilobites, crinoids and bryzoans in bed 18 indicate a subtidal environment which would have existed at the bottoms of the channels.

On the other hand, the dominance of all types of spar filled voids, and dolomite in beds 15 and 16 indicate that these beds would also be members of high intertidal or supratidal environments (Shinn, 1983).

Figure 7 Cross Section of Possible Lowville Limestone Paleoenvironment



(After King, 1992)

In addition, the Tetradium layer in bed 21, a layer traditionally associated with wave baffle margins, would indicate that the environment had moved beyond the protection of the beach ridge. More exhaustive research is needed to accurately determine the more subtle changes in local sea level and environment.

Conclusions

The Lowville Limestone at the Ingham Mills locality represents an ancient tidal flat environment. There are abundant mudcracks concentrated at the upper and lower areas of the formation. There are two sets of channel structures, the lower of which are highly complex. Figure 7 provides one explanation for the sequence of beds and features contained within the formation.

References

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Nearshore Carbonate Sedimentology of the Lowville Limestone, Mid Ordovician, Near Ingham Mills, New York

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Introduction

Some of the most interesting and well exposed Ordovician rock sequences of North America occur in the Mohawk Valley of New York State. Specifically, the Lowville Limestone near Ingham Mills is extremely well exposed due to its outcropping below a dam in an old, abandoned quarry. This carbonate sequence, sometimes referred to as the Gull River Limestone, belongs to the Black River Group which spans from Central New York up into Ontario, Canada (Cameron and Mangion, 1977; Rickard, 1973). The outcrop studied lies within the Little Falls Quadrangle and is near the town of Ingham Mills, which is along the East Canada Creek. Strata in the district are almost perfectly flat-lying. Preexisting studies have dated the Lowville Limestone as Mid Ordovician and cited as being within the *Climacograptus bicarnis* graptolite zone of the Caradocian stage (Keith, 1988; Rickard, 1973). At the quarry studied, the 10 m of Lowville Limestone is sandwiched between two unconformities: below is the Little Falls Dolomite (Cambrian), above, the Denley Limestone of the Trenton Group (Mid Ordovician).

Tectonic Setting

During the Mid Ordovician, the study area is considered to have been situated on a passive carbonate platform that extended over much of the North American craton during the Cambrian and Ordovician. The Taconic orogeny occurred to the east of the platform during Caradocian time; it signaled the intiation of the closing of the Iapatus Ocean. Approximately 65 km to the east of the study area, normal faulting began during Black Riverian time. This faulting moved progressively westward as a result of Taconic thrusting and flexing of the lithospheric plate. Block faulting in the Ingham Mills area is post-Lowville deposition (figure 1). It has been suggested that the Timor Trough is a modern analogue for this tectonic model (Bradley and Kidd, 1991; Cisne et al., 1981).

Observations

Beds at this outcrop are laterally continuous and can be followed for many tens of meters. Overall, the study area represents a transgressive, peritidal sequence that roughly goes from shallow water intertidal to subtidal. Yet within this transgressive sequence there are smaller cycles of relative sea level change as represented by facies migration. Three main facies are observed in this outcrop and they include: A) intertidal, B) subtidal, and C) wave baffle. Contacts are sharp and at least two within the Lowville are erosional.

The intertidal facies consist of externally medium to thick bedded, internally thin laminated to massive, light grey to grey lime mudstone (pelmicrite) that weathers to a buff color. Shaly, perhaps terrigenous, clay layers occasionally interbed with the lime mudstone. Beds within contain one or more of the following: fining up sequences, algal layering, fossil hash, rounded breccia clasts, solution fractures. Intertidal criteria include: aerial exposure as evidenced by occasional, large, well defined mudcracks; prevalent *Skolithos verticalis* and *S. linearis*, common *Paleophycus*, rare *Chondrites* and *Beaconites baretti* trace fossils, and common ostracod allochems. Small scale tidal channels show pinch and swell bedding. These channels are intrinsic to this intertidal model.

The subtidal facies consist of massively bedded, medium to dark grey lime mudstone (biomicrite). Variation in the degree of bioturbation is indicative of rate of sediment input to the system. Where oncolites and many burrows are observed, the rate is slow. Where few burrows are observed, the rate is faster. There is moderate diversity in the fossil fauna; most shells are disarticulated. Presently, the diagnostic fauna found in the subtidal facies are: common brachiopod valves, *Loxoplocus* gastropods, *Actinoceras* nautiloid fragments, broken crinoid stems, *Rugosa zaphrenthis* coral, and abundant *Strictopora labyrinthica* bryozoa and *Hedstroemia* algae. Walker (1972) states that blue-green algal mats dominate the subtidal community here. He noted a protected subtidal/tidal channel in these Lowville facies at Ingham Mills. Lack of dessication features in these facies support the evidence of a permenantly submerged environment.

The wave baffle facies, as Walker coined the term (1972), consist of a massively bedded, medium grey lime mudstone (pelmicrite) that weathers to a buff color. Internally, this facies can be split into two, distinct