The Paleoecology of Stromatoporids and Tabulate Corals from the La Vieille Formation, Silurian, Southern Gaspé Peninsula, Québec, Canada

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The Silurian stromatoporids and tabulate corals of eastern Canada have been focal points of recent systematic examinations (see Young and Noble, 1987a). This project is one of the first evaluations of the paleoecological relationships between stromatoporids and tabulate corals and their biotic and physical environments in a portion of the eastern Canadian Silurian system.

The area of collection is a railway cut approximately one and a half miles east of Gascons, Québec, near the Bay of Chaleurs (Figure 1). This particular locality is in the lower member of the La Vieille Formation in the middle of the Chaleurs Group (Figure 2). It consists of approximately 60% nodular limestone and 40% gray shale that is medium bedded. At this location favositid, syringoporid, halysitid, heliolitid, and rugose corals were found as well as stromatoporids, brachiopods, and crinoids. The most common brachiopod is the pentamerid *Costistricklandia lirata.*

Field Study

The La Vieille Formation in eastern Canada consists of three superposed members (Bourque et al., 1989; see Fig. 2). The first is the "Lower member", which consists of nodular bioturbated mudstone to wackestone with shale interbeds containing a diverse and abundant biota of halysitid, favositid, and syringoporid corals, colonial and solitary rugose corals and abundant brachiopods, especially large shells of *Costistricklandia lirata*. The second is the "Middle member", composed of algal limestones, oolite and peloid grainstones, and coral-algal boundstones. The biota of the middle member varies; gastropods, brachiopods, ostracods, algal-sponge-bryozoan-balls, stromatolites, echinoderms, corals, and stromatoporids can all be found in this member. The third is the "Upper member" a nodular bioturbated mudstone to wackestone with shale interbeds, and almost devoid of fossils. These three members are grouped into five facies by Bourque et al. (1989). The La Vieille Formation's upper-most lower member is studied here. It is Wenlockian in age. Bourque et al. (1989) refer to this member as Facies V - Nodular limestone facies.

Methods

The materials described in this study were collected from a railway cut near the village of Gascons, Québec. The sampling began at ground level west of an erosional gully and east of a fault zone. Acetate peels and thin-sections of stromatoporids and heliolitid, favositid, and halysitid corals were studied under a stereoscopic microscope with a drawing tube attachment. Other measurements such as tabularium diameter, tubule diameter, and the spacing of tabulae could be recorded and compared to tables made by Lee and Noble (1988), and Young and Noble (1984, 1987a&b). Encrusting relationships were first described from thin-sections and later studied with a scanning electron microscope.

Paleoenvironmental Interpretation

Lateral and vertical facies changes occur in the La Vieille Formation (Bourque et al., 1989). Vertically the La Vieille Formation shows a shallowing upward phase (lower and middle members), and a transgressive phase in the upper member which marked a return to the initial conditions. The middle member exhibits lateral variation from proximal (nearshore) facies to a distal (off-shore) facies (Bourque et al., 1989). The rocks in this study were deposited in an off-shore mud facies that was exposed to low wave action but was still within the photic zone. In a study conducted by Noble and Howells (1974), the nodular characteristics of this facies were interpreted as originating from an early cementation of the mud within the top few meters of the sediment (Bourque et al., 1989). This does not mean that the substrate was hard, but it was rather a firm mud which gave epifaunal, benthic organisms an opportunity to settle and proliferate.

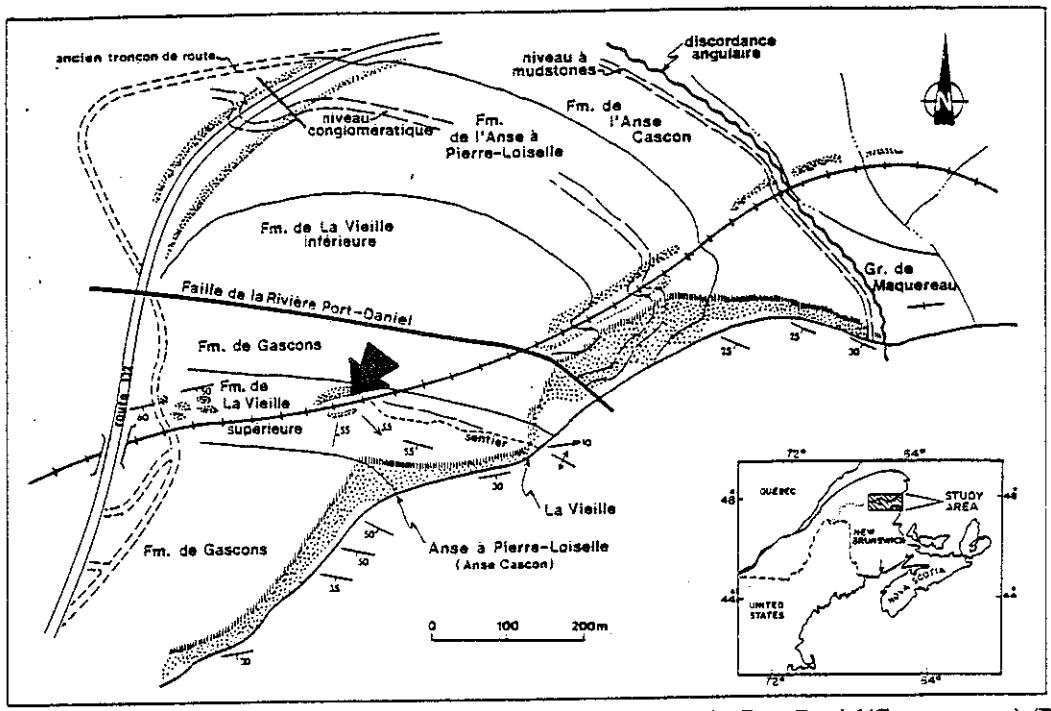

Figure 1. Location map of the southeastern portion of the Gaspé Peninsula (Port Daniel/Gascons area) (Bourque et al., 1989) and northeastern United States (inset) (Young and Noble, 1987b).

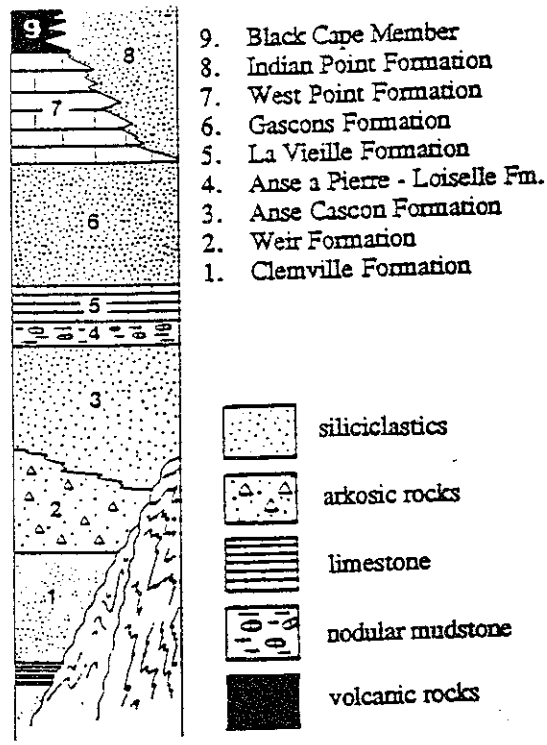

Figure 2. Stratigraphic column of the Chaleurs Group. The La Vieille Formation (5) lies in the middle of this group (after Bourque et al., 1989).

Results

During the initial stages of this study it was thought that the major emphasis would be the tabulate corals of this region. However, it is now apparent that the tabulate corals, solitary rugose corals, brachiopods, and crinoids all took secondary roles to those of the stromatoporids. Of the specimens examined, most were stromatoporids. In most of these, the stromatoporids were found encrusting or overgrowing other organisms.

The stromatoporids were dolomitized to the point that most could not be identified below the family level. The identifiable specimens appear to be *Clathrodictyon.* In a study conducted by Kershaw (1984) on the Silurian stromatoporids of Gotland, Sweden, the stromatoporids that were almost always found to encrust other organisms were *Clathrodictyon.* In this study *Clathrodictyon* encrusted halysitid and heliolitid corals, solitary rugose corals and other stromatoporids. In turn, stromatoporids sometimes provided a hard substrate on which favositid, heliolitid, and halysitid corals encrusted. Brachiopods were also used as hard substrates for organisms to encrust, but only to a minor degree.

Interpretations

The La Vieille stromatoporids exhibit characteristics similar to those described by Kershaw (1984) in the Silurian of Gotland. He classified a typical assemblage into three growth forms: *a*) those which grew as regular laminar, domical, or bulbous forms that have not been disturbed during their lives; *b*) those that began growth but were subsequently affected by dynamic environmental factors which produced effects attributable to movement or sedimentation; and *c*) forms with inherent growth irregularities which may or may not include the effects of *b* (Kershaw, 1984). The growth patterns of this study are of the *a* category with two specimens that possibly fall into the *b* category.

The stromatoporids of this study, eighteen total, are domical in shape with only two laminar and two bulbous specimens. Stromatoporids had their greatest diversity of form in shallow marine environments; they were less diverse in deeper environments (Kershaw and Riding, 1978). When examined in thin-section, sixteen of the eighteen stromatoporids displayed sediment interdigitations (ragged margins), which shows that there was moderate sedimentation in this region. This is consistent with the interpretation of Bourque et al. (1989) which was discussed earlier.

A sediment-shedding capability would have been desirable for benthic organisms of this type. Domical and bulbous forms would have shed sediment from the apical areas, enabling them to survive moderate sedimentation. The sediment interdigitations seen in this study most likely contain sediment from topographically higher parts of the coenostea; the stromatoporids could have lived easily even if the lower parts were suffocated. Another possibility for the domical and bulbous growth patterns is the competition for oxygen and food. The apices of the domical specimens were not only higher in the water column but they would have also interrupted the flow of water around them. This disruption would have created eddies which kept the water well mixed in their immediate vicinity (Kershaw, 1987). A scenario such as this would have meant competition for the highest position in the water column.

Conclusions

The La Vieille Formation represents a relatively thin horizon in the Chaleurs Group of the Silurian in southeastern Canada (Figure 2). The site of collection for this study is the upper-most lower member of the La Vieille Formation at the boundary between the lower and middle members. The exact position of the site was determined from the analysis of the fossils present and examination of the lithology. The presence of an abundant biota of fossils places the site in the lower member of the La Vieille Formation.

Originally thought to be secondary, stromatoporids became the focus of this study. Tabulate corals, as well as crinoids and rugose corals, occurred in a secondary role to the stromatoporids. It appears that more often than not the stromatoporids provided an initial hard substrate for tabulate corals, crinoids, and heliolitid corals. The pentamerid *Costistricklandia lirata* was also used as a hard substrate on which to encrust.

Most of the stromatoporids found were either encrusting other organisms or being encrusted. Typically, solitary rugose corals and crinoids encrusted the upper portions of the stromatoporids while the tabulates would encrust both the upper and the lower surfaces. When the stromatoporid was threatened by an encruster it responded quickly by attempting to overgrow or embed the intruder within the coenosteum. Occasionally stromatoporids encrusted or overgrew one another showing competition for the food or oxygen supply.

The relationship between the organisms and their paleoenvironment is represented by their growth

morphologies, especially that of the stromatoporids and the tabulate corals. The stromatoporids and tabulates displayed a regular domical or a regular bulbous growth pattern with low diversity. These two shapes are associated with stable, low energy environments that have moderate to low sedimentation rates. The low diversity of the stromatoporids is an indicator of a deep, off-shore environment (Kershaw, 1980). This association corresponds with the interpretations of Bourque et al. (1989).

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