THE PALEOENVIRONMENT OF THE BOULEAUX MEMBER OF THE WEST POINT FORMATION, SILURIAN, GASPÉ PENINSULA, QUÉBEC

Robyn Sommer
The College of Wooster
Wooster, OH 44691

INTRODUCTION

The Silurian succession on the southern Gaspé Peninsula is of particular geologic interest because it is nearly complete. It is a very thick sequence, reaching thicknesses of as much as 5 km, compared to the relatively thin Silurian succession of the North American interior (Bourque, 1987). All facies are well-preserved and little affected by metamorphism, which is not the case in most other parts of the Appalachians.

Magnificent exposures of Silurian rocks are found in southern Gaspé on the shores of the Baie des Chaleurs (Figure 1). The West Point Formation, in the Chaleurs Bay Synclinorium, represents a mixed carbonate-siliciclastic unit containing rich and moderately well-preserved fossil assemblages (Lee and Noble, 1988) (Figure 2). This formation is best termed a carbonate buildup because it consists of superposed reef and bank complexes. The Bouleaux Member is part of the lower reef complex, which is a shallowing upward sequence of sea floor facies.

Sedimentological data and fossils are vital to the interpretation of the paleoenvironment of the Bouleaux Member of the West Point Formation. This study began with the measurement and description of a section in the upper part of the Bouleaux. At the best exposed bedding plane, a grid sketch of 14 square meters was constructed. The grid included the identification and dimensions of the fauna present. Samples were then collected, including stromatoporoids, corals, trace fossils, and parts of the matrix.

FOSSIL FAUNA

Stromatoporoids.--Stromatoporoids are a difficult fossil group for systematic study. Diagenesis has frustrated most paleontologists who study their systematics (Stock, 1983). The stromatoporoid has been variously assigned to the hydrozoans, the sponges, and the foraminiferans (Stearn, 1975). After many decades of controversy over their biological affinity, stromatoporoids are now finally recognized by most paleontologists as sponges (Kershaw, 1988). Stromatoporoids are abundant in reefs and biostromes that vary in size from a few tens of centimeters in diameter and thickness to enormous barrier reefs. Their growth forms can be strikingly diverse. Kershaw (1988) divides their growth forms into four basic shapes: laminar, domical, bulbous, and dendroid (branching). Stromatoporoid growth forms were controlled by a combination of factors, including: substrate consistency, sedimentation and turbulence (Kershaw, 1988). The stromatoporoids found in the Bouleaux Member are dominantly laminar in shape and are of the family Clathrodictyidae.

Trace Fossils.--Trace fossils record the behaviors of ancient animals. These behaviors are controlled by sedimentation, substrate type, and availability of food (Crimes, 1970). The most common trace fossil in the Bouleaux Member is *Scalarituba missouriensis* Weller 1899, which is especially abundant in the upper portion. *Scalarituba* is interpreted as the feeding burrow of a worm (Martinsson, 1971). It is described as a sub-tubular structure approximately 5 mm in diameter, with concavo-convex transverse ridges spaced 2-3 mm apart (Martinsson, 1971). These transverse "scalariform" ridges may be only poorly preserved or lacking in argillaceous rocks (Häntzschel, 1975). In the argillaceous siltstones of the Bouleaux Member, specimens indeed have no visible transverse ridges.

Encrusters.--Encrusted skeletal substrata are very common in the fossil record (Taylor, 1990). Stromatoporoids collected from the Bouleaux Member are encrusted with a variety of organisms, including favositids, heliolitids, and auloporids. Careful mapping of the encrusters on a single large stromatoporoid was the first step in evaluating the community structure. There is no definite zoning to the encrusted organisms. This is contrary to the conclusions of a study conducted by Segars and Liddell (1988) who suggested that there are zones of stromatoporoid encrustation.

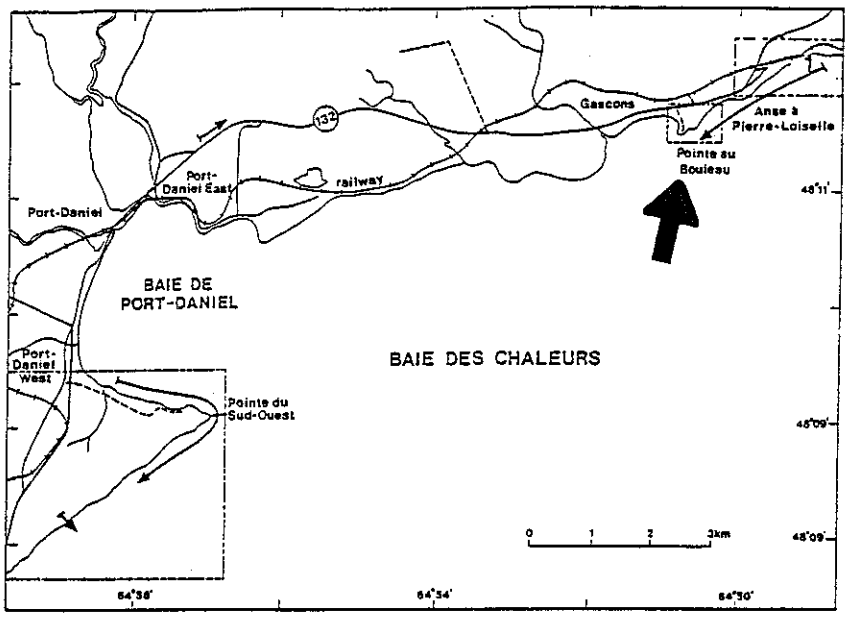

Figure 1: Map showing the location of the Baie des Chaleurs and the study area Pointe aux Bouleaux (Bourque, 1987, Figure 1).

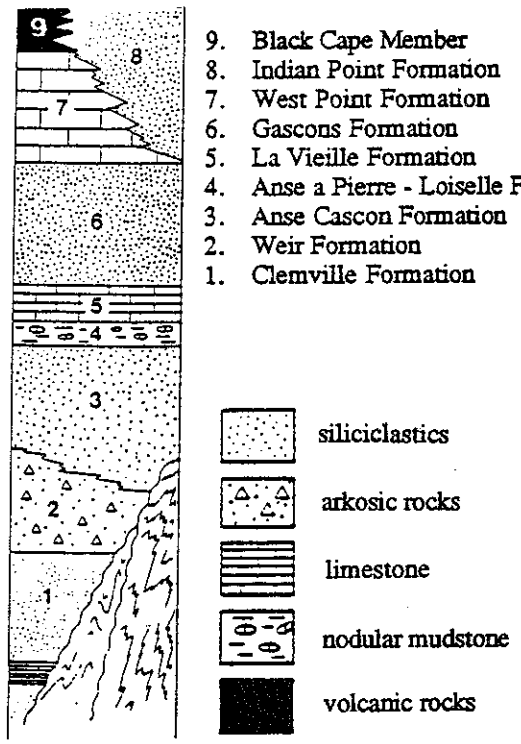

Figure 2: Silurian stratigraphy of the southern Gaspé Peninsula (After Bourque, 1987, Figure 2).

PALEOENVIRONMENT

Bourque et al. (1989) suggest that there was a marked decrease in sedimentation rate in the Bouleaux Member. This lower sedimentation rate allowed the abundant stromatoporoids of the Bouleaux to establish themselves. The laminar stromatoporoids would be expected to show ragged margins and sediment inclusions if sedimentation was a significant factor (Kershaw, 1981). The stromatoporoids examined in this study did not show ragged margins with sediment inclusions. Kershaw (1981) also observed that the thin laminar nature of stromatoporoids coenostea is indicative of a low rate of sedimentation.

The hypothesis of low sedimentation is also supported by the abundance of *Scalarituba missouriensis* trace fossils. These fossils were best developed in moderately low-energy conditions where sedimentation rates were moderately low (Pickerill et al., 1977). Bourque et al. (1986) also supports this by adding that the main factor in the colonization of the Bouleaux sea floor by metazoan organisms was the lowering of the sedimentation rate and the beginning of carbonate sedimentation.

Another paleoenvironmental factor is substrate. The substrate of concern in this study is controversial. Bourque et al. (1986) refer to early cementation of substrates within the Bouleaux Member. However, from the information collected in this study, it seems more likely that the substrate was not cemented during its exposure to the sea floor. Rodriguez and Gutschick (1970) found that the trace fossil *Scalarituba* lived on soft silt substrates marginal to carbonate mounds in shallow subtidal environments. The abundance of this trace fossil is substantial evidence to support the hypothesis of at least an initially soft substrate.

Stromatoporoids also provide evidence for a soft substrate. Kershaw (1988) proposes that laminar stromatoporoids, in low energy muddy sediments like those in the Bouleaux, may have been spreading their weight in snowshoe style so that they did not sink into the sediment. The Bouleaux stromatoporoids also apparently were the only possible hard substrates for encrusters. Taylor (1990) states that in hostile environments, as in some muddy deposits, the rare hard substrates, in this case stromatoporoid coenostea, constitute important "habitat islands" for sessile species, which often form dense encrustations. To add support to this, there were no fossils observed encrusting the Bouleaux Member bedding planes.

Stromatoporoids were also found intergrowing with syringoporid corals. When organisms are found intergrowing within the stromatoporoid coenostea, as the syringoporids are in the samples collected, this state is known as "caunopora". This relationship occurs in stromatoporoids with continuous laminae which apparently provided a more stable base for the coral to grow upon (Kershaw, 1981). All of the stromatoporoids found in the Bouleaux were of the family Clathrodictyidae. Kershaw (1981) states that Clathrodictyidae is a family in which the response of intergrowths seems particularly strong. This relationship is possible in Clathrodictyidae because of the stout open network of laminae and pillars this stromatoporoid possessed (Kershaw, 1981).

CONCLUSIONS

1. The Bouleaux Member of the West Point Formation consists of a sequence of nodular limestone, limestone with siltstone, and siltstone.,

2. The fossils found in the Bouleaux Member include stromatoporoids, syringoporids, favositids, auloporids, rugosans, crinoids, and the trace fossil *Scalarituba missouriensis* Weller 1889.

3. The sediments of the Bouleaux have been referred to as "early cemented", but it is concluded here that the substrate was not cemented during its exposure on the seafloor. Evidence for a soft substrate includes the occurrence of laminar stromatoporoids, which may have been spreading their weight in snowshoe style so that they did not sink into the sediment. In addition, the abundant trace fossil *Scalarituba* is interpreted to have been formed in soft silt substrates with low rates of sedimentation.

4. Stromatoporoids coenostea were the only available hard substrates during the deposition of the Bouleaux sediments. Stromatoporoids were thus "habitat islands" for species requiring hard substrates; they were densely encrusted with favositids, auloporids, and heliolitids. There was no zoning to this encrustation. The skeletons of syringoporid corals were mutually intergrown into the stromatoporoid skeleton.

5. The silts and limestones of the Bouleaux Member accumulated at a low rate of sedimentation. This low sedimentation rate allowed the stromatoporoids to establish themselves and spread laterally into laminar forms, and it permitted the development of extensive encrusting communities.

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