SEDIMENT DISTRIBUTION ACROSS A WAVE CUT PLATFORM, POINT MIMI, ST. YVON, QUEBEC

Ann L. Montgomery
Department of Geology
Whitman College
Walla Walla, WA 99362

The beach at Point Mimi, St. Yvon, is forming over a wave cut platform. The bedrock underlying the wave-cut platform is upturned turbidites. Some of the wave cut platform, which is composed of turbidites, is completely obscured by sediment, while other parts are exposed bedrock. Clasts of shale and sandstone, plus the hard parts of rocky shore biota, collect in tide pools between sandstone ridges and near the base of cliffs.

Point Mimi represents a potential angular unconformity, if the overlying sediment were to be lithified. Most unconformities in the geologic record can be studied only in cross section, and are rarely examined as a rocky shore horizon. By studying an unconformity in the making (i.e., a modern rocky shore), the map view can also be studied, perhaps resulting in a clearer picture of what a fossilized rocky shore looks like, and of how this particular type of rocky shore will be preserved.

METHODS

Sediment, shell and rock samples were collected from 153 surveyed points on the Point Mimi platform. Point counts were performed on thin section of impregnated sediment samples. The results were mapped in terms of percent and total distributions of grain types.

RESULTS

The distribution of grain types across the wave cut platform has a definite pattern. Distinct biofacies exist; the biogenic fragments strongly resemble the patterns of their living counterparts. The death assemblages are, however, more homogenous than the living assemblages. Hard parts are susceptible to wave and current activity, whereas living organisms have specific niches. The biogenic fragments decrease gradually away from the living environment, while the niches sometimes cease abruptly.

About 50% of the platform's lithics consist of shale; 10% consist of sandstone fragments. Lithofacies are similar in that the proportion of fossil fragments to sandstone and shale fragments is more or less constant. The high populations of gastropods, *Stronglyocentrottus*, and *Mytilus* on the platform suggest that their remains should be high in frequency, but none of the groups are present at more than 20% in any given area (figure 1). Gastropods are almost nonexistent in thin section; this may be due to their resistance to breakage.

What is present in the sediment is *Ensis* fragments. *Ensis* lives in sandy environments. *Ensis* fragments dominate the shell distribution across the platform, ranging from 20% to 42%. The proportion of *Ensis* fragments decreases away from the bay (figure 2c), but still holds a high percentage (figure 1).

CONCLUSIONS

The postmortem transport of rocky shore biota is not great. A rocky shore, unlike a beach or lagoon environment, is restricted to its original geographic position. The biota can not migrate beyond the rocky shore environment due to their specialized niches, and the biogenic remains rarely extend far beyond the Point Mimi platform. A rocky shore is commonly buried by beach sediment, resulting in isolated preservation. Few remains of the wave-cut platform biota are found on the adjacent beach more than 50 meters away from the platform.

Point Mimi's fossilization potential is not high, but many of its characteristics are very similar to ancient rocky shores in the literature. MacDonald (1976) found postmortem transport minimal, and the live-dead correspondence high. In the Deschambault Formation of the Trenton Group (a Paleozoic rocky shore deposit in Quebec), little *in situ* material was found, but much rocky shore material was present. Unbroken gastropods and fragments of echinoderms, arthropods and brachiopods also occur in the Deschambault Formation. Zullo, and others, (1987) describe a Pennsylvanian angular unconformity have a low fossilization potential, unless they were fortunate enough to be encrusted by *Lithothamnion* .

The three snails (*L. littorea, T. lapillus*, and *B. undatum*) had relatively high fossilization potentials, and so did the calcareous algae (*Lithothamnion* sp.). Columella fragments from the snails would probably be over-represented in the fossil record, relative to other snail shell fragments. *Lithothamnion* does not show a trend in abrasion pattern.

There are three main factors in taphonomic analyses: abrasion, dissolution and transportation. My taphonomic analysis took into account only one of these three main factors. I was testing to see how differential erosion affects the fossilization potential of the hard-bodied organisms from the tidal pools. I did not take into account the process of dissolution. Young and Nelson (1988) described how dissolution of shells can occur on cool-water shelves, especially if the shells have been bored. Many of the shells at Pointe à Mimi had been bored, so the possibility for dissolution is at least fair. Flessa and Brown (1983) discussed how shells of differing compositions dissolve at different rates; calcitic hard parts dissolve faster than aragonitic ones. This would have a radical effect on the shells that would be left in the fossil record. For example, the snail shells were quite resistant to abrasion, but they were often bored and might not be so resistant to dissolution in sea water. Transportation is the third factor affecting fossilization potential. In order for organisms to be preserved within a fossil community, they must be preserved in situ (Lawrence, 1968). I did not take transportation into account in my research.

Another problem that I encountered while doing my tumbling analysis was the shrinking of the siltstone pebbles due to abrasion. They shrank in overall weight from 136.9 g to 95.3 g after being tumbled for 560 hr. This means that the shells tumbled towards the end of my experiment may not have received as much force from the pebbles as those that were tumbled at the beginning. I do not think this had a large effect on my results, because there is also weight in the tumbler from the other shells. In other words, not all of the abrasion was due to the pebbles.

I also have to keep in mind the fact that I studied this platform only during one season of the year, summer. The severe storms of winter might have a radical effect on the species distribution. Dethier (1982) found that tidepool algae in Washington state have different distributions depending on the time of year. Changing temperature and light conditions may set the upper limit of the algae, whereas herbivory plays a bigger role in algal zonation.

To conclude, two zones were identifiable in the rocky intertidal at Pointe à Mimi: a lower zone (*M. edulis /T. lapillus*), and an upper zone (*Fucus* sp. dominated, with abundant *L. littorea* and *Lithothamnion* sp.). The lower zone has a good chance of being preserved, with *T. lapillus* being the dominant fossil type. The upper zone would not have as good a chance at being preserved; however, *L. littorea* and *Lithothamnion* sp. would be well preserved and might appear as a zone in the fossil record. I should again mention that I took only abrasive action into account in my study; when dissolution and transportation are taken into consideration the results might look quite different.

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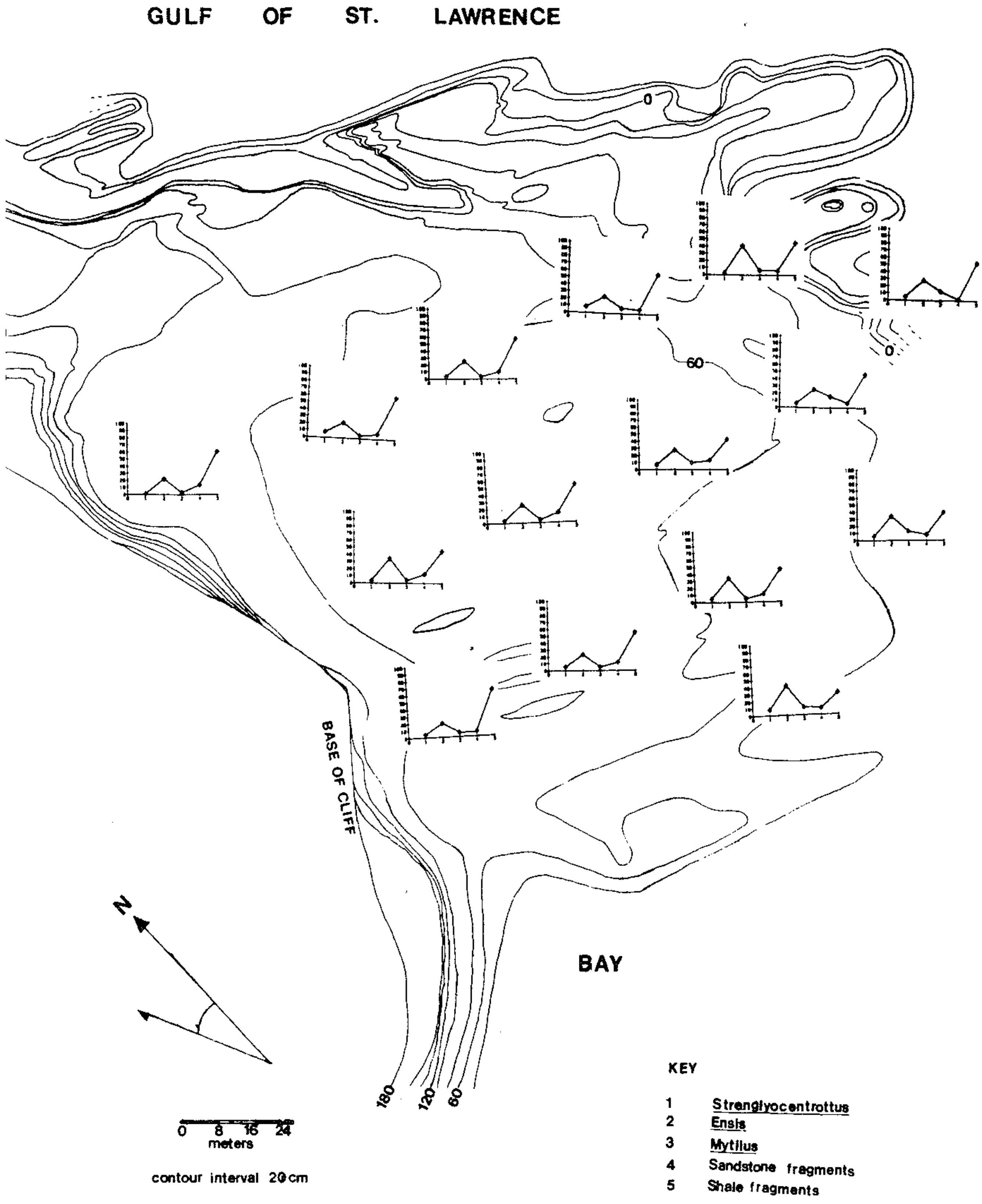

FIGURE 1: PERCENT DISTRIBUTION OF GRAIN TYPE

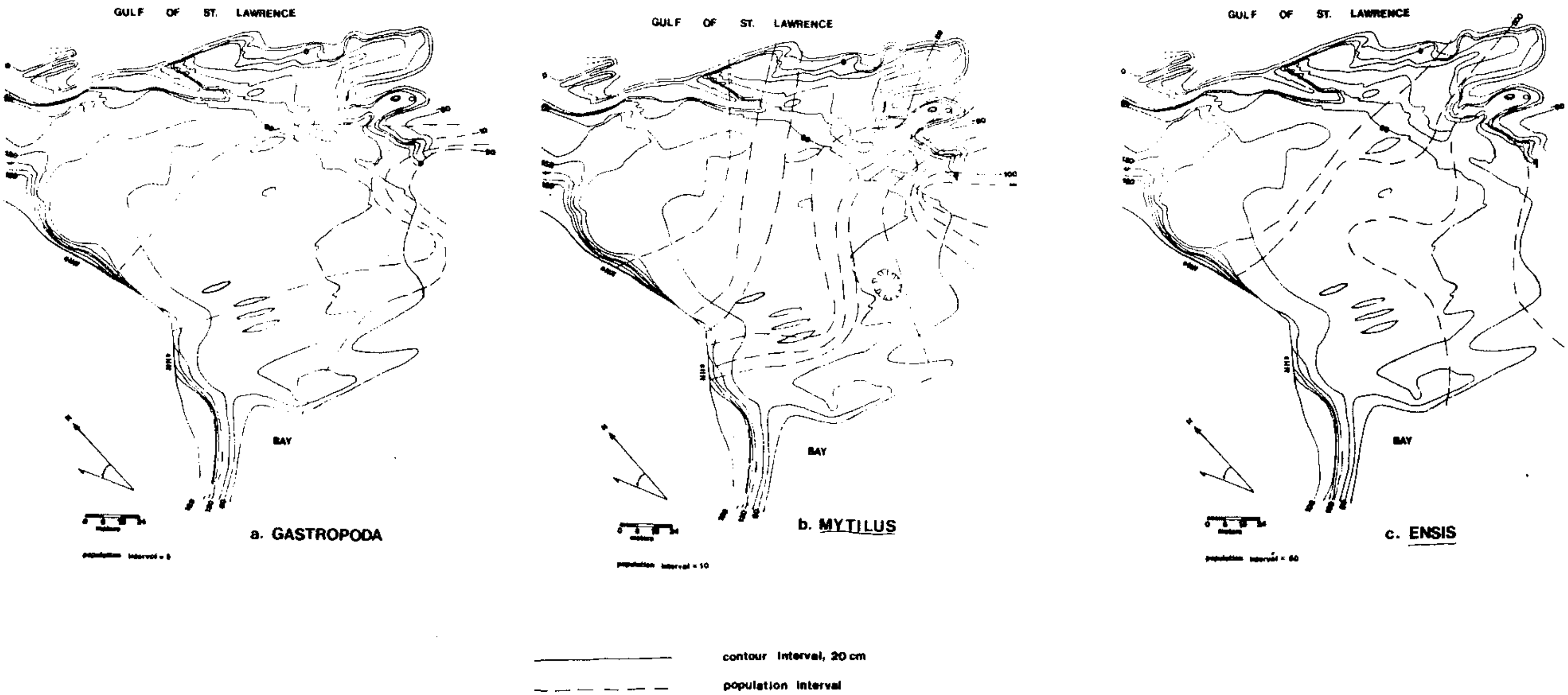

FIGURE 2: TOTAL DISTRIBUTIONS OF SPECIFIC GRAIN TYPES

overlain by a Cretaceous conglomerate dominated by biogenic material. Were Point Mimi's wave-cut platform deposits to lithify, it would be similar. The deposits lie across an unconformity, the biota experiences little postmortem transport, and the rock formed would have a high percentage of animal hard parts. This modern rocky shore can give an accurate picture of how similar rocky shores developed in the past.

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SHELLY DETRITUS AS A PALEOCURRENT INDICATOR: A MODERN EXAMPLE FROM THE GASPE PENINSULA, QUEBEC

Andrew L. Moore
Department of Geology
Carleton College
Northfield, MN 55057

Introduction

One problem with reconstructing ancient population distributions is that the vast majority of fossiliferous rock is made up of sand sized and smaller grains, while most reconstructions are based on whole fossils or large fossil fragments. In this report I propose a method by which populations can be reconstructed and an oscillatory flow paleocurrent deduced by analysis of the shelly debris "fans" which I hypothesise should be created on the lee side of a population.

This paper is divided into two sections. The first is a theoretical argument for the existence of debris fans. The second shows the results of a field study on modern sediments from a wave-cut platform near Cloridorme, Quebec. This study focuses on the population and debris distribution of the gastropod *Littorina saxatilis*, the rough periwinkle. *L. saxatilis* was used for this study because of its relative abundance on the platform and because of the relative ease with which its sediments can be distinguished from those of other organisms inhabiting the platform.

Theoretical Studies

Komar and Miller (1975) show the relationship between particle size and entrainment velocity under oscillatory flow (Figure 1). Settling velocity for large grains is given by Rubey (1933) as:

$$V = \frac{\sqrt{\frac{4}{3} g\rho_f(\rho_p - \rho_f) r + 9\eta^2} + 3\eta}{\rho_f r} \tag{1}$$

where V is the settling velocity, g is gravity, rho_f is fluid density, rho_p is particle density, r is particle radius, and eta is the fluid coefficient of viscosity. By plotting the solution to this equation on Komar and Miller's diagram, it is apparent that not only are small (non-cohesive) grains more likely to be entrained than larger ones, but also that small grains will travel farther before being deposited than will large grains. Since grains will travel in the direction of current flow, the result of current passing over a sediment source (like a population of organisms) is a fan grading from coarse to fine in the downcurrent direction.

Chave (1962) reports that grains will disintegrate with time exposed to a wave train. Given this, even a relatively homogenous population will produce debris that will fragment with time in transport, thus disintegrating to smaller sizes, and again forming a sediment fan.

Field Study

Method

I conducted an experiment to study the usefulness of this method on a wave-cut platform on the north shore of the Gaspé Peninsula in Quebec. The purpose of this experiment was to determine if small populations of relatively homogenous organisms (in this case, *Littorina*) do, in fact, produce debris fans that can be observed and quantified to any degree. This experiment focused primarily on the coarsest fraction of sediment available (-2 phi and -1 phi) because these sizes were the most easily identified.

The study area for this experiment was a small (100m x 200m) wave-cut platform on the south bank of the St. Lawrence estuary near Cloridorme, Quebec (Figure 2). The platform is composed of a thinly interbedded turbidite, with beds ranging in thickness from <1cm to 25cm. The beds were oriented roughly perpendicular to the shoreline. The platform is bounded to the south by a rocky cliff, and on the other three sides by medium sand.