OFFSHORE SEDIMENT DYNAMICS IN THE BAIE DE MALBAIE, GAPSÉ PENINSULA, QUEBEC

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INTRODUCTION

La Malbaie includes an area approximately 10 kilometers from north to south and approximately 12 kilometers from east to west. The western most boundary of the bay is formed by a spit than runs from cliffs in the south to a tide-dominated inlet in the north (Figure 1). The eastern side of the bay opens to the Atlantic Ocean although it is sheltered by Nova Scotia and New Foundland. A lagoon is present behind the spit into which four rivers drain. These rivers, along with the eroding cliffs along the south extent of the bay are the major source of sediment for the bay. West of the lagoon is a topographically flat area of relatively low relief.

Major storm events in the area are most intense in the winter months (Gauthier, 1991). It is during this time of year that most of the material from the cliffs is deposited in the bay. The tidal inlet to the north is a constant source of sediment throughout the year although the rivers' discharges are assumed to be highest following these winter storm events and in the spring as the snow and ice begin to melt.

FIELD METHODS AND ANALYSIS TECHNIQUES

The bay was sampled using a grab sample from a 16 foot Zodiac inflatable boat. One set of 29 samples was collected and located using a Magellan Satellite Network System secured to the boat. This locates position in longitude and latitude with an accuracy of approximately ±5 meters. Another set of 15 samples was collected just offshore along the spit using a small bucket and hand sampling in approximately 5 feet of water. The location of these samples was also determined using the Magellan SATNET.

All samples were dried in an oven, then disaggregated in an ultrasonic bath for at least 45 minutes and then redried in air. Any remaining aggregates were broken up by gently using a mortar and pedestal. This disaggregation procedure resulted in total aggregates of less than 10% in each sample. The samples were sieved in 1/4-phi intervals on a Ro-Tap machine for 15 minutes. Graphic mean, inclusive standard deviation, skewness and kurtosis were calculated using the method described by Folk (1974).

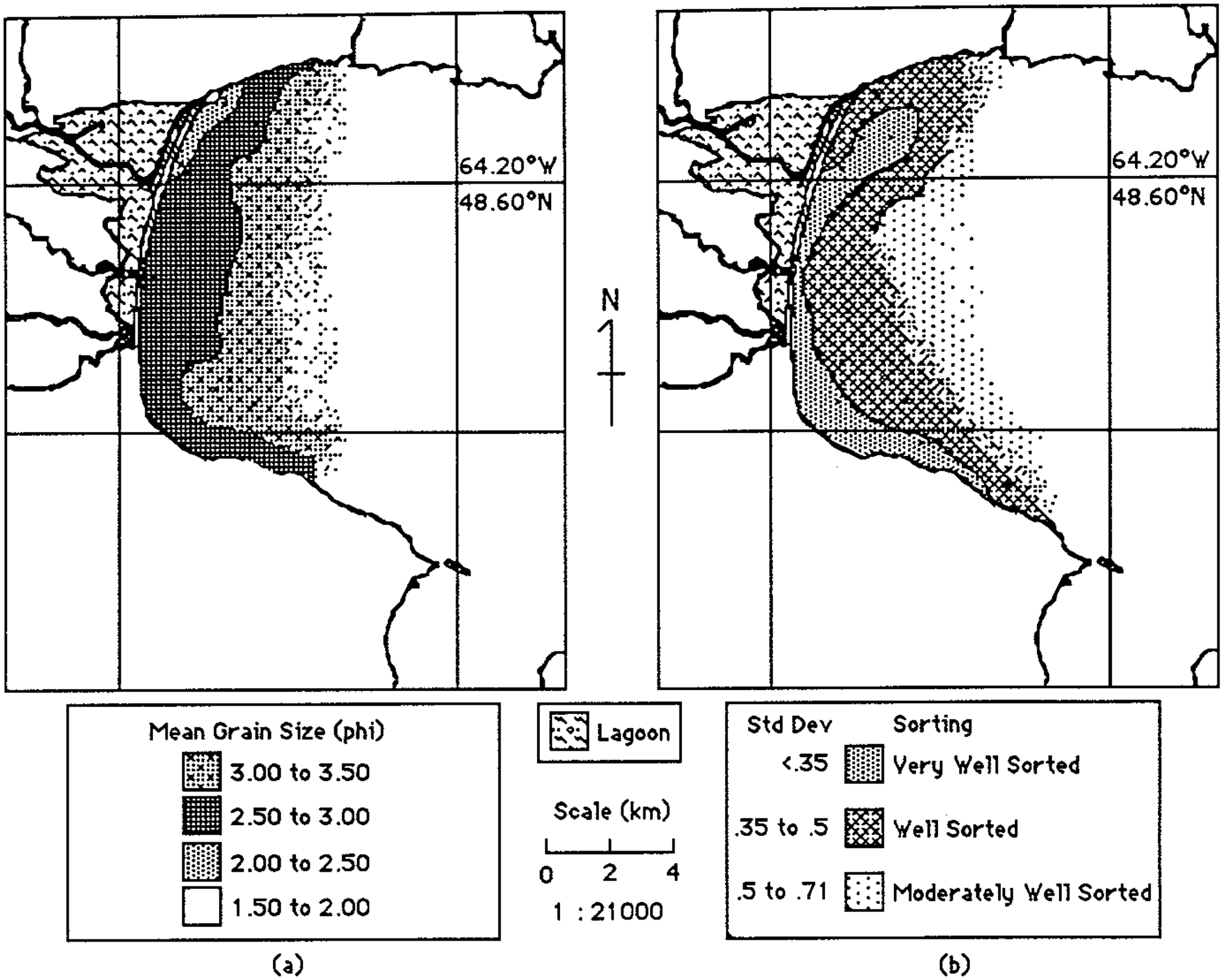

Figure 1. (a) Map of La Malbaie Area showing mean grain size distribution. (b) Map showing sorting of samples. Values for both calculated using graphic mean and inclusive graphic standard deviation (Folk, 1974).

DISCUSSION

The data resulting from grain size analysis was used to construct the maps in Figure 1. The maps show mean grain size and standard deviation within the sampling area of the bay. The maps are based on the 29 offshore samples. Mean grain size is approximately 3.00 phi over the majority of the area sampled. The coarsest material was found to the west of the inlet. Grain size offshore along the spit was found to be relatively constant. Size decreases with depth of water as energy becomes less and the finer material comes to rest. Sorting was highest along the length of the spit although it was lower near the inlet. Sorting also decreases into the deeper water due to the inclusion of the finer material. The relatively constant mean grain size as well as the high level of sorting over the bay, shows the efficiency with which the bay reworks sediments. As material falls or collapses from the cliffs to the south, it is quickly moved north via longshore currents as described by Creaser (1990). The zone around the inlet is less stable due to the domination of the tides. The energy in this area of the bay removes finer sediment, leaving coarser grain sizes. The decrease in sorting of this area is a result of the influx of sediment from the rivers that empty into the lagoon. These rivers erode local conglomerates as well as glacial till, resulting in a range of coarser grain sizes.

Data from the 15 shallow water samples, yet to be analyzed, is needed to accurately constrain the characteristics within the wave zone. They may be indicative of the processes occurring in the deeper water of the bay.

CONCLUSION

The results of the analysis of samples collected during the summer reveals the efficiency with which the bay reworks sediment deposited from the cliffs during large winter storms and from the river during the spring as ice melt is added to the discharge of the rivers. Grain sizes and sorting over the sampling area are indicative of these processes, although coarser, well sorted material would be expected in the south near the cliffs. The absence of this coarser material shows the ability of the longshore current in the area to move the sediment north, depositing it on the beach during storms, leaving finer material to be winnowed back out into the bay.

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DEPOSITION AND EVOLUTION OF THE DOUGLASTOWN - HALDIMAND SPITS, GASPÉ PENINSULA, QUEBEC, CANADA

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INTRODUCTION

This study was undertaken to help unravel the geology of the Douglastown and Haldimand spits, which are located at the extreme eastern end of the Gaspé Peninsula. By researching these spits I hope to add to the larger picture of regional geology. I plan to explore the relationship between the ebb and flow currents of the St. Jean River, the currents of the Gaspé Bay, and how this interaction determines not only the present shape of the spits, but may also control their future evolution.

My field area of study included the Douglastown and Haldimand spits, which are located at the mouth of the St. Jean River. An estuary is formed behind the spits as the river enters the Gaspé Bay. The two spits separate the estuary from the bay and are, in turn, separated by a tidal inlet which is approximately 68 meters wide. A railroad bridge connects the two spits. These spits are generally sandy, although some areas have a concentration of rounded pebbles. The sand consists of angular grains of quartz, feldspar, and greenish ferromagnesian minerals from an igneous / metamorphic source area.

METHODS

The first step in exploring the geology of the Douglastown - Haldimand spits involved making a base line for the measurement and sampling of each of the spits. The base lines were created by placing stakes at 500 foot intervals along both spits. These lines then could be used to plot profiles of the beach and as general reference points. All angles and distances were calculated exactly using a theodolite (Figure 1).

Twenty-five profiles of the beach were made using the stake and horizon method. Each profile was measured perpendicular to the shoreline, from one of the base line stakes to approximately one meter under water, which was generally where the slope levelled off (Figures 2a and 2b).

At every even-numbered profile, or 1,000' apart, five surface sediment samples of approximately 200 grams each were taken along the line of the profile. Each sample was later analyzed for phi mean, standard deviation, skewness, and kurtosis. Phi values for the 5, 16, 25, 50, 75, 84, and 95th percentiles were calculated. A spline function also was fitted to the cumulative frequency curve of the weight percents (Folk and Ward, 1957; and Middleton, 1990).

Five profiles were made of the offshore bars that form at the mouth of the estuary. They were both conducted at low tide using the stake and horizon method, and elevation change at every twenty feet was determined. All profiles were taken perpendicular to the beach. A profile also was made of the inlet channel by taking depth measurements at distances along the railroad bridge that crossed the channel.

On June 21, 1991, the currents from a full tidal cycle were measured along the inlet between the spits. The longshore currents also were measured at the same times at a point 250 feet from the inlet along each of the spits. Twelve readings were taken during the day, noting the velocity and direction of the current. At lowest tide, three more current measurements were taken using the same method at distances of 500', 750', and 1000' from the inlet.

Two trenches were dug during low tide in order to see the longer-term effects of deposition and erosion on the spits. One trench was dug on each spit from approximately the same point where the longshore current measurements were taken, which was 250' from the inlet as measured along the high tide line.

RESULTS

Sediment analysis shows that there is a patchy distribution of grain sizes along the spits. The coarsest sand is found near the inlet and at the far ends of the spits. The finest material is located along the mid sections, and the sands become slightly coarser toward the dunes. Although only documenting one moment in time, information gathered from profiles of the beach front indicates that more accretion occurs