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 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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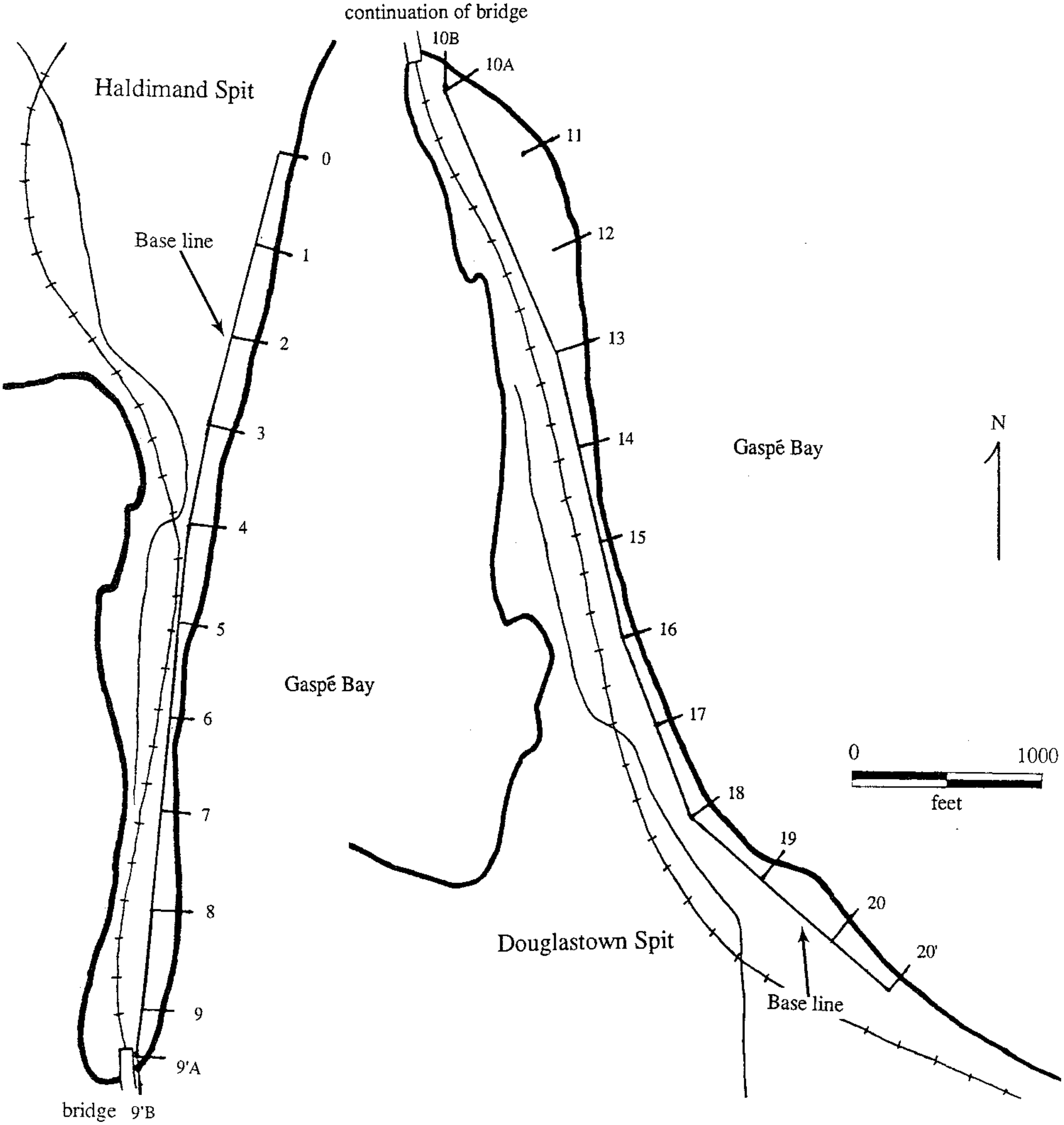

Figure 1: Maps showing location of base line and lines of profile.

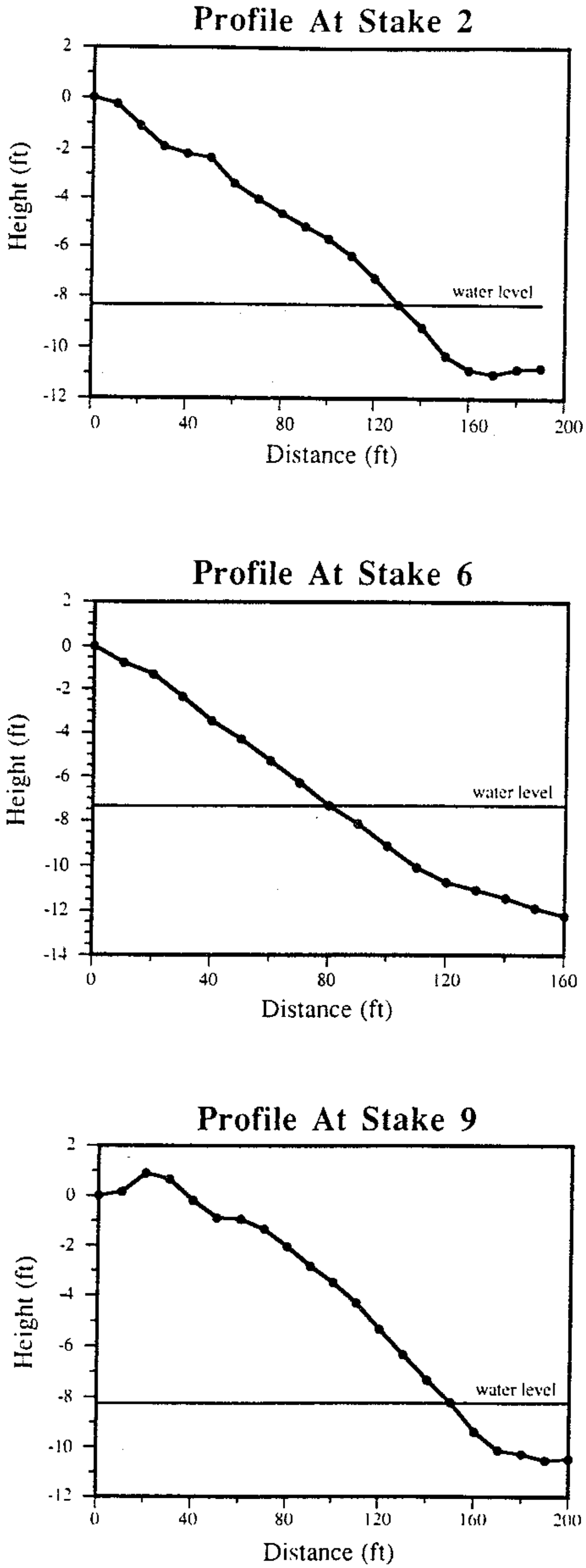

Figure 2a: Profiles from Haldimand Spit

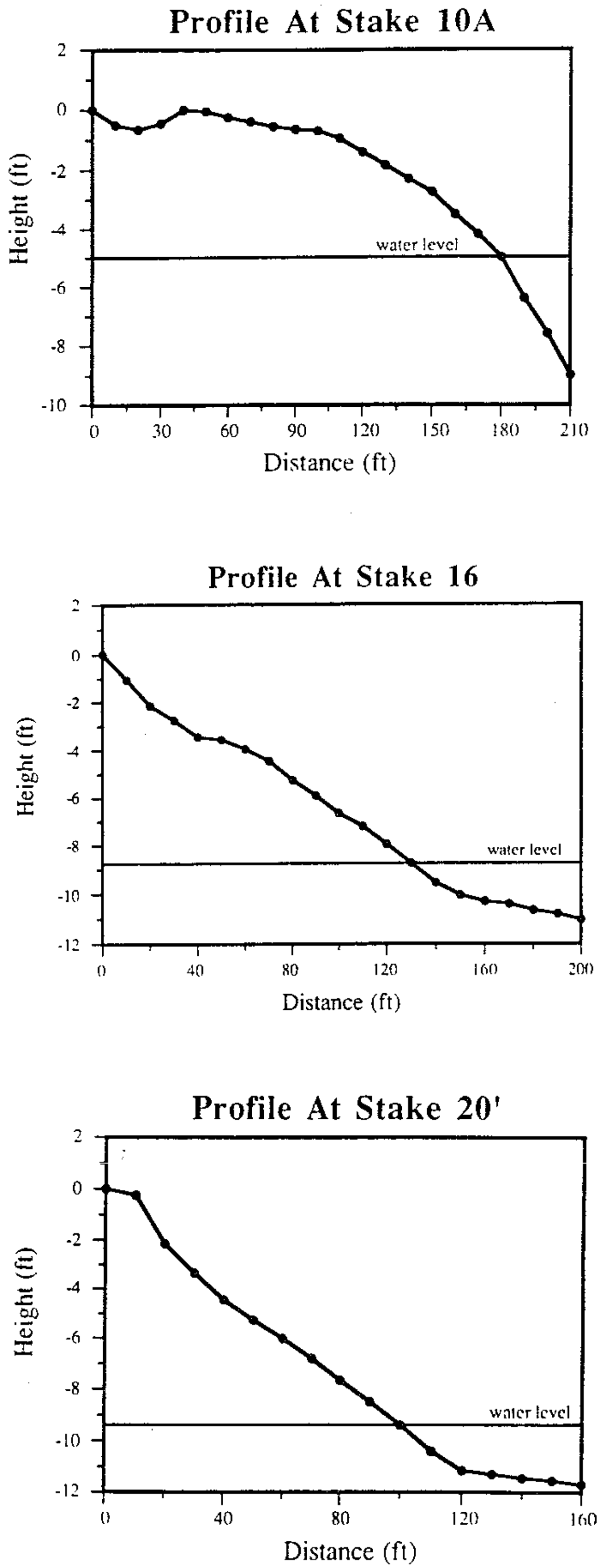

Figure 2b: Profiles from Douglastown Spit

along the mouth of the inlet and at the distal ends of the spits. The central portions of the spits seem to be eroding (Figures 2a and 2b).

The offshore bars are located where the inlet enters the Gaspé Bay, and they appear to be in the classic delta form. Tides and currents move in and out between the estuary and bay depending on time of day. The trenches show basic yearly accumulation patterns with strongly horizontal layering.

DISCUSSION

Preliminary results indicate that there is a complex interplay of forces operating on the very similar Douglastown and Haldimand spits. The grain-size analysis and beach profiles indicate that longshore currents have distributed sediments coming from the St. Jean River along both spits. The finer material is deposited in the areas of lower energy, while higher energy deposits are represented by the coarser areas at either end of the spits (Chappell, 1967). The offshore bars represent areas of deposition from the St. Jean which may form one source of sediment for bayward growth of the spits.

Photographs dating back to 1927, as well as the current location of the railroad bridge, indicate the direction of recent spit migration. The bridge, which appears far to the estuary side of the spits in recent air photos, points to the conclusion that sediment is being accumulated toward the bay, at least around the area of the inlet. Eventually, the bridge may well be stranded in the estuary.

Trench data supports this evidence, showing layers which are parallel to the beach face and indicate accretion at the inlet end of both spits.

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