# SEDIMENT DISTRIBUTION AND TRANSPORTATION ALONG ANSE DU CHEIN BLANC, A POCKET BEACH ON THE GASPÉ PENINSULA, QUEBEC, CANADA

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## INTRODUCTION

The Gaspé Peninsula between Percé and Gaspé consists of a series of headland pocket beaches alternating with baymouth bars and spits. Within the context of the Keck Gaspé research project, sediment studies of pocket beaches can provide essential data on sediment sources for and the sediment sources and mechanisms of transport from the headlands to the spit and bar systems. This study the beach within Anse du Chein Blanc (Bay of the White Dog) focused on following and describing the transportation of sediment particles, both clasts and grains, from near-beach source areas to distribution along the beach.

## FIELD AREA

Chein Blanc Beach is a narrow pocket beach, constrained at each end by a sandstone cliff. It extends for nearly 1 kilometer along the northeast shore of the Gaspé Peninsula at Ste. George du Malbaie. A local fault between the Lower Devonian Battery Point Formation and the Lower-Middle Devonian Malbaie Formation described in Rust (1976) is here interpreted as bisecting Chein Blanc such that the northern cliff is Battery Point Sandstone and the southern cliff is Malbaie Sandstone (Figure 1). Glacial till fills the original fault zone. A small stream originating in the till flows across the beach and significant seep occurs from the northern edge of the till onto the beach. The predominant direction of longshore current is to the north. The beach itself does not exceed 30 meters in width from cliff base to mean low water. What makes the site particularly interesting is the range of sediment sizes and possible sediment sources. Chein Blanc Beach is predominantly covered by sand, but several areas evidence significant gravel cover (Figure 1). The gravels are generally pebble sized on the Wentworth scale, but some cobbles and boulders have eroded off of the northernmost and southernmost cliff faces.

## FIELD AND LABORATORY METHODS

Fieldwork on Chein Blanc Beach was carried out during June, 1991. A topographic map from the cliff base to the mean low water line was created using plane table and alidade. Cliff heights were determined using the laser theadolite. On the resultant base map, six stations were designated at regular intervals along the beach. Each station was profiled from the cliff base to a water depth of 5 feet using the stake and horizon method. Detailed stratigraphic sections were drafted for the Battery Point Formation and the Malbaie Formation cliff. Notable features of each lithography were sketched and photographed and 2 rock samples were taken from each cliff and cut to produce thin sections.

Along each profile, consolidated beach sediment samples were taken at approximately 15 feet, 30 feet, and 60 feet from the cliff base, corresponding to the backbeach, berm crest, and foreshore. Four additional sediment samples were taken between the 6 profiles. The glacial till was sampled to aid in determining the effect of fine sediment leaching from the till onto the beach in seep areas.

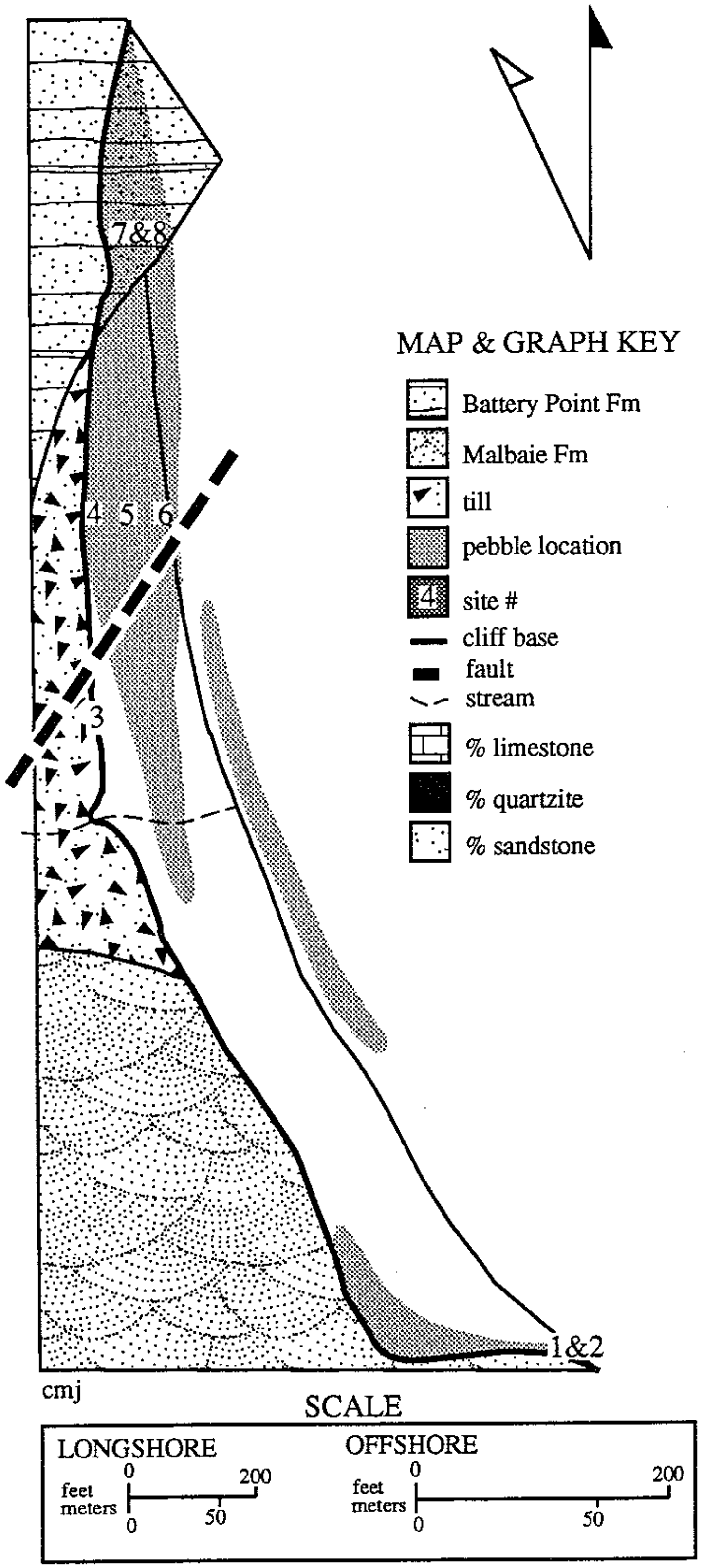
Seven distinct populations of 100 pebbles and cobbles were studied. For pebbles a 10 meter line was laid down and a sample was selected each 10 centimeters. For cobbles 2 parallel 50 meter lines were laid out and a sample was selected each meter. One hundred clasts were also excavated from the till, following the cobble sample convention. The long, intermediate, and short axes of each clast were measured, lithology was determined, and roundness was estimated according to Power's scale (1953, as seen in Boggs, 1987). Till clasts were examined for striations.

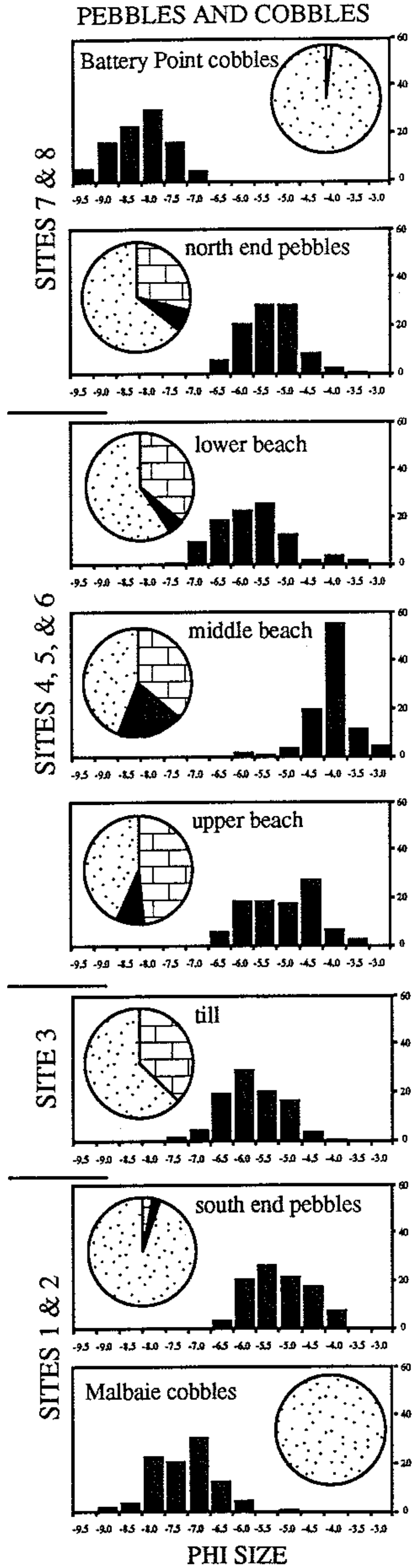
In the lab, the unconsolidated sediment samples were sieved and subsequently characterized by mean grain size, standard deviation, skewness, and kurtosis according to Folk and Ward's mathematical parameters (1957) using the IBM programs PROBSPL.5 and SIEVE. Contour maps were constructed for mean grain size and standard deviation (Figures 2 and 3).

Clasts were designated as limestone, quartzite, or sandstone for ease of analysis. The clast data was analyzed for mean grain size, standard deviation, sphericity, and form using the IBM program SHAPE91. The program provides triangular form and sphericity diagrams of the type suggested by Folk and Sneed (1958). Data from the program was also utilized in the creation of various histograms for each site comparing frequency, phi size, and sphericity generally (Figure 1) and for each rock type.

**FIGURE 1**

-Map of clast source areas and distribution, also illustrating beach, cliff, and stream organization.
-Pie graphs indicating % rock type per site
-Histograms indicating frequency of phi size at each site.



## DISCUSSION

Gravel and cobble sites fall into two categories, sediment source area and sediment beach deposit. The north and south end cobbles and boulders, sites 1 and 8, and the till, site 3, are considered source areas. The north and south end pebbles, sites 2 and 7, and the cross-beach sequence of sites 4, 5, and 6 are included as beach deposits. During the course of fieldwork, the apparent location of the three main beach pebble populations shifted somewhat following several storms; however, the shift was predominantly the result of sand movement rather than of significant pebble transport. Thus, at the northern end of the beach, the sand may blanket a pebble base.

The predominance of sandstone pebbles in the beach deposits is due to the disaggregation of the north and south end sandstone cobbles and the erosion of clasts from the till. Limestone pebbles are derived almost exclusively from the till, although the few limestone clasts at site 2 may have originated in a till or conglomerate farther to the south and been transported north by the longshore current. The single limestone cobble in the northern source population probably eroded from till atop the Battery Point cliff and dropped onto the bedrock shelf. The source of the quartzite pebbles is not immediately apparent, as none of the source areas contain any quartzite. The difficulty encountered in sampling the till, the low percentage of quartzite across the beach, and the relatively smaller size of the quartzite pebbles suggest that quartzite exists infrequently in the till. The stream, therefore, is most likely the primary source of quartzite pebbles, as the extensive path it carves through the till allows it increased opportunities to entrain infrequent quartzite pebbles.

Site 3, the till, and site 4, by the base of the till, display similar broad (4ø) ranges of clast sizes, implying that the tremendous variety of sediment associated with glacial till is moving onto the beach as the till is eroded back (Figure 1, site 3 and 4 histograms). The greater percentage of limestone at the beach site presumably results from the addition of limestone clasts from stream deposits. Site 5, along the mid-beach, consists of relatively smaller, more spherical clasts and contains the highest percentage of quartzite pebbles. A northward migration of stream sediment along the berm of clasts which have been subjected to stream transport will tend to give higher sphericities than those deposited directly out of a source area. Site 6 evidences a near-normal distribution curve with a tail of finer pebbles related to the more consistently high energy environment at the near-shore.

A number of initial observations can be made from the contour maps (Figures 2 and 3). As with the gravel populations, both the stream and the till exert a significant influence on sediment distribution. Adjacent to the till mean grain size is large and sorting is poor. Both characteristics reflect the influx of silts and coarser grains from the unsorted till. In Figures 2 and 3, a fan shaped deposit extends forth from the stream, again displaying the larger mean grain size and poorer sorting related to the till. Sediment distribution along the rest of the beach is consistent with a moderately high energy environment. The northward fining distribution apparent on the mean grain size contour (Figure 2) supports the northward longshore current as a primary mechanism of sediment transport.

## CONCLUSION

Clast and grain distribution along Chein Blanc Beach displays a northward direction of transport in keeping with the predominant northward longshore current. Gravel distribution indicates that the southern Malbaie cliff and boulders and the till are the primary sources of sandstone pebbles, the till is the primary source of limestone pebbles, and the stream is the primary source of quartzite pebbles. The predominant source of sand for Chein Blanc Beach is presumably erosion of the constraining sandstone cliffs, particularly the Malbaie Formation cliff to the south. Detailed examination of the Malbaie and Battery Point thin sections should aid in confirming the correlation of the beach sediment and the lithified grains.

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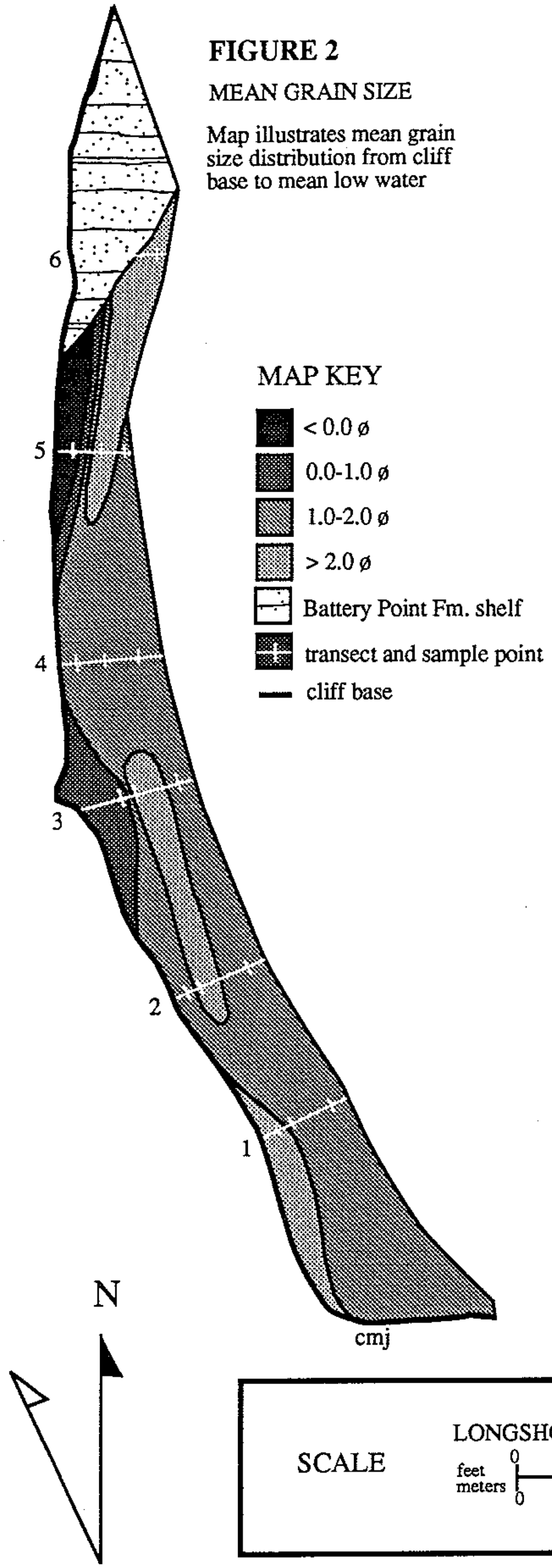


**FIGURE 2**

MEAN GRAIN SIZE

Map illustrates mean grain size distribution from cliff base to mean low water

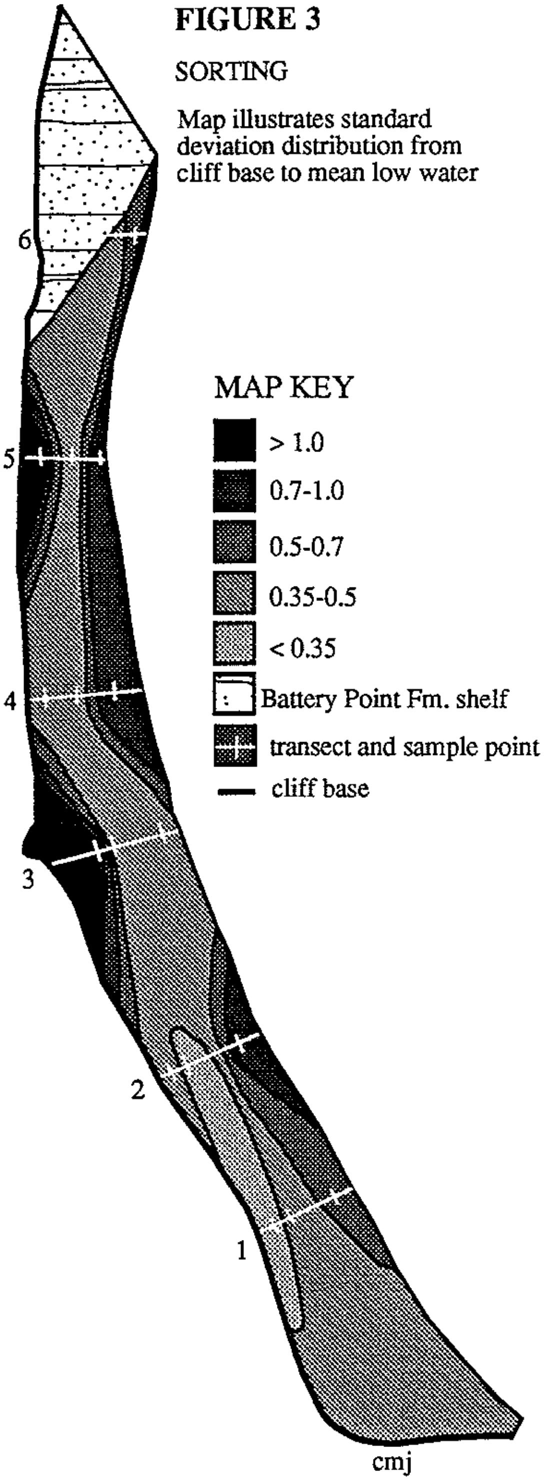


**FIGURE 3**

SORTING

Map illustrates standard deviation distribution from cliff base to mean low water