

SUBSURFACE STUDIES, USING SEISMIC METHODS, ON MALBAIE SPIT, GASPE PENINSULA, QUEBEC, CANADA

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INTRODUCTION

Malbaie spit is located in Baie de Malbaie on the eastern shore of the Gaspé Peninsula, Quebec, Canada. The Peninsula is approximately 150 miles long and 85 miles wide. The Appalachian mountain range extends onto the peninsula. The Shickshock mountains, part of the Notre Dame mountains, constitute a large portion of the peninsula. The peninsula was glaciated during the Pleistocene. The most recent retreat of the glaciers was approximately 10,000 years ago (Press and Siever, 1986, Stanley, 1987).

Malbaie spit is approximately 8 kilometers long and 200 meters wide. It is connected to the mainland at its southern end and extends to the north from bedrock cliffs. Bedrock cliffs border the bay on both the north and south. The northern end of the spit is separated from the mainland by a channel that is approximately 200 meters wide. This channel connects the tidal flats and salt marshes on the west side of the spit to Baie de Malbaie on the east. There are four rivers which flow into the tidal flats and salt marshes: Rivière Murphy and Rivière du Portage to the south, Rivière Beattie in the center and Rivière Malbaie to the north.

The spit is of particular interest because of its location. Typically a spit that forms at a bay extends from the mainland across the mouth of the bay in the direction of the longshore current. This occurs because the embayment causes a disruption in the longshore current, causing it to slow down. When the current slows down, any sediment being transported by the current is deposited, extending from the mainland in the direction of the current, forming a spit. Malbaie spit is set far back into the interior of the bay instead of at the mouth of the bay.

PURPOSE

The main goal of this study is to determine if there is a controlling mechanism in the shallow subsurface for the location and form of Malbaie spit. The spit is set so far back into the bay that perhaps normal processes of spit formation are not responsible for its location.

METHODS

Seismic refraction surveys were conducted on Malbaie spit and adjacent areas to determine the velocities with which energy waves travel through the materials in the shallow subsurface. A battery powered, twelve channel ES-1210 Signal Enhancement seismograph was used to record the data. Two different sources were used to produce energy. The source used most often was a 10-gauge shotgun blank fired from a buffalo gun. A second source was a sledgehammer struck against a metal plate. An array of twelve equally spaced geophones was used to record the waves passing through the shallow subsurface by recording the vibrations of the geologic materials caused by the waves (Fig. 1). The lengths of the seismic lines varied from 5.5 meters to 225 meters with geophone intervals varying from 0.5 meters to 10 meters. Analysis of the data was done on a Macintosh computer using a program called RefractSolve (Burger, 1992). Using known velocities of geologic materials, correlations were made between the velocities obtained and the materials they represent.

Seismic surveys were conducted at ten different locations on the spit and surrounding areas (numbered on Fig. 2). Six of these locations were used to prepare a cross section of the spit and develop a subsurface model (Fig. 3). The six locations chosen were 2, 1, 3, 5, 11 and 9. Four of these locations, 2, 1, 5 and 11, are all directly on the spit. Locations 3 and 9 were chosen because they are the two locations nearest the spit that maintain elevations nearest the elevations of the locations on the spit.

INTERPRETATIONS AND CONCLUSIONS

Velocities of known materials suggest that the deepest layer detected in the surveying is bedrock. This layer is most shallow, approximately 1 meter to 3 meters, at the north end of the spit. It forms a deep channel to a depth

of at least 67 meters beneath the center portion of the spit, possibly the result of a preglacial river or earliest glaciation. The layer again becomes shallow, approximately 9 meters to 17 meters, at the south end of the spit. It is interpreted that the material above the bedrock is primarily a mixture of till which was deposited during Pleistocene glaciation, and saturated sediments which were deposited during a probable rise in sea level associated with the retreat of the glaciers. The uppermost layer has been interpreted to consist primarily of dry sand and gravel.

It is concluded that the location of the spit is not a result of any mechanism of subsurface control. The subsurface topography does not exhibit a form that would trap and collect sediments. There is no specific feature beneath the spit, such as a glacial end moraine for example, upon which the spit could have been deposited. The spit results from the convergence of river currents flowing northeast, and ocean currents flowing northwest. The rivers which enter the bay at an interior location, are considered to be the primary source of sediment for the building of the spit. The convergence of these river and ocean currents yields a resultant current which flows north. This resultant current has a decreased velocity and a decreased carrying capacity which leads to the deposition of sediments carried by these currents. The deposited sediments build up well in the interior of the bay and extend from the mainland in the direction of the resultant current, forming a spit.

REFERENCES

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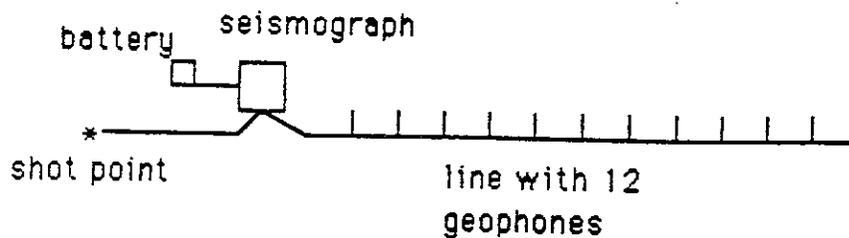


Fig. 1. Diagram illustrating a typical line set-up. The geophones are equally spaced and connected to a cable. The cable, battery, and energy source are all connected to the seismograph.

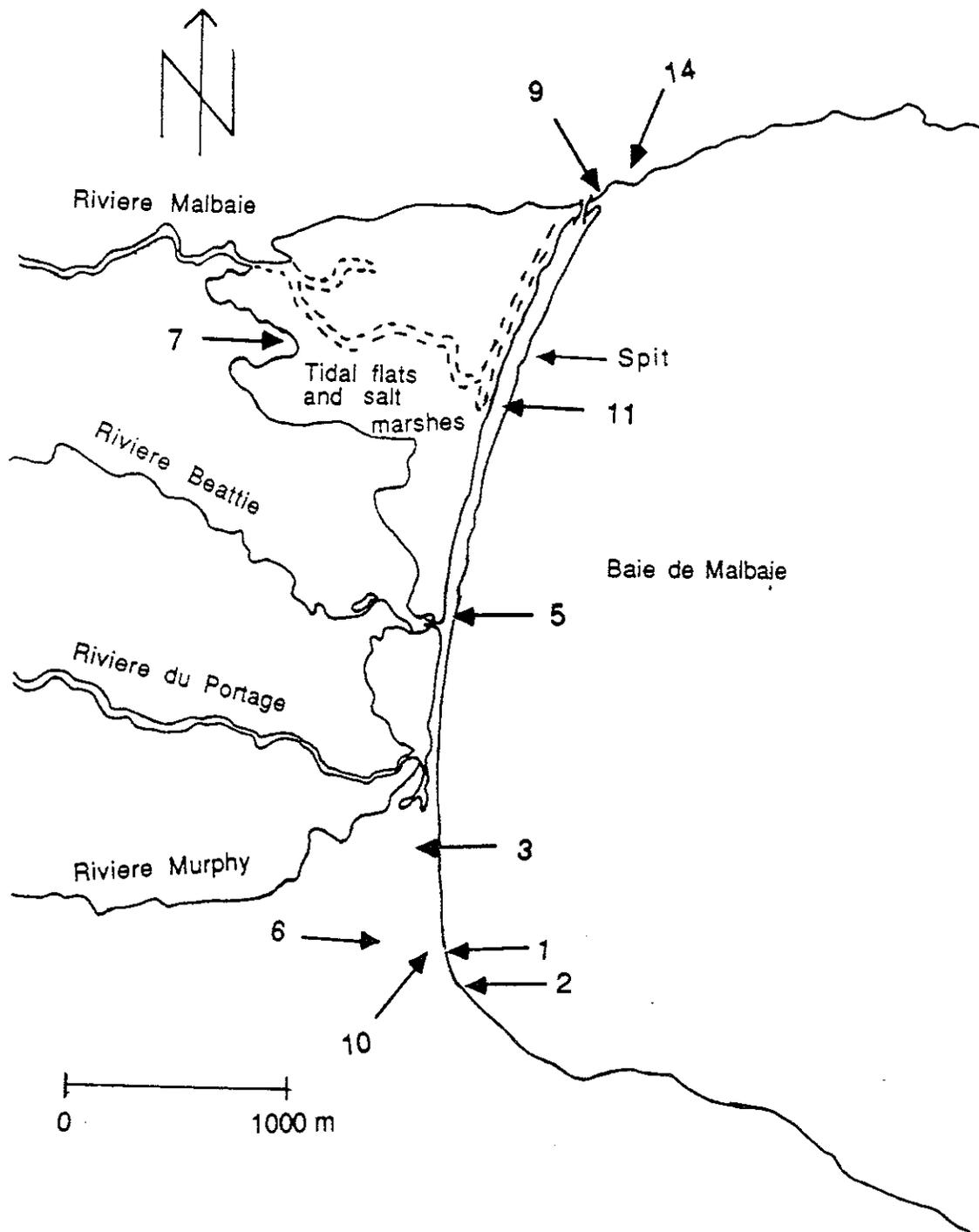


Fig. 2. Reference map illustrating the ten seismic survey locations used for this study.

