Shoreline Changes of San Luis Pass, Texas from 1930 to 1990

Maryellen Sault
Department of Geology
SUNY College at Buffalo
Buffalo NY 14213

Rebecca Thomas
Department of Geology
Williams College
Williamstown MA 01267

Introduction

San Luis Pass is located about 45 km southwest of Galveston, Texas on the Gulf of Mexico. The pass is a tidal inlet that separates Galveston Island on the north from Follets Island on the south. It also connects the Gulf of Mexico with West Bay. Using aerial photographs (Plate 2) and a landsat image (Plate 3), we studied erosion and deposition along the north and south shorelines of San Luis Pass at approximately ten year intervals from 1930 to 1990.

Methods

Six stages were used to develop a model for shoreline evolution of San Luis Pass; (1) make a mosaic of the aerial photographs, (2) trace the shorelines as seen on the photographs, (3) reduce or enlarge the shoreline traces so that they all have the same scale and orient them so that north is at the top of the page, (4) lay the tracings for successive intervals and outline areas of erosion and deposition, (5) from these outlines computed the approximate areas of erosion and deposition and (6) graph the rates of deposition and erosion for each interval.

Aerial photographs for the years 1930, 1939, 1952, 1965, 1974, 1982, and 1990 were obtained from the Texas Bureau of Economic Geology. The photographs were used for observing the shoreline changes at San Luis Pass at approximately 10 year intervals. The entire pass was not always contained in one photograph. In order to obtain a complete picture, a mosaic was formed by using Adobe Photoshop™ 2.5. This is a process that uses two separate photographs that have common, easily identifiable features which are merged together and matched pixel by pixel. Often, the features that were to be merged together had to be rotated and cropped to line up the identified features.

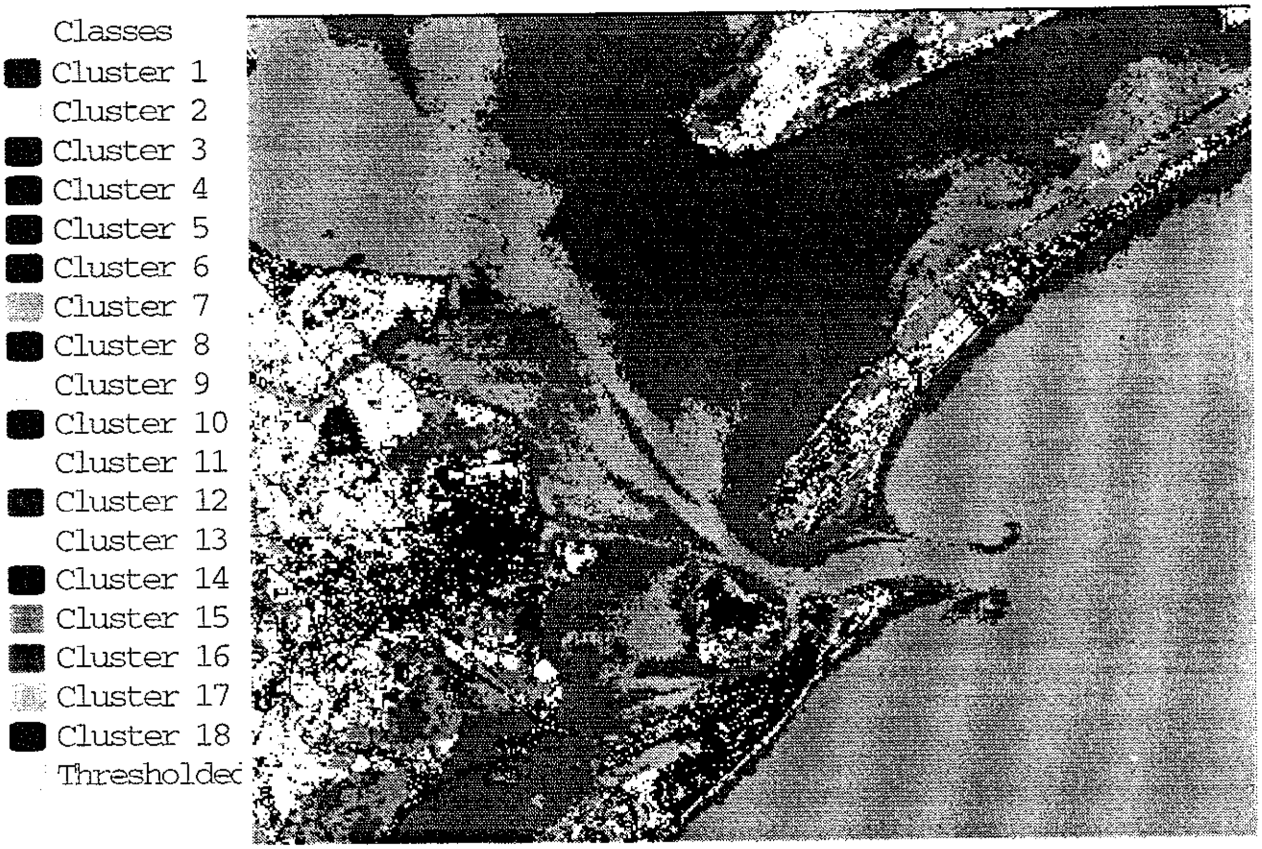
To trace an outline of the shoreline, the mosaic image was transferred to Canvas™ 3.5.1. These tracings were then placed over a 1965 air photograph. (Plate 2) To fit the various shorelines to scale, easily identifiable features, such as roads, intersections and houses, were located on each photo and marked on the tracings. These were then rotated and enlarged or reduced to fit the 1965 base map. The shoreline tracings were then superimposed on the 1965 base photograph to give an overview of the changes that occurred over the whole interval. A mosaiced topographic map that was scanned into the computer to orient the shorelines north. The rulers in the program Canvas™ 3.5.1 were set to calculate the scale of these diagrams by comparing the length between common road intersections of the original map and the 1965 photograph. Two successive shoreline tracings were put together and the areas of change were outlined using Canvas™ 3.5.1. These areas were then color-coded (and patterned) to show the difference between erosion and deposition. (Figure 1.)

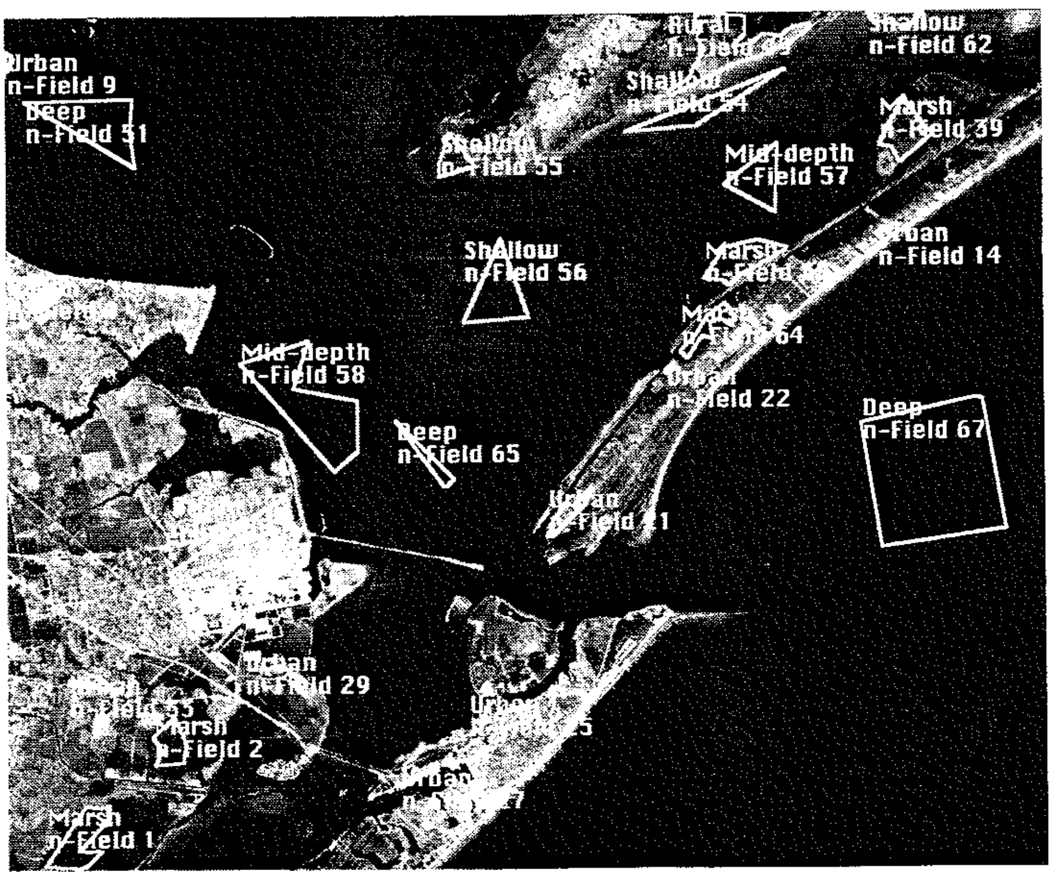
The areas of deposition and erosion, north and south of the pass, were then calculated for each shoreline change diagram using Canvas™ 3.5.1. To find the average deposition of each year of the interval, we summed the areas for each time span and then divided by the total number of years in the time span. Using KaleidaGraph™ 3.0.1, we graphed the average areas of deposition against time for the shorelines south and north of the pass (Figures 2a and 2b). We also added the areas of deposition north and south of the pass to produce the net total deposition of the San Luis Pass. Then, using KaleidaGraph 3.0, we graphed the net total deposition (Figure 2c). The same process was used for erosion, and plotted on the graphs with the rate of deposition.

Results

On the north shore line, the overall rate of deposition is at its highest during the interval from 1930 to 1939. It decrease during the next two blocks, with almost no deposition during the interval from 1952 to 1965. From 1965 to 1974, there is a relatively large increase in the rate of deposition, then it falls to an almost constant rate during the last two intervals. The rate of erosion is at its greatest during the interval from 1952 to 1965. The rate of erosion increased to that point and decreased to its lowest rate in the last interval. (Figures 1 and 2a)

On the south side of the inlet, there was almost no deposition during the first two intervals. There was a slight increase during the time interval from 1952 to 1965. The was a large increase in the rate of activity from 1965 to 1974. For the last two intervals, there was almost no deposition. Erosion on this side of the


Classes
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Cluster 5
Cluster 6
Cluster 7
Cluster 8
Cluster 9
Cluster 10
Cluster 11
Cluster 12
Cluster 13
Cluster 14
Cluster 15
Cluster 16
Cluster 17
Cluster 18
Thresholdec


Urban
n-Field 9
Deep
n-Field 51
Shallow
n-Field 62
Shallow
n-Field 55
Marsh
n-Field 39
Mid-depth
n-Field 57
n-Field 14
Shallow
n-Field 56
Mid-depth
n-Field 58
Deep
n-Field 65
Urban
n-Field 22
Deep
n-Field 67
Urban
n-Field 29
Marsh
n-Field 2
Marsh
n-Field 1

bay increased from very little from 1930 to 1939, to a maximum rate from 1965 to 1974. Then it decreased to an approximately constant rate during the last two intervals. On this side of the pass, the rates of both erosion and deposition reach their maximum during the interval from 1965 to 1974. (Figures 1 and 2b)

Overall, the rate of deposition in the pass starts out around 0.14 km^2/yr and decreases to a constant rate. It suddenly jumps to a maximum of 0.6 km^2/yr from 1965 to 1974. Then the rate of erosion falls for the last two intervals. The rate of erosion generally increases from about 0.05 km^2/yr to a maximum of 0.5 km^2/yr from 1974 to 1982. Finally the rate of erosion dropped back down to about 0.06 km^2/yr. (Figure 2c)

Discussion

Except for the intervals from 1930 to 1939 and from 1965 to 1974, the rate of erosion has been greater than the net rate of deposition, as seen in Figure 2c. This erosional trend is due to a variety of reasons, which include both natural and human influences.

First, the topography of the area is a major factor. Both Follets Island and the western end of Galveston Island are of low relief and readily washed over by storm waves and surges. Follets Island is a thin body of sand 5 to 8 feet thick that overlays marsh land, creating an unstable landform. Western Galveston Island is well vegetated, so there is less erosion than on Follets Island (McGowen, Garner, Wilkinson 1977 pp. 21-22)

The direction of wave approach and shoreline orientation dictates sediment transport and longshore currents (McGowen, Garner, Wilkinson 1977 p. 20). In this area, the shoreline is oriented so that the sediments are transported away from the inlet, toward Mexico. The problem is that the sediment supply to this system has been depleted. Humans have built reservoirs on the Trinity and San Jacinto River. Sediments that would have been carried into West Bay are now trapped behind these reservoirs. For example, the amount of suspended sediment carried by the Trinity River in the 1930's and 1940's was 2,00 to 9,000 acre-ft/yr; in the 1970's, the rivers carried 100 to 1,000 acre-ft/yr (Paine and Morton 1986 p. 19). This would help to explain why the rate of erosion did not exceed the rate of deposition during the interval from 1930 to 1939.

Conclusion

If past trends continue, it has been theorized that continued reduction of sediment transport by the Trinity and San Jacinto Rivers (due to reservoir construction), jetty construction on the coastlines, channel dredging, and rising sea-levels will contribute to increased erosion rates in the future (Paine and Morton 1989 p. 39)

Plate 2. 1965 Air Photograph of San Luis Pass with traces of the shorelines of the pass over approximate ten year intervals from 1930-1990.

Plate 3. Landsat Thematic Mapper image of West Bay are including San Luis Pass (in the center), Galveston Island (to the northeast), and Follets Island (to the southwest). This false color composite assigns PC (principal component) band 1 to red, PC band 2 to green and PC band 3 to blue.

References Cited

McGowen, J.H., Garner L.E., and Wilkenson, B.H., 1977, The Gulf Shoreline of Texas: Processes, Characteristics, and Factors in Use, Bureau of Economic Geology, Geologic Circular 77-3, 27p.

Morton Robert A., and Paine, Jeffrey G. , 1986, Historical Shoreline Changes in Trinity, Galveston, West, and East Bays, Texas Gulf Coast, Bureau of Economic Geology, Geologic Circular 86-3, 58p.

Paine, Jeffrey G., and Morton, Robert A., 1989, Shoreline and Vegetation-Line Movement, Texas Gulf Coast, 1974 to 19482, Bureau of Economic Geology, Geologic Circular 89-1, 50p.

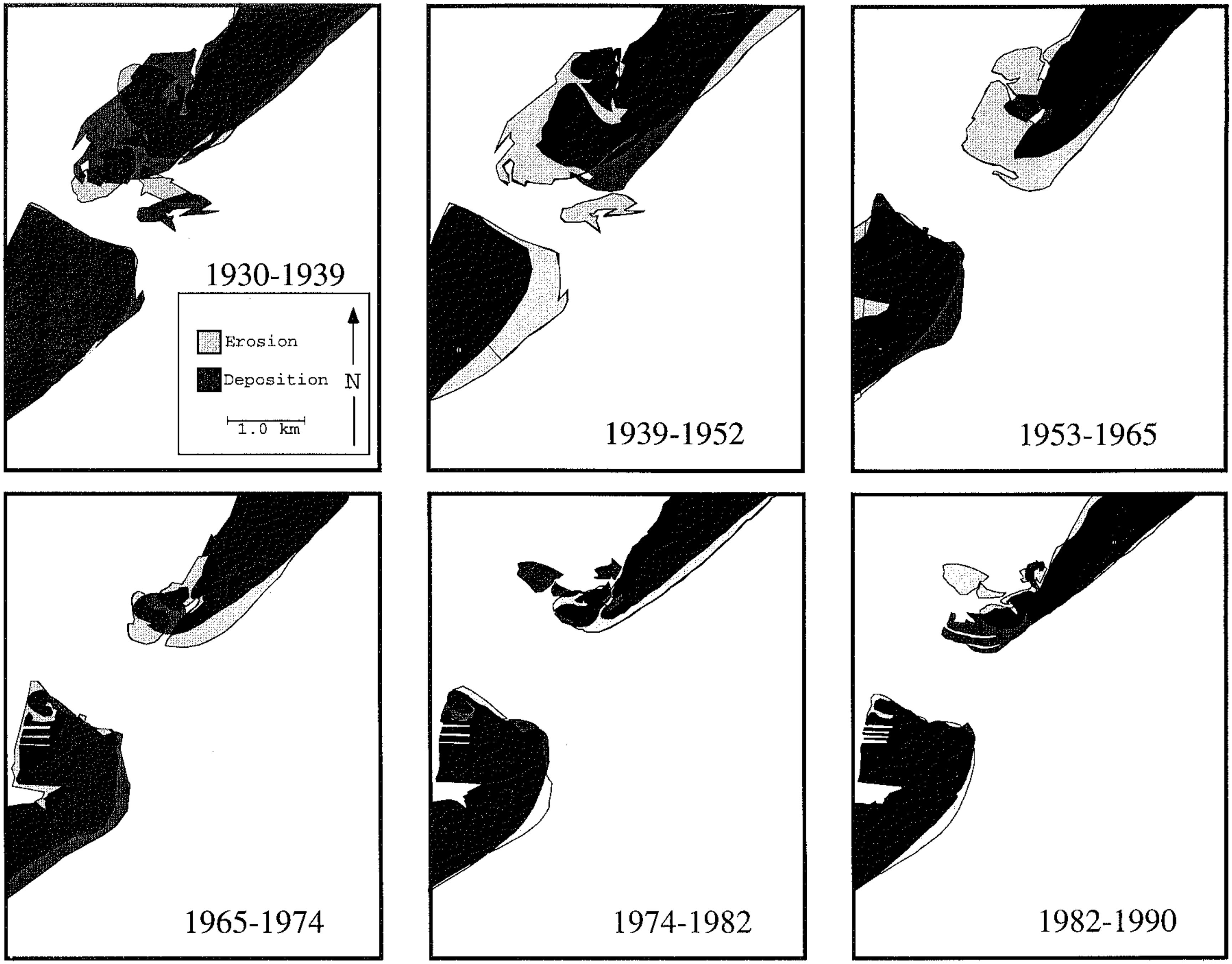


Figure 1. A Comparison of San Luis Pass Shorelines Over Periods of Approximately Ten Years

Fig. 2a: North Shoreline Change

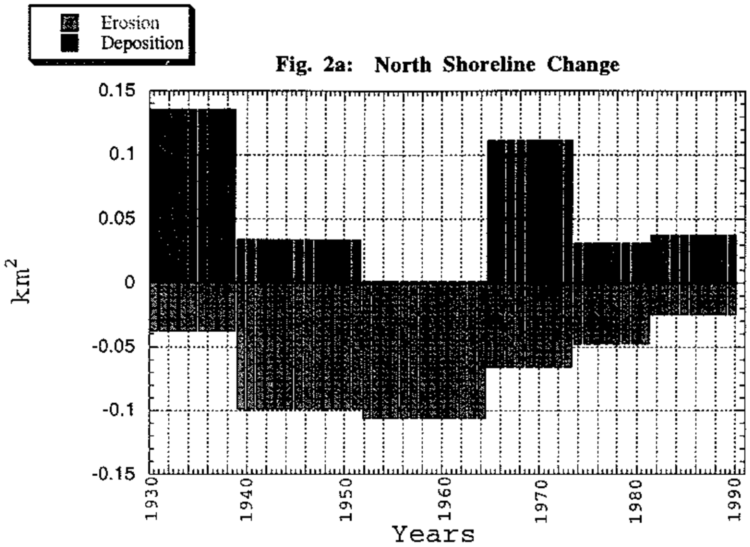


Fig. 2b: South Shoreline Change

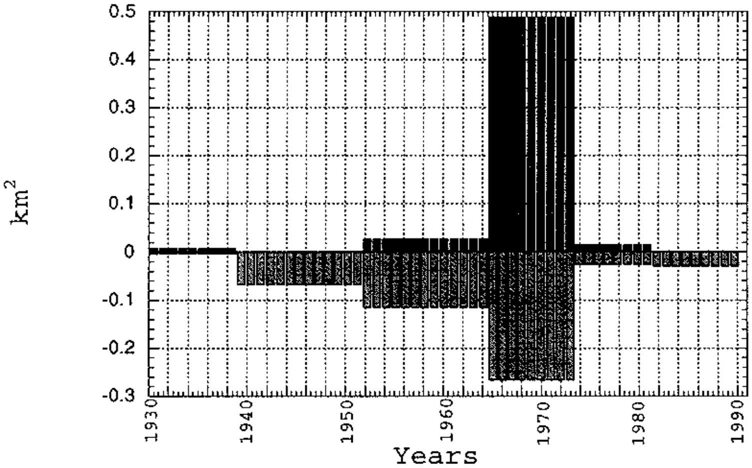
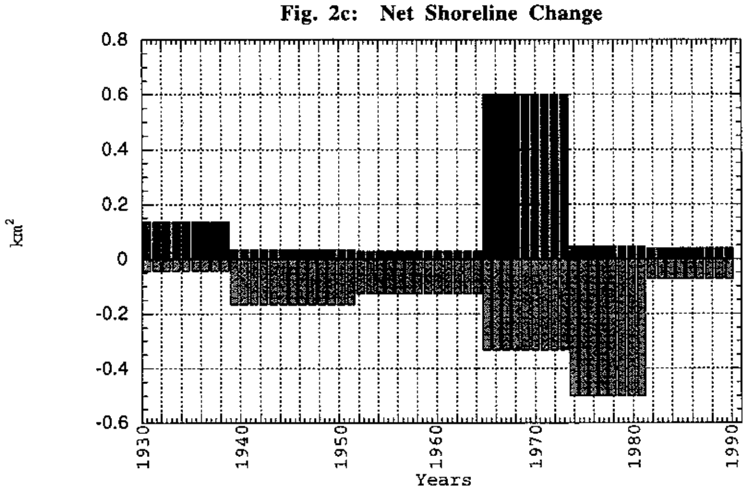


Fig. 2c: Net Shoreline Change



SILURO-DEVONIAN PLUTONIC AND ASSOCIATED VOLCANIC ROCKS OF THE COASTAL MAINE MAGMATIC PROVINCE

FACULTY

Robert A. Wiebe, Franklin & Marshall College
Reinhard A. Wobus, Williams College

STUDENTS

Stephen Adams, Franklin & Marshall College
Wendy Cunningham, Amherst College
Eva Fung, Smith College
John Lien, Colorado College
John Phipps, Williams College
Jennifer Roberts, Trinity University

VISITORS

Henry N. Berry, University of Maine, Orono
Peter Crowley, Amherst College
Dan Lux, University of Maine, Orono
Sheila J. Seaman, University of Massachusetts, Amherst
Christine Smith, Colorado College
Diane R. Smith, Trinity University
David West, University of Maine, Orono