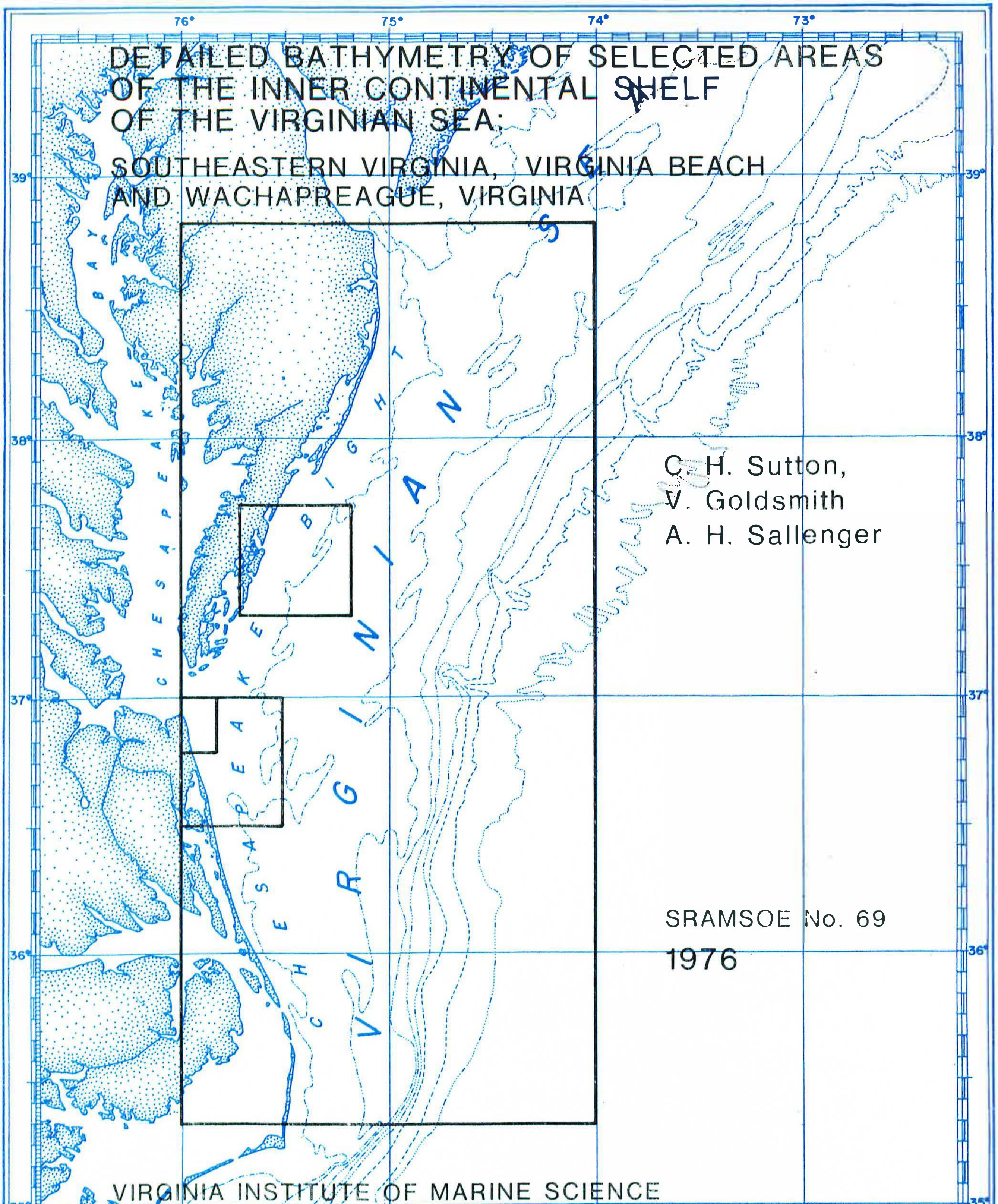
DETAILED BATHYMETRY OF SELECTED AREAS OF THE INNER CONTINENTAL SHELF OF THE VIRGINIAN SEA:

SOUTHEASTERN VIRGINIA, VIRGINIA BEACH AND WACHAPREAGUE, VIRGINIA



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SRAMSOE No. 69
1976

VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia 23062

DETAILED BATHYMETRY OF SELECTED AREAS OF THE INNER CONTINENTAL SHELF OF THE VIRGINIAN SEA: SOUTHEASTERN VIRGINIA, VIRGINIA BEACH, VIRGINIA; WACHAPREAGUE, VIRGINIA

by

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INTRODUCTION

The increased need for information involving the physical processes affecting the inner continental shelf has led to these detailed compilations of the nearshore bathymetric data of the Virginian coastline. For example, the growth of population has increased the usage of our beaches for recreation. Contrived short-term and the apparent long-term shortages of fuel, so recently impressed upon the public, have initiated an intensive study of the adjacent continental shelf area for possible future sites of offshore drilling rigs, power plants and port facilities. Among the basic oceanographic information required in all such studies is detailed depth information. To help meet these needs we have prepared these detailed bathymetric maps containing significantly more information than has previously been compiled and made available from this region of the Atlantic shelf.

PURPOSE

The initial accumulation of these depth data was for use in the development of the Virginian Sea Wave Climate Model (Goldsmith, et al., 1974). This first order model covered the continental shelf and shoreline, an area of 20,000 square nautical miles from Cape Henelopen, Delaware to Cape Hatteras, North Carolina. The depth grid established employed a total of 84,420 depths with a grid depth density of 0.5 nm. Nineteen different wave parameters were calculated for each separate wave input condition employed for the shelf and adjacent shoreline of the study area. These wave outputs were then used as input data into the development of the smaller grids (second and third order).

The three second order grids developed were located as follows: (1, 2) in the nearshore area of Wachapreague Inlet to approximately 25 nm offshore; and (3) in the area from Cape Henry to the Virginia-North Carolina State Line. The only third order grid developed covers approximately 15 nm of shoreline south from Cape Henry along the resort area of Virginia Beach. This third order grid (called the Virginia Beach Grid) differs from the second order grid (Southeastern Virginia Grid) of the same area in that the density of depths is greater. The Southeastern Virginia Grid has a grid depth density of 0.25 nm, whereas the Virginia Beach Grid is composed of depths at a 0.1 nm density.

COMPILATION OF BATHYMETRIC DATA

The data base grids employed were taken from a portion of the original Transverse Mercator Projection used in the development of the Virginian Sea Wave Climate Model (Goldsmith et al., 1974). The areas of the base map selected for compiling the depths used in the second order grids were photographed from the original scribe coat negative and enlarged two times. The third order Virginia Beach Grid was photographed using the same procedure, but was enlarged four times. In both cases, the enlargement allowed for the increase in density from 0.5 nm in the Virginian Sea Grid to those of densities of 0.25 and 0.1 nm, respectively in the Southeastern Virginia and Virginia Beach Grids.

The procedure for transferring depths from the numerous original bathymetric sounding sheets to the grid base entailed a point-by-point transfer of each individual depth according to the selected interval. The sounding sheets were divided by latitude and longitude and the depths transferred onto the grid using this coordinate system. In a few isolated cases, depth density did not allow for the direct reading of points. When this occurred, the depths surrounding the point were averaged, taking into consideration how far each depth was from the original point. This interpolation method was difficult and time consuming because of a greater degree of depth change over a greater distance. In this case we employed the use of contours to give a better idea of the features presented on the sounding sheet so that they could be transferred to the grid. This particular method was selected to alleviate any problems which might arise due to the variation in projection from the sounding sheets (polyconic) to the grid (transverse mercator).

These depths were read off the grids according to an x - y coordinate system employing a grid of 5 nautical mile squares superimposed on the curved latitude and longitude lines at ten minute intervals. These numerous square grids were further divided into the appropriate interval by employing a clear gridded overlay (Fig. 1). This overlay provided not only the proper grid interval, but also provided the mobility needed to cover lengthy rows of numbers without a great deal of confusion. It is these depths on a square grid, which were originally transferred to computer cards and used as data input for the wave refraction analyses, which have now been used to develop the contoured charts which are being presented herein. A check on the procedures was made by computer-plotting all the depths on the computer cards in the form of east-west bathymetric profiles. In doing so "anomalous" depths became quite apparent in such profiles. These depths were then double-checked against the original hydrographic sounding sheets.

The depth contouring was done on an overlay of Milar stable base material, at six foot intervals for the second order grids and at three foot intervals for the third order grid (Virginia Beach Grid).

Table one summarizes the corner latitude and longitude locations, the grid intervals, etc. for the four grids presented here.

Figures 2 and 3 illustrate the locations of the original hydrographic sounding sheets used for the southeast Virginia and Wachapreague areas. The years of the surveys, chart scales, etc. are presented in Table 2. The survey precision, based on instructions to hydrographic survey boat captains is presented in Figure 4 and in Table 3 (from Sallenger, et al., 1974).

BATHYMETRIC CHANGES

The detailed 1852 hydrographic survey adjacent to Wachapreague Virginia (H.O. No. 348) was compiled in the same manner as described above. The efficacy of such comparisons has been thoroughly discussed in Sallenger, et al., 1975. The apparent bathymetric changes between 1852 and 1934 are shown in Plate 5. These bathymetric changes were determined by taking the difference in the depths located at the 0.25 nautical mile grid intervals between the 1852 and 1934 grids. The importance of the depth changes on changing the shoreline wave climate, especially in the inlets, was reported by Goldsmith, et al., 1973.

ACKNOWLEDGEMENTS

The support by Sea Grant Project number 04-5-158-49 is gratefully acknowledged. We would also like to thank Mike Williams of the VIMS Art Department for his talented efforts in redrafting the original contoured maps and Ken Thornberry for photographic preparation of the plates. Special thanks to Cindy Otey for typing the text and tables of this report.

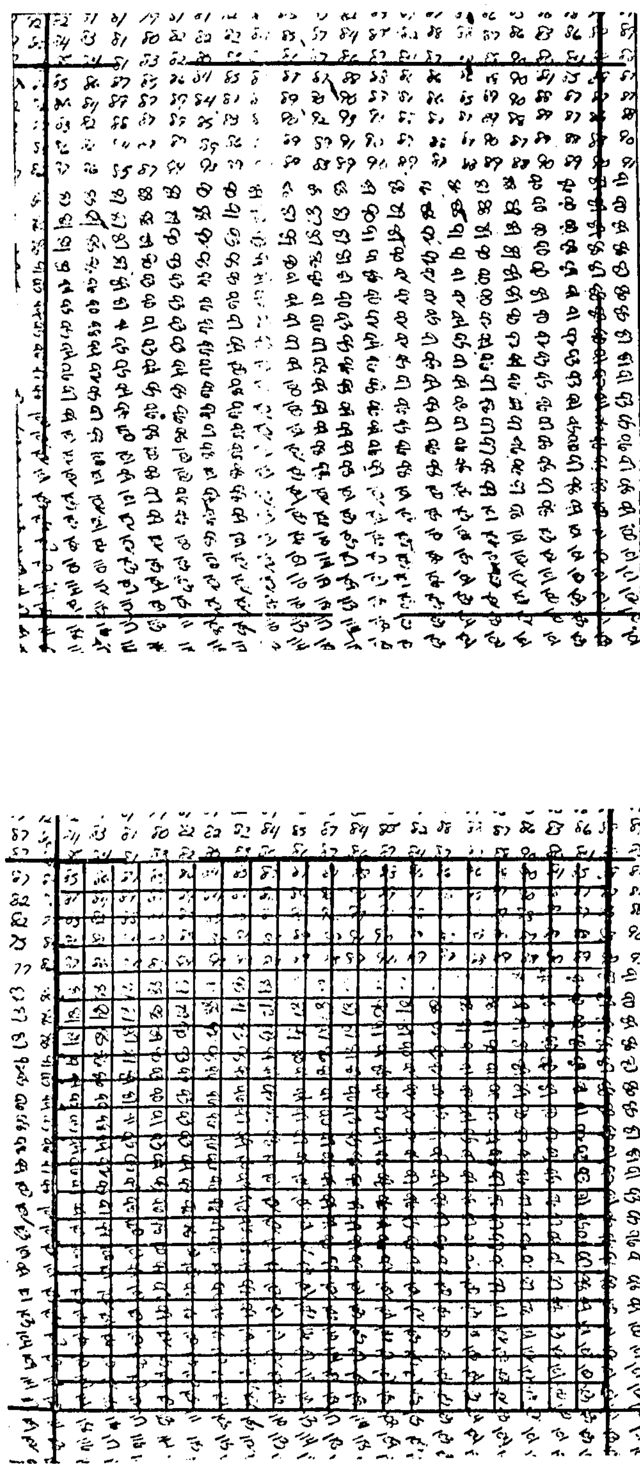


Figure 1. The top diagram illustrates the 5 nm square as seen on the grid. The bottom diagram shows the same square with the overlay used for reading, positioned directly over the square.

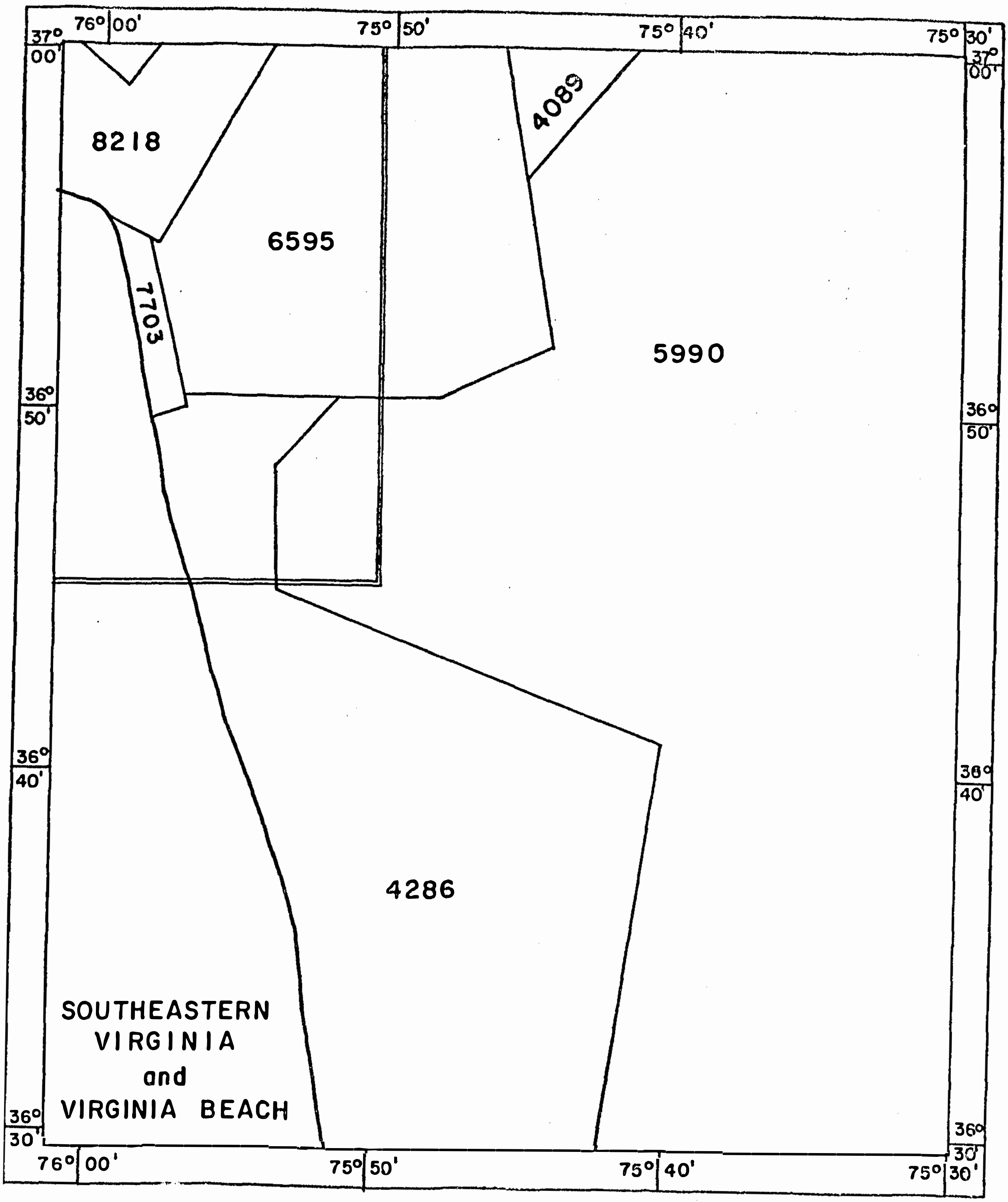


Figure 2. Sounding Sheet Index for Southeastern Virginia and Virginia Beach, Virginia.

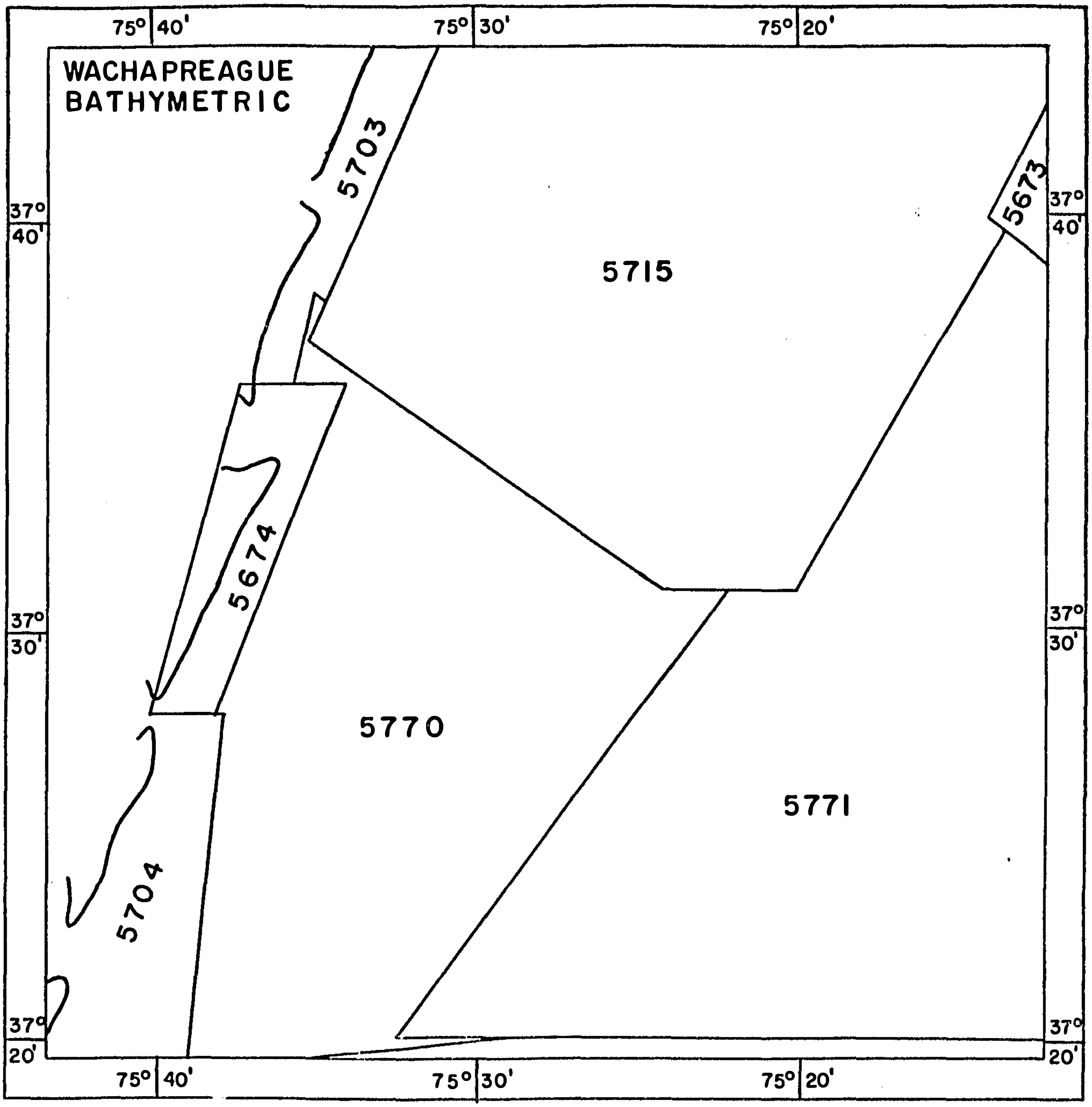


Figure 3 Sounding Sheet Index for Wachapreague, Virginia.

TABLE 3. Sounding accuracy criteria (Sallenger et al., 1974).

YEAR	CRITERIA
circa 1844	
circa 1860	"The allowable error at sounding-line crossings was not to be more than 3 percent of the depth, with a limiting error of 5 percent."
1878/1883	"Lines of soundings at these crossings were not to exceed, in depths of 15 feet and under, two-tenths of a foot; between depths of 15 and 30 ft., three-tenths; 30-48 ft., five-tenths; 48-72 ft., three-fourths of a foot; 72-96 ft., one foot and a half; 96-150 feet, two feet. In sea depths the limit should not exceed 1 percent..."
1894	"...the admissible percent of error at sounding line crossings was a maximum of 1.5 percent of the depth at that point."
1957	"Maximum errors: (1) 0-11 fm, 1.0 feet; (2) 11-55 fm, 3 ft; (3) 55 fm and deeper: one percent of depth."

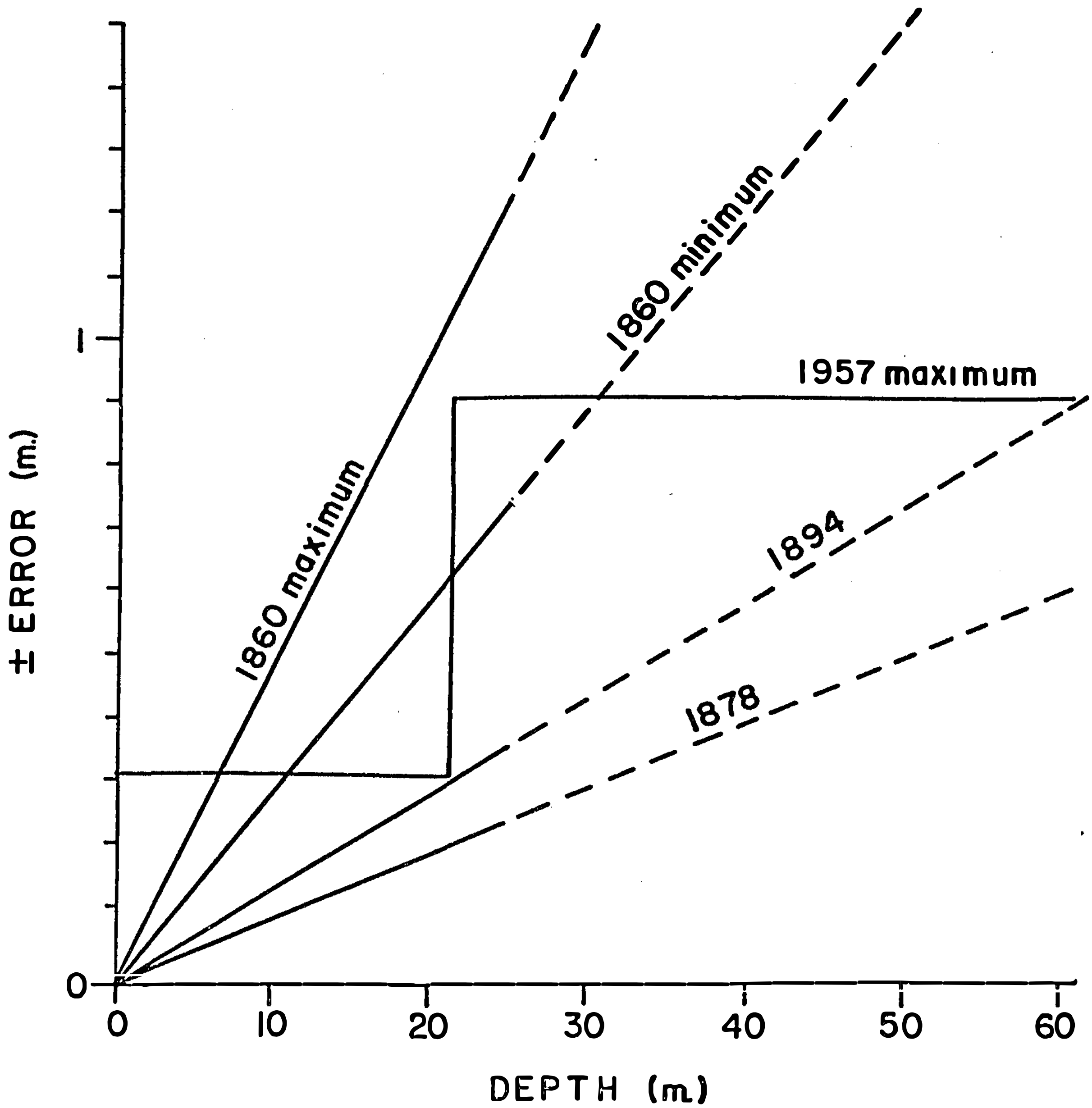


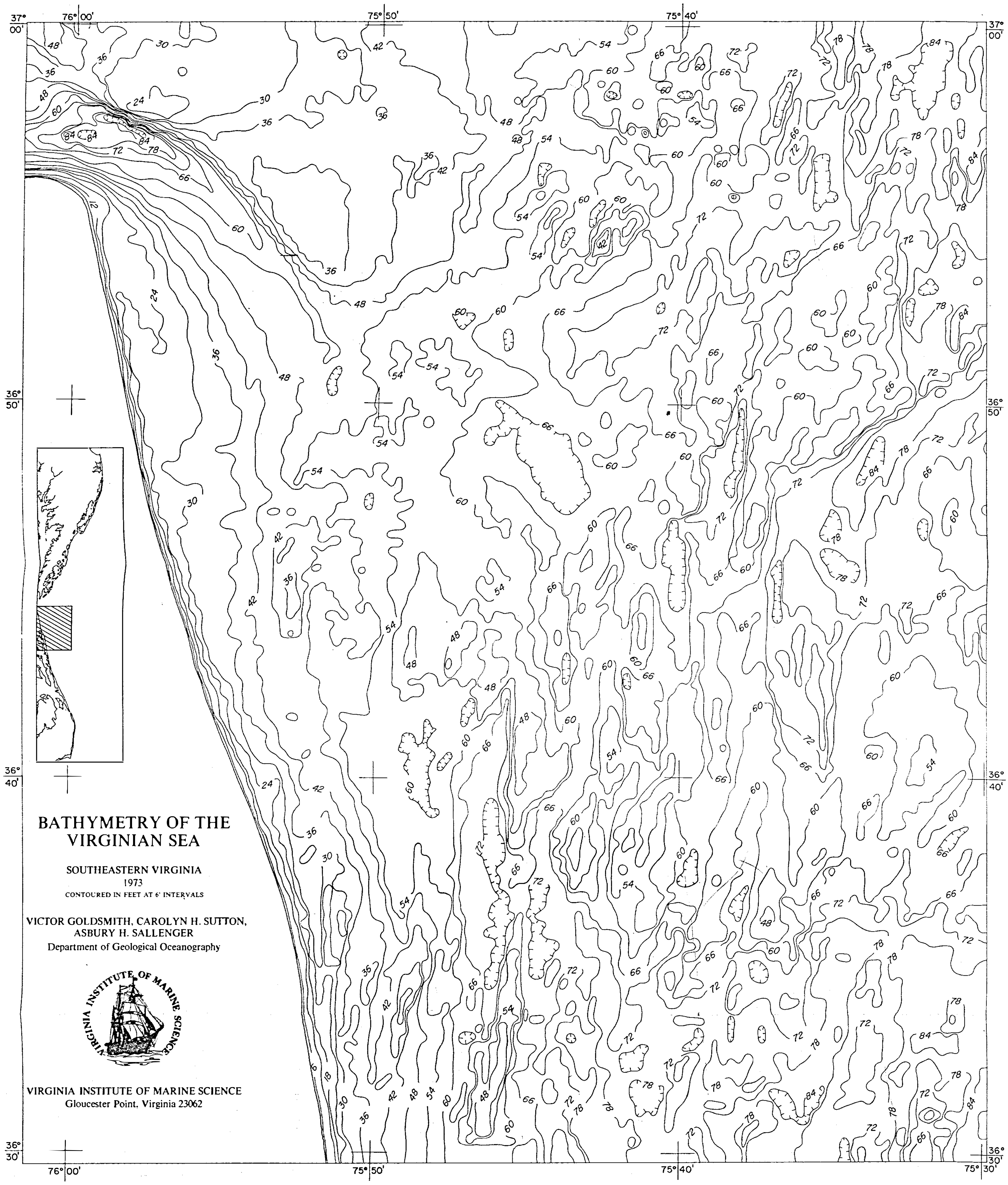
Figure 4. Sounding Error Criteria.

TABLE 1. Summary of scale, latitude-longitude boundaries and grid depth density for maps.

Name	Scale	Boundaries				Grid Density
		N W	S W	S E	N E	
Southeastern Virginia	1:188,000	37°00'N 76°01.5'W	36°30' 76°01.5'	36°30' 75°30'	37°00' 75°30'	0.25
Virginia Beach	1:74,000	36°59.5'N 76°01.5'W	36°45' 76°01.5'	35°45' 75°49.3'	36°59' 75°49.5'	0.1
Wachapreague	1:186,700	37°45'N 75°43'W	37°20' 75°43'	37°20' 75°10'	37°45' 75°10'	0.25

TABLE 2. Source Map Index

Name	Number	Date	Scale	Comments
Wachapreague	5673	1934	40,000	Depths in feet at MLW
	5674	1934	20,000	
	5703	1934	20,000	
	5704	1934	20,000	
	5715	1934	40,000	
	5770	1935	40,000	
	5771	1934	40,000	
S.E. Virginia	4089	1919	40,000	Depths in feet at MLW
	4286	1922	40,000	
	5990	1935	80,000	
	6595	1940	40,000	
	7703	1948	10,000	
	8218	1954	25,000	
Virginia Beach	4286	1922	40,000	Depth in feet at MLW
	6595	1940	40,000	
	7703	1948	10,000	



BATHYMETRY OF THE VIRGINIAN SEA

SOUTHEASTERN VIRGINIA

1973

CONTOURED IN FEET AT 6' INTERVALS

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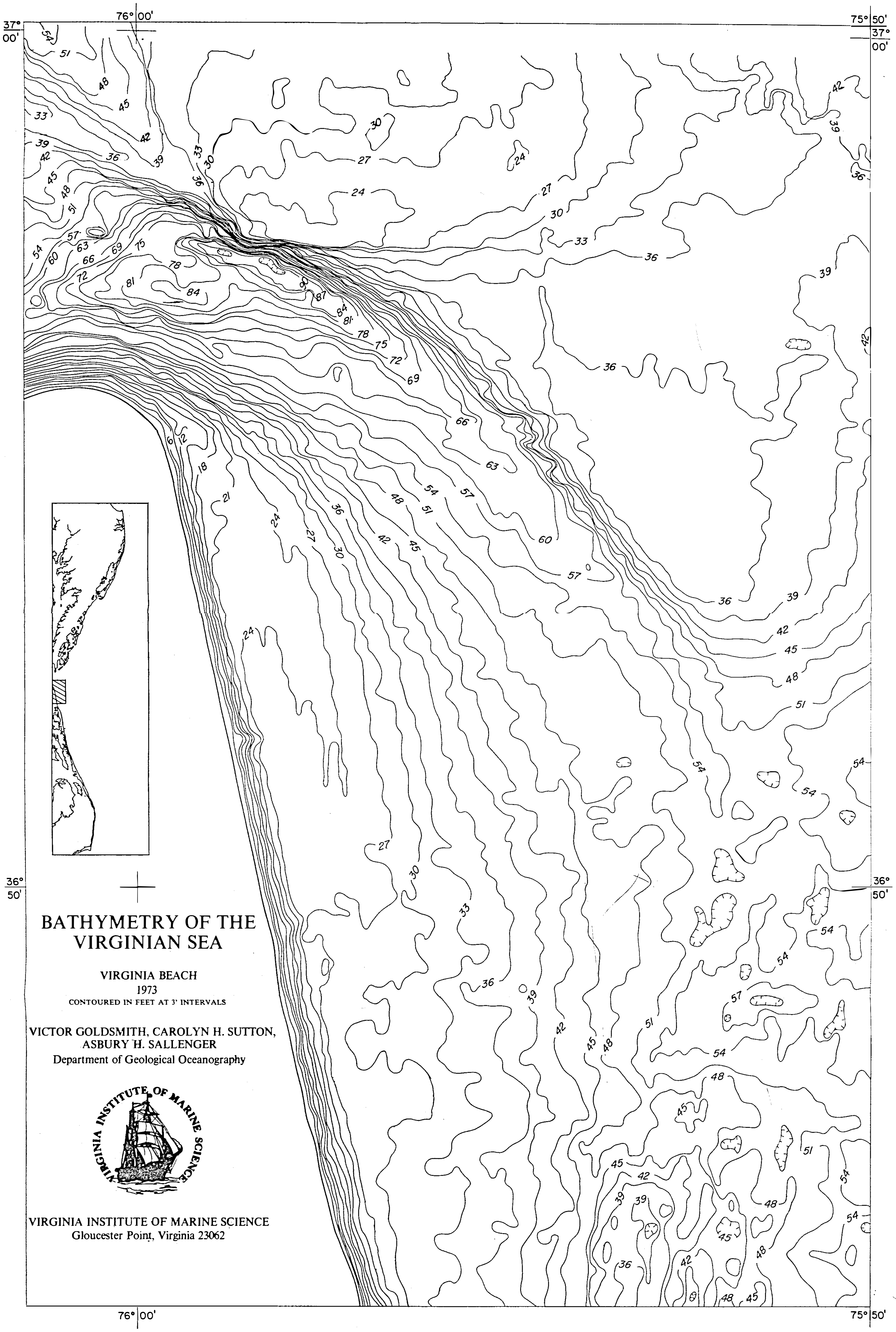
76° 00'
75° 50'
37° 00'
36° 50'
BATHYMETRY OF THE VIRGINIAN SEA
VIRGINIA BEACH
1973
CONTOURED IN FEET AT 3' INTERVALS
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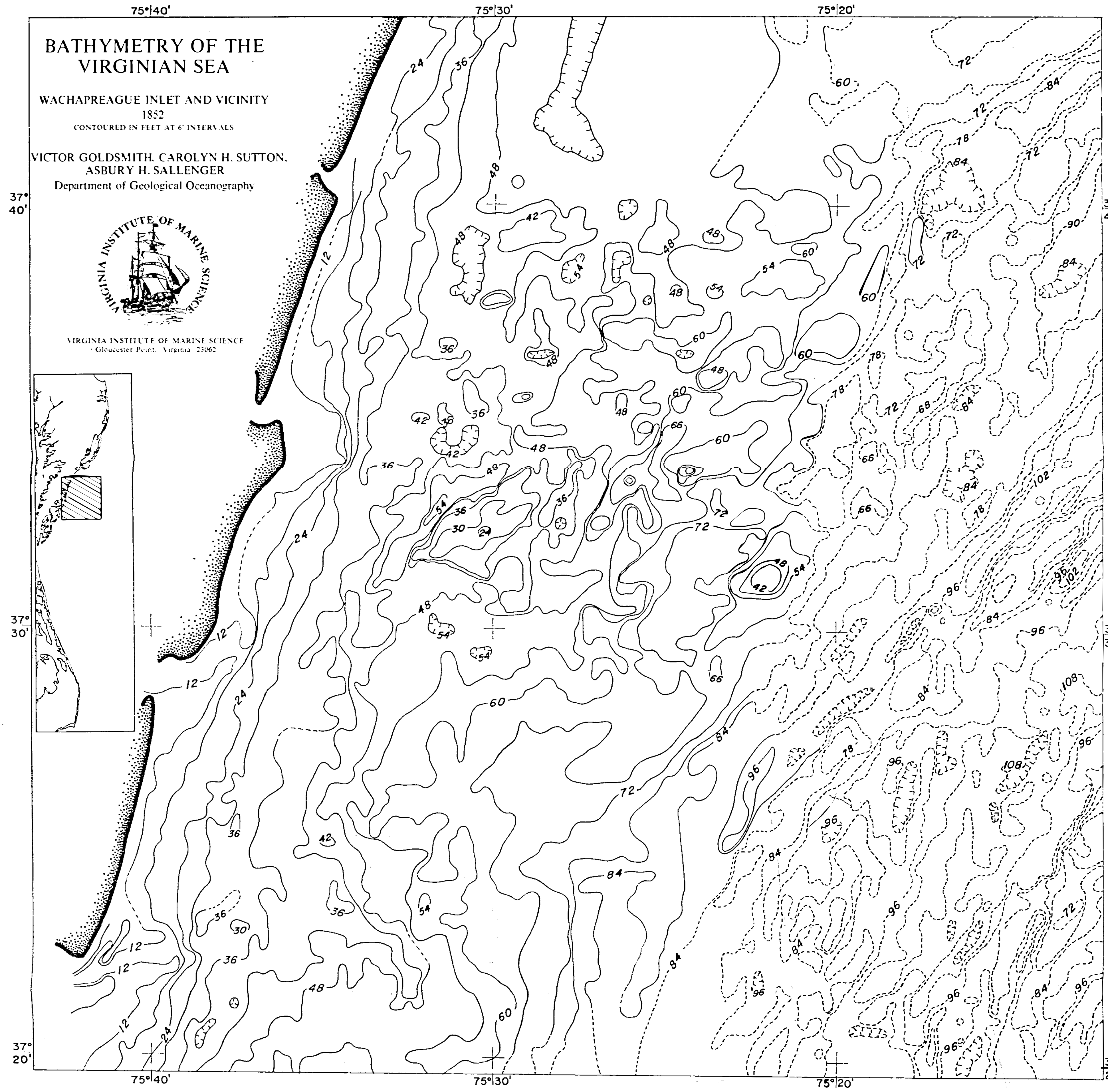

BATHYMETRY OF THE VIRGINIAN SEA
WACHAPREAGUE INLET AND VICINITY
1852
CONTOURED IN FEET AT 6' INTERVALS
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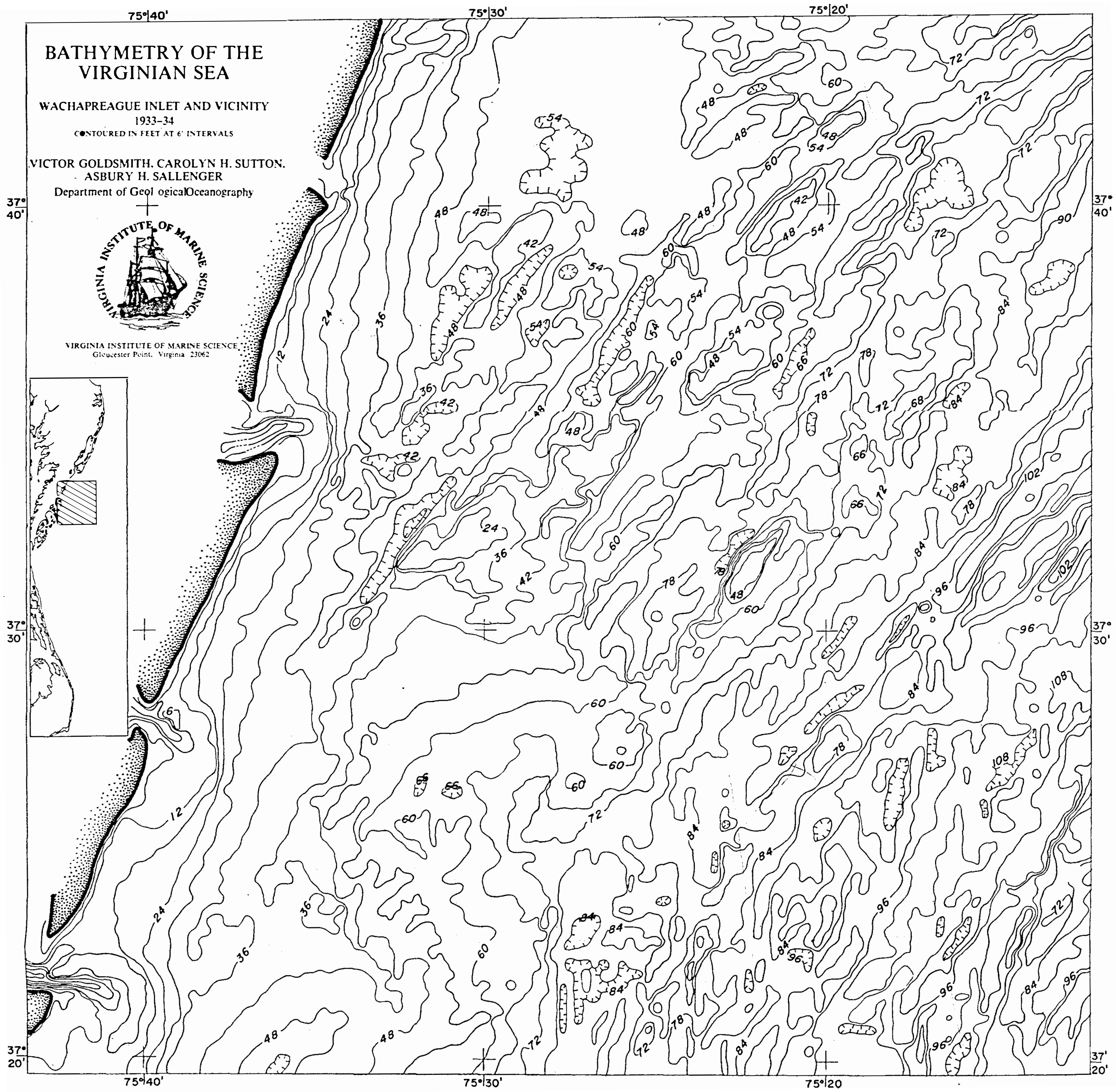
75°40'
75°30'
75°20'
37° 40'
37° 30'
37° 20'


BATHYMETRY OF THE VIRGINIAN SEA
WACHAPREAGUE INLET AND VICINITY
1933-34
CONTOURED IN FEET AT 6' INTERVALS
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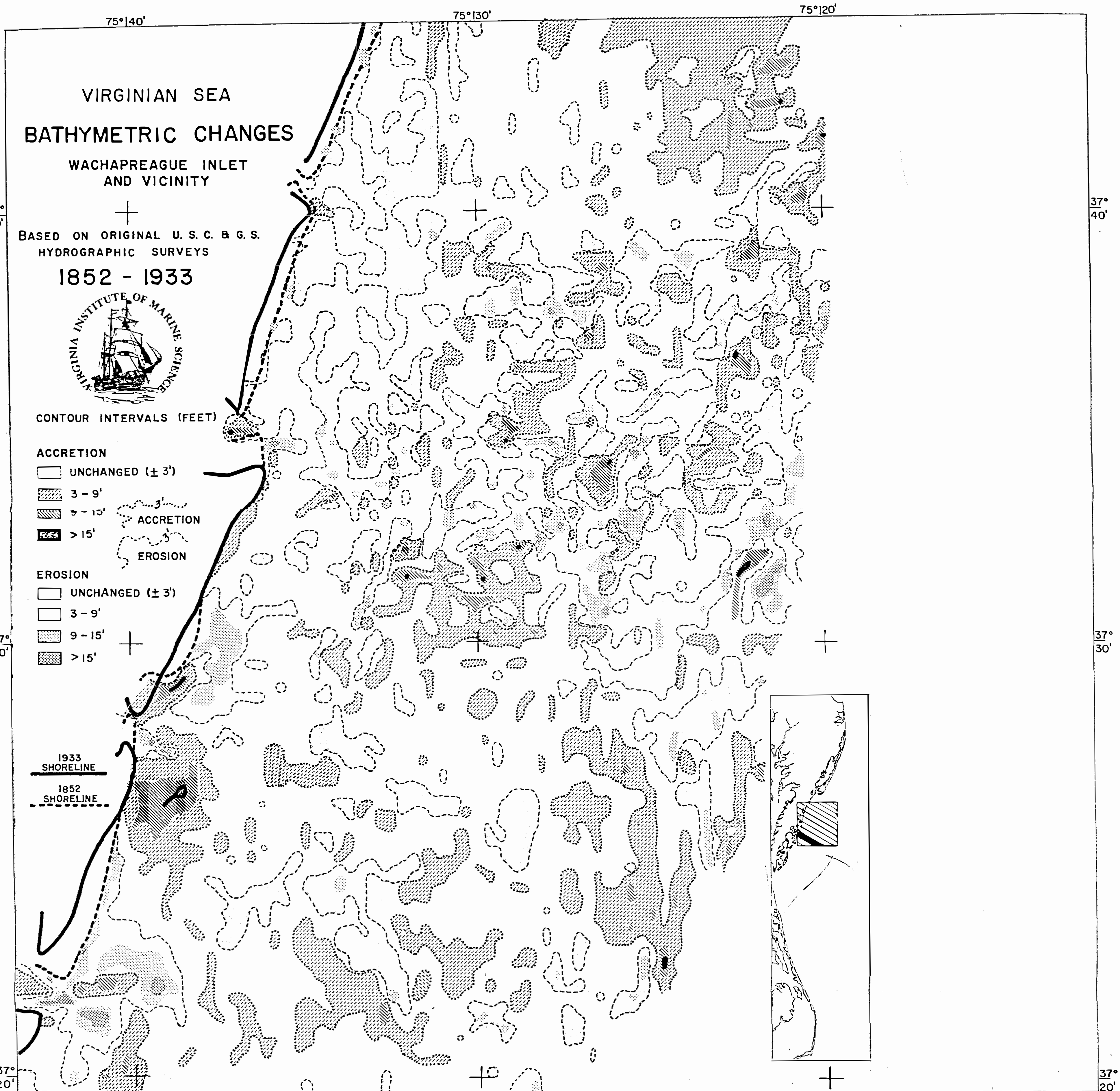

VIRGINIAN SEA
BATHYMETRIC CHANGES
WACHAPREAGUE INLET AND VICINITY
BASED ON ORIGINAL U. S. C. & G. S. HYDROGRAPHIC SURVEYS
1852 - 1933
VIRGINIA INSTITUTE OF MARINE SCIENCE
CONTOUR INTERVALS (FEET)
ACCRETION
UNCHANGED (± 3')
3 - 9'
9 - 15'
> 15'
3'
ACCRETION
3'
EROSION
EROSION
UNCHANGED (± 3')
3 - 9'
9 - 15'
> 15'
1933 SHORELINE
1852 SHORELINE
75°40'
75°30'
75°20'
37° 40'
37° 30'
37° 20'