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**CHARACTERISTICS OF WATER FLOW
AT THE NORTH END OF THE
WASSAW BARRIER ISLAND COMPLEX**

Wassaw Island Erosion Study
Part II

by
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INTRODUCTION

This report supplements an earlier report on the "Sedimentary framework of a channel margin shoal of an ebb delta, Wassaw Sound, Georgia". The purpose of this report is to produce an overview of water currents that may affect the sediment carpet described in the earlier report.

Water flow was recorded at four different stations around the marginal shoal (Fig. 1). At each station, data was recorded for two tidal cycles (approximately 25 hours) at six minute intervals. In all, approximately 2,000 data points were collected.

OBSERVATIONS

Stations A and B were located on the leeward side of the shoal and stations C and D were located on the channelward side of the shoal. Plotted data of water flow surveys illustrate the reversing flow of tidal currents above the shoal and adjacent shoreface. In all cases, flow reverses corresponded to the predicted change in the semi-diurnal tide (Figure 2,3,4,5).

Maximum current speeds were recorded at station C located at approximately -6 meters (MLW) on the margin of the shoal and the channel. Station D was located approximately one quarter mile closer to the shoal than station C and at approximately -2 meters (MLW). The mean current speeds at stations C and D were 40 cm/s and 20 cm/s, respectively. Higher velocities at station C illustrate the channelized flow of the main channel. Increases in "bed drag" at station D caused a reduction in flow speed. During the ebbing tide the offshore flow of water was "shielding" by the marginal shoals and confined to the main channel. During the flooding tide, "shielding" caused water

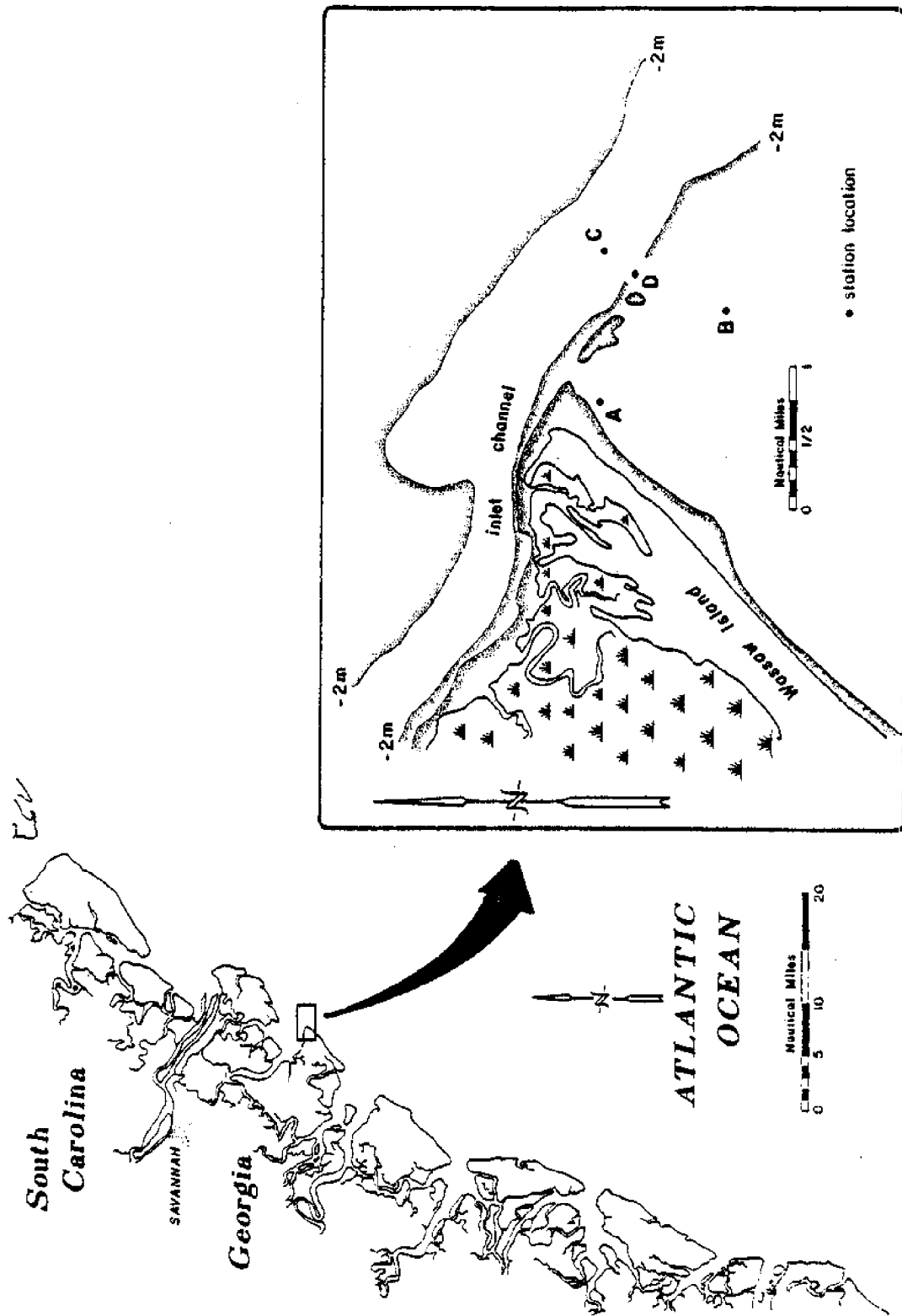


Figure 1. Location map of study area and current meter stations.

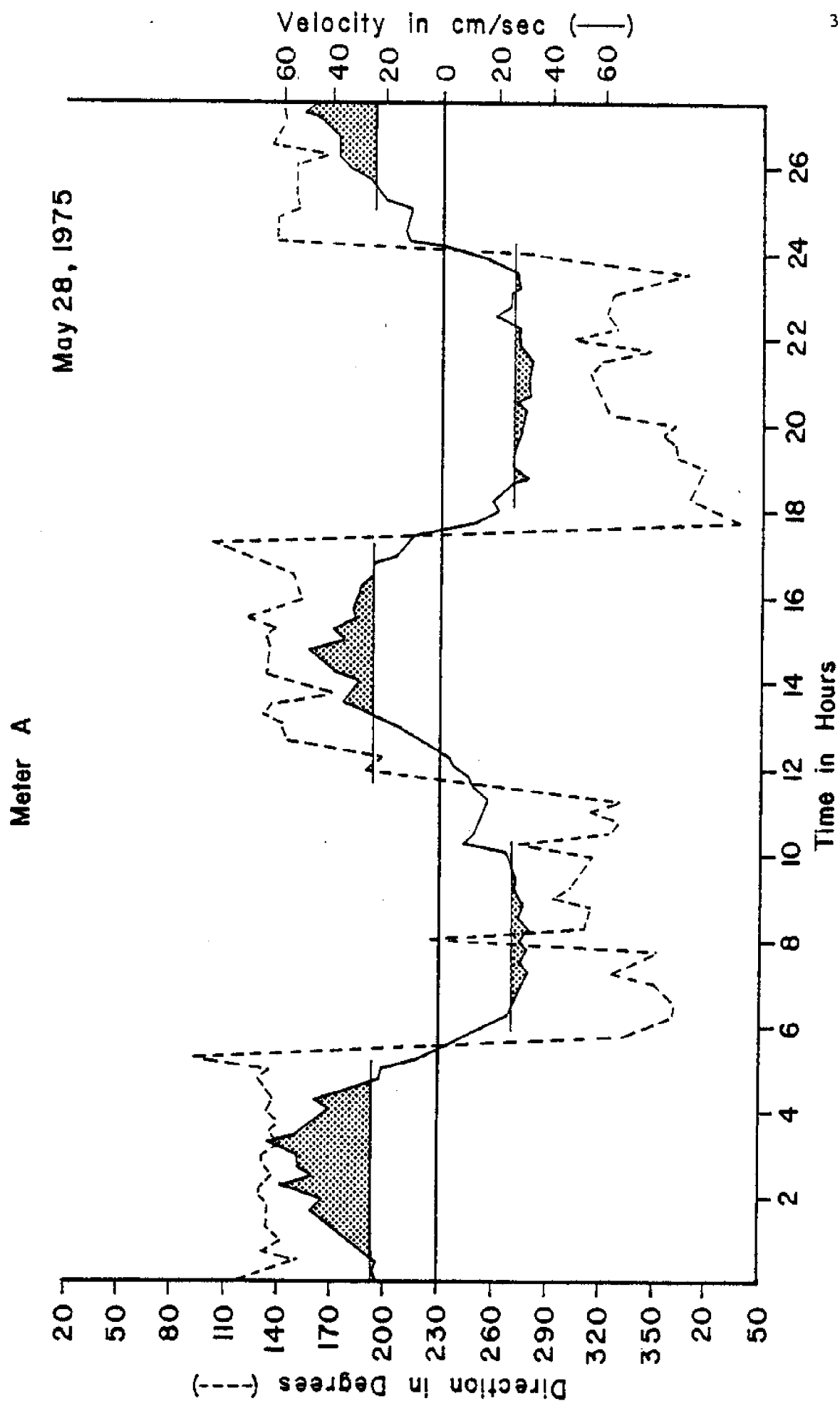


Figure 2. Graphic representation of tidal current velocities and directions at Station A during a 26-hour interval (2 complete tidal cycles). Stippled area indicates the portion of the sample when velocities were above the estimated threshold velocity for the sediment at the seabed.

Meter B

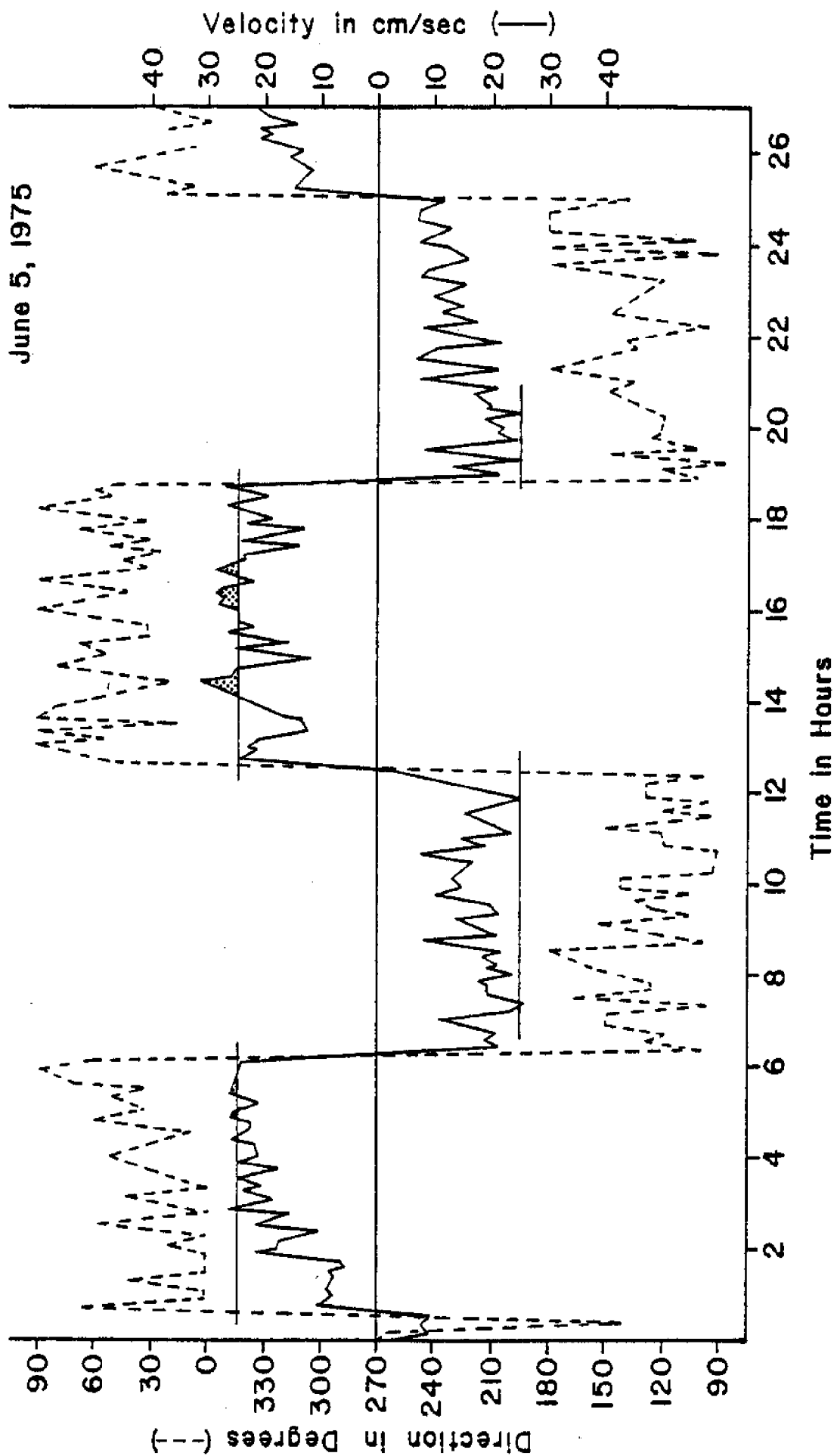


Figure 3. Graphic representation of tidal current velocities and directions at Station B during a 26-hour interval (2 complete tidal cycles). Stippled area indicates the portion of the sample when velocities were above the estimated threshold velocity for the sediment at the seabed.

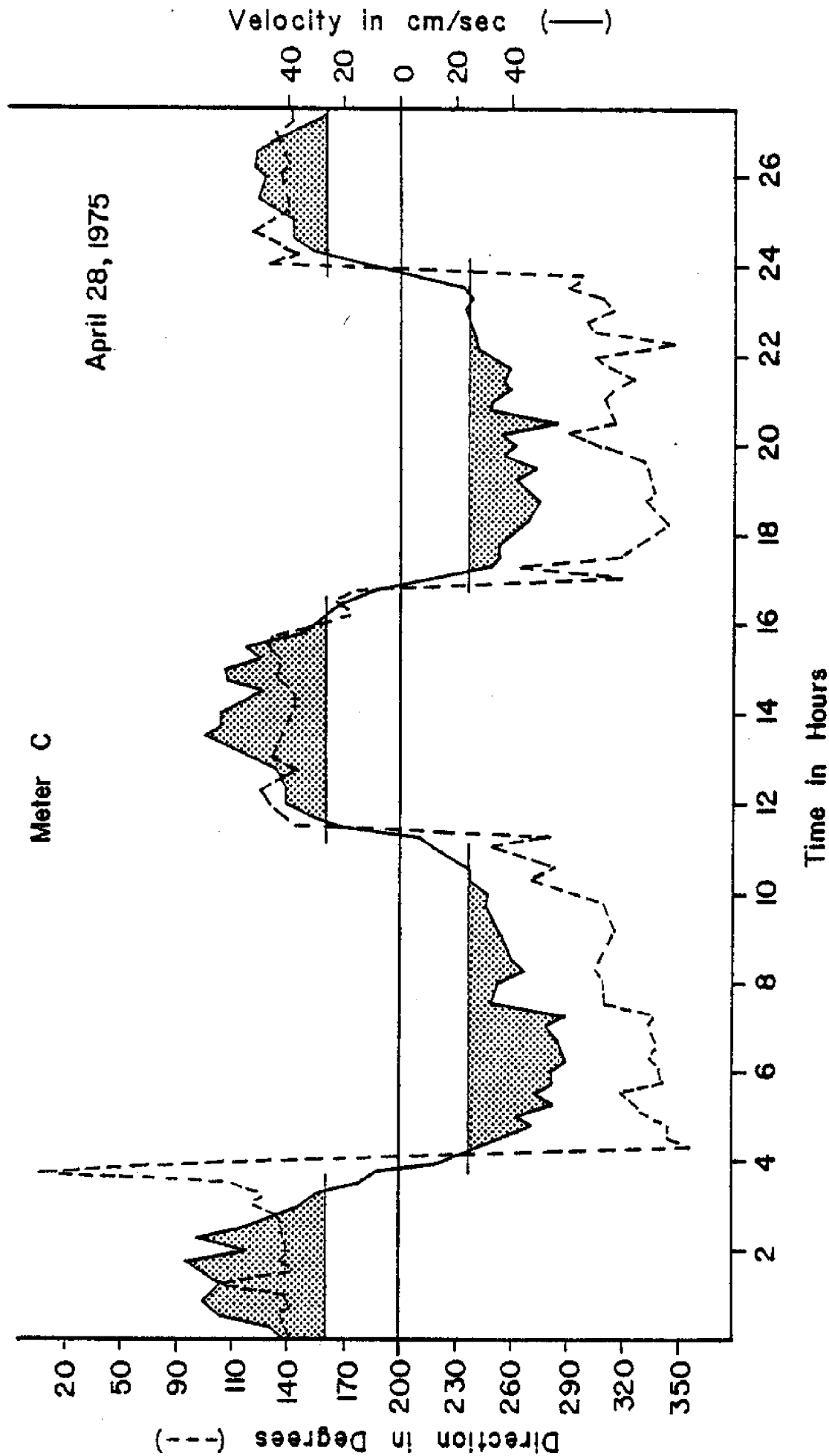


Figure 4. Graphic representation of tidal current velocities and directions at Station C during a 26-hour interval (2 complete tidal cycles). Stippled area indicates the portion of the sample when velocities were above the estimated threshold velocity for the sediment at the seabed.

Meter D

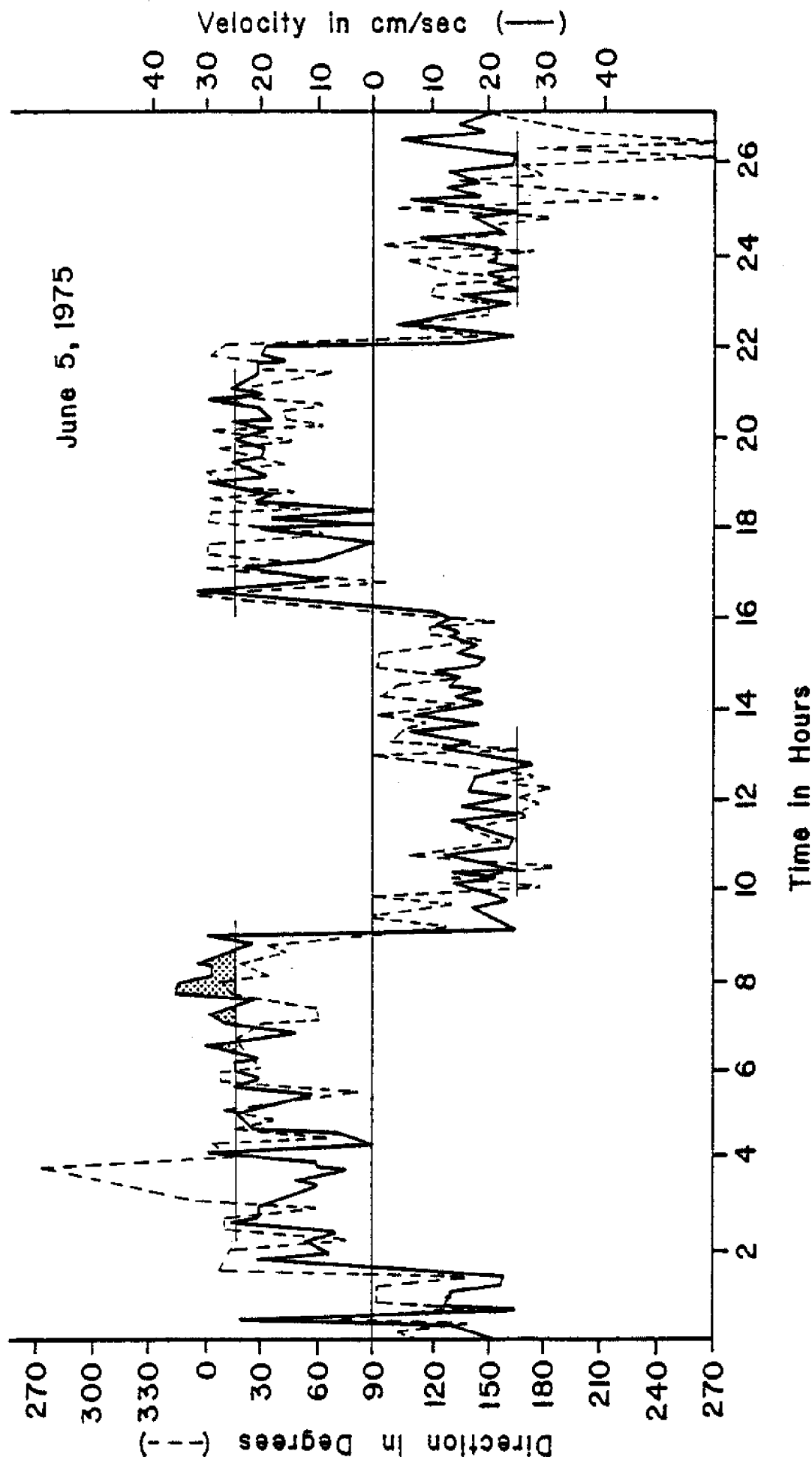


Figure 5. Graphic representation of tidal current velocities and directions at Station D during a 26-hour interval (2 complete tidal cycles). Stippled area indicates the portion of the sample when velocities were above the estimated threshold velocity for the sediment at the seabed.

to flow northeast around the distal end of the shoal and "spill" into the main channel. In the channel, landward flooding water was confined by channel walls and flow was to the northwest. Flow vectors were determined at each station by obtaining the products of the mean speed and duration, and plotted in the mean directions for the ebb and flood. Vectors and the graphic resultants of vectors are illustrated in figure 6.

The resultant of the ebb and flood vectors at station D was oriented toward the central axis of the channel. The resultant at station C was very small and oriented away from the channel axis.

After two complete tidal cycles, station D appeared to illustrate a residual flow of water "spilling" over the shoals toward the axis of the main channel. This was produced by the flow of flood water toward the channel axis and not directly toward the inlet throat. The flow at station C was parallel to the axis of the main channel and directly toward the inlet throat during flood tide and directly away from the inlet throat during ebb tide.

Although stations A and B were shielded from the main channel by marginal shoals, they also illustrated semi-diurnal reverses in flow direction. The speeds were 25 cm/s and 19 cm/s for stations A and B, respectively.

At station A, the flood vector was oriented toward the end of Wassaw Island, and the ebb vector was oriented in a southeast direction. The resultant of the ebb and flood vectors was oriented toward a "spillover" channel in the shoal. Observations indicate that water flows over the entire shoal surface during the early flood and is issued through "spill-over" channels during the late flood. The largest "spill-over" channel on the marginal shoal was located adjacent to Station A.

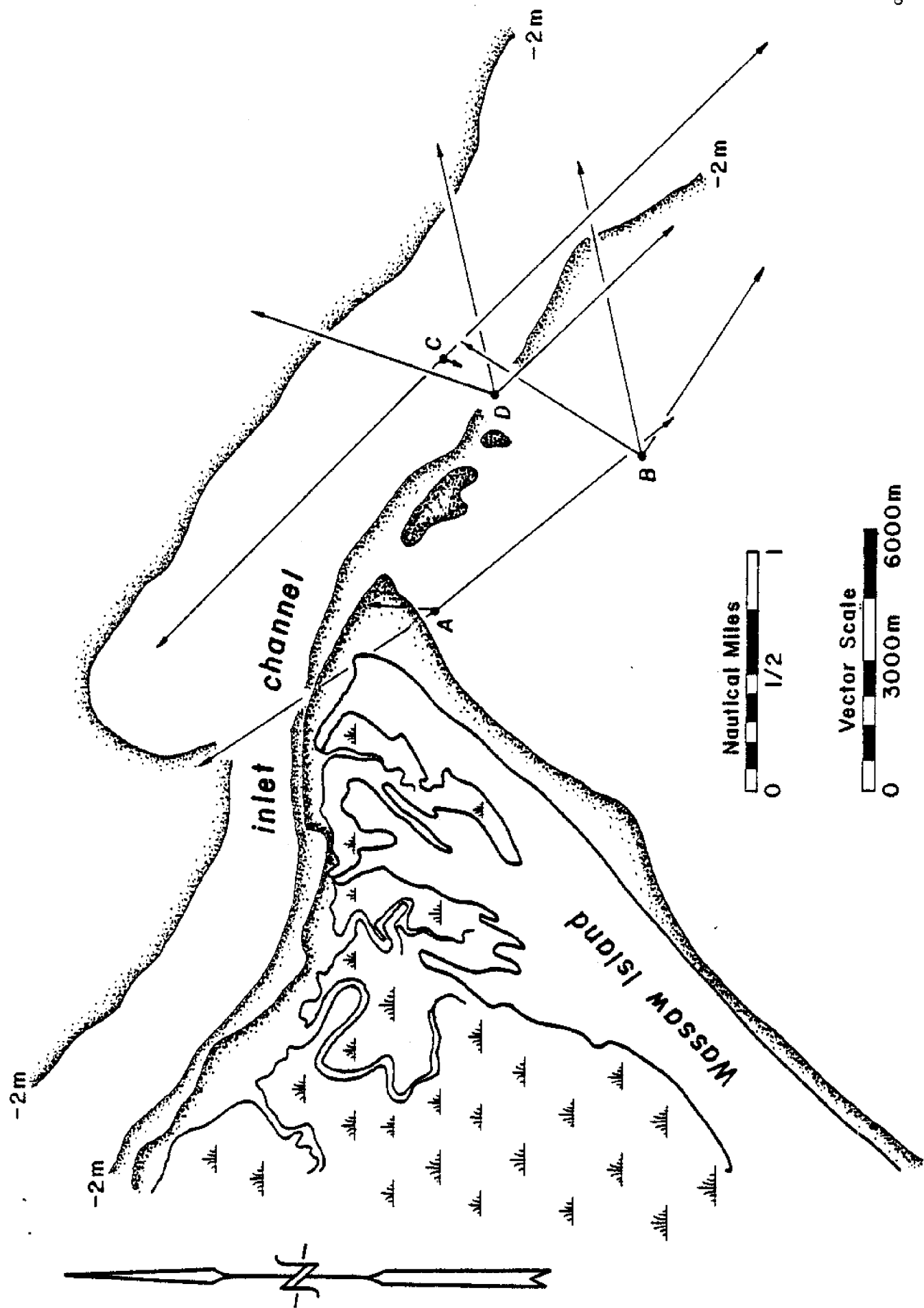


Figure 6. Vector map for all current velocities recorded 1m above the seabed. Vectors are the product of the mean direction and speed for the ebb and flood portions of the two complete tidal cycles. The resultant is the graphic average of the ebb and flood vectors.

At station B, water is transported toward the axis of the shoal during the flood, however, ebb currents are southeasterly and parallel to the axial flow of the main channel. The resultant flow at station B was toward the axis of the main channel but in an offshore direction.

The general scheme of circulation is similar to the models presented by Oertel (1974) and Hayes (1975). Reversing tidal currents are the major agents of water transport at Wassaw Inlet. On the inlet side of the shoal reversing tidal currents were bipolar and parallel to the channel axis as a result of confinement by the channel walls. On the leeward side of the shoal, ebbing currents paralleled the axis of the shoal and channel, however, flooding currents were oblique to the axis and flowed toward the channel. The resultant flow from stations outside of the main channel is toward the channel axis and not necessarily toward the inlet throat.

While the data described above yields information on the total velocity field, only a portion of these velocities is competent enough for sediment transport. A gross estimate of the sediment-transporting currents is made by plotting the resultant of the duration and mean velocity of currents greater than 25 cm/s (estimated threshold velocity).

In figure 7, ebb, flood and resultant vectors were plotted for products of the duration and speeds greater than 25 cm/s. The resultant vectors representing these currents were considerably smaller than the vectors for the total velocity field. Leeward of the shoal, the resultant flow was toward the channel axis. In the channel (station C) the sediment flow was small and away from the channel axis.

The resultant pattern of potentially competent currents is toward the axis of the marginal shoals. Observations of bedform orientations appear to confirm this pattern. On the channelward side of the shoal,

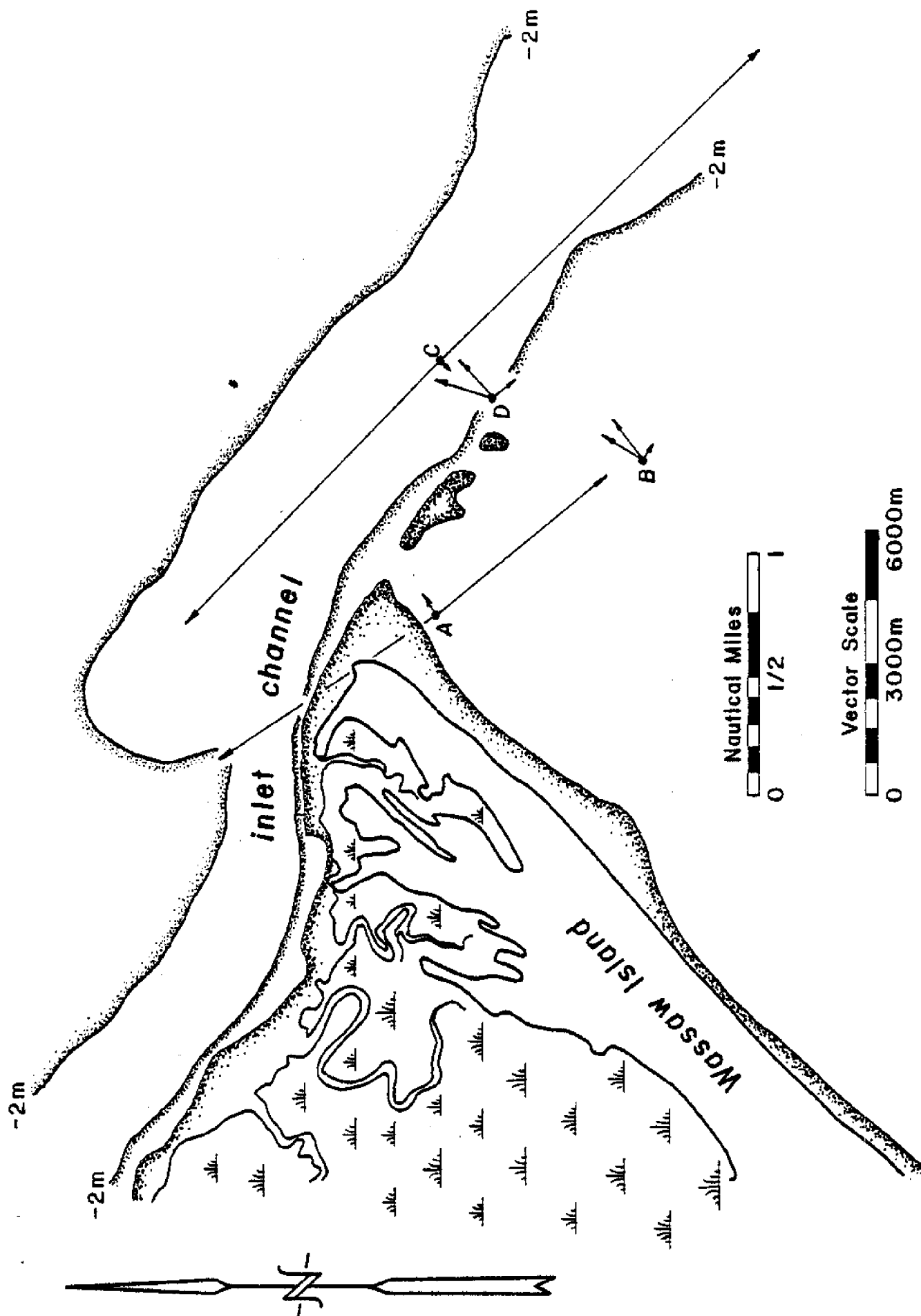


Figure 7. Vector map for current velocities greater than 25 cm/sec recorded 1m above the seabed. Vectors are the product of the mean direction and speed of velocities greater than 25 cm/sec for the ebb and flood portions of two complete tidal cycles. The resultant is the graphic average of the ebb and flood vectors.

megaripples appeared to be migrating toward the shoal axis in an oblique offshore direction. On the leeward side of the shoal, megaripples appeared to be migrating toward the shoal axis in an oblique onshore direction. Spill-over channels that transect the shoal surface are important structures necessary for maintaining this type of sand and water circulation. The spill-over channel closest to the shore is particularly important for bringing sediment to the north end of Wassaw Island. Events that produce the closure of this channel, would consequently cause stagnation of sediment in the floor of the spill-over channel and decrease the quantity of sediment being transported to the adjacent beach and shoal. The sediment starved area at the north end of Wassaw would erode until the spill-over channel was reopened.

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REFERENCES

- Hayes, M.O., 1975, Morphology of sand accumulations in estuaries, in Cronin, L.E. (ed.), Estuarine Research, 2, Academic Press, New York, N.Y.
- Hoyt, J.H., R.J. Weimer and V.J. Henry. 1964. Late Pleistocene and Recent sedimentation, central Georgia coast, U.S.A., p. 170-176, In Straaten Van, L.M., J.V. (ed.), Deltaic and Shallow Marine Deposits, Elsevier, Amsterdam.
- Oertel, G.F. and C.F. Chamberlain. 1975. Differential rates of shoreline advance and retreat of coastal barriers of Chatham and Liberty Counties, Georgia. Trans. Gulf Coast Assoc. Geol. Soc. XXV: 383-390.