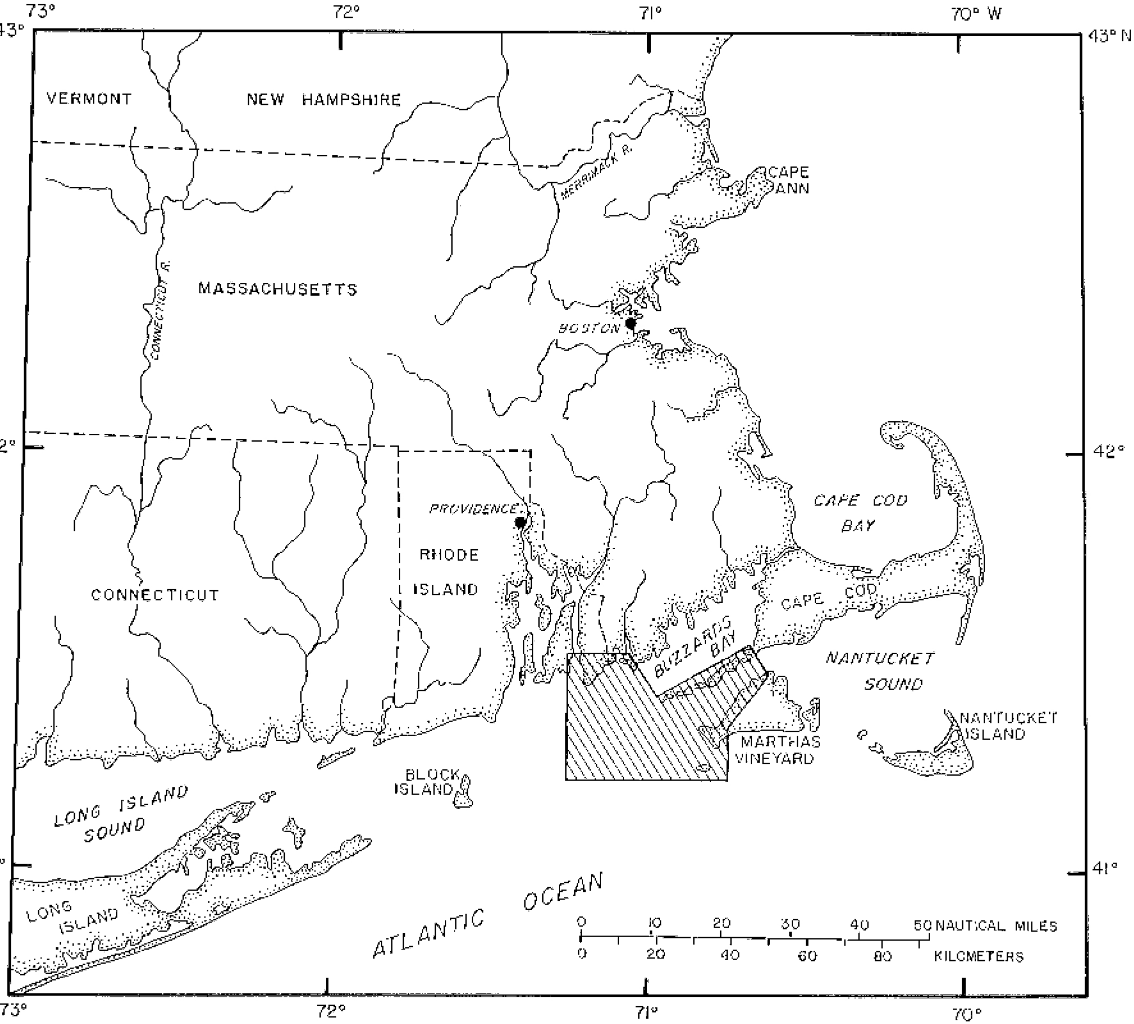
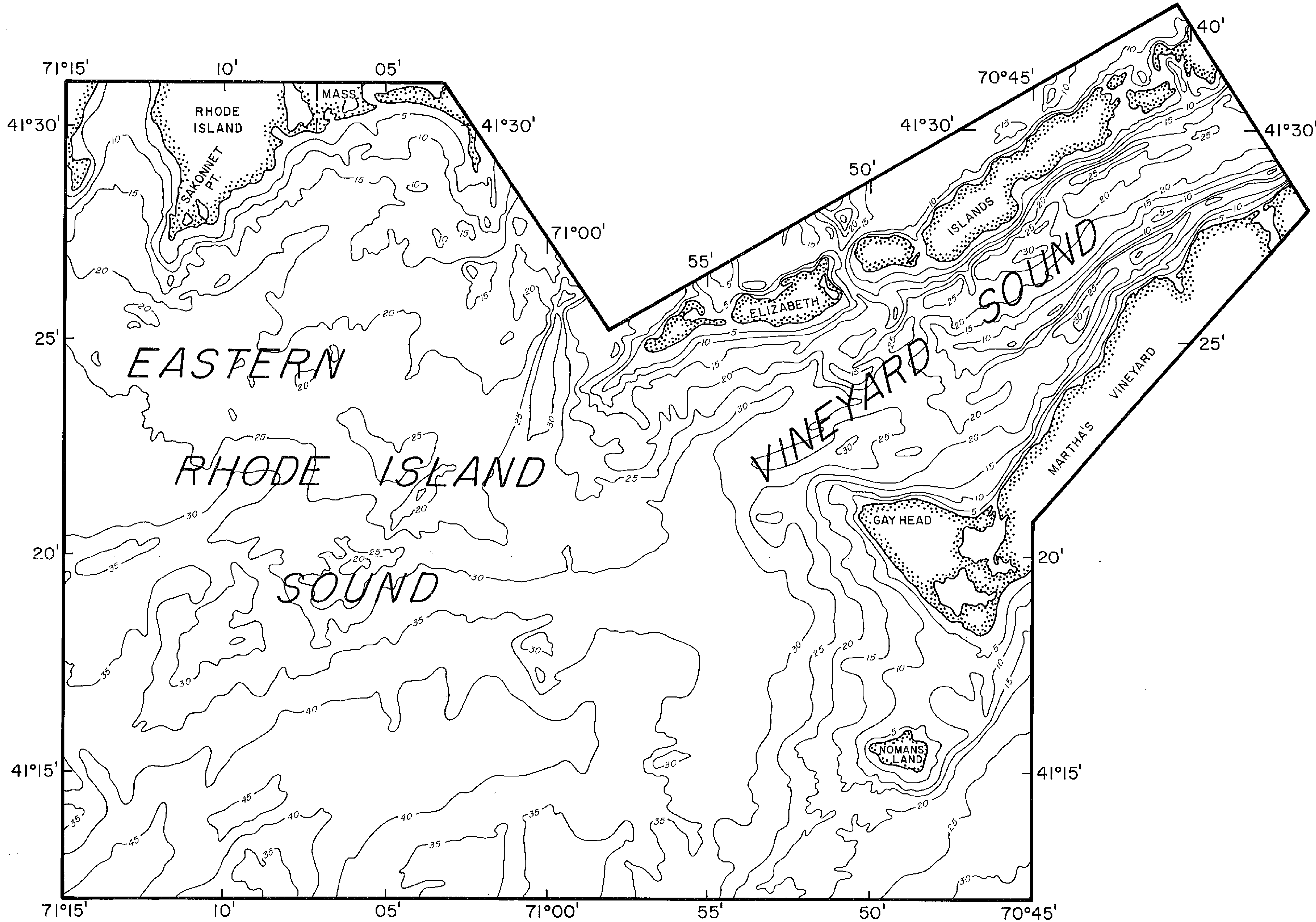


INDEX MAP SHOWING STUDY AREA



Modified from Coast and Geodetic Survey Chart 0808N-51
Mercator projection

Bathymetric contour interval 5 meters
Datum mean low water

SCALE 1:125,000

1 0 1 2 3 4 5 NAUTICAL MILES

1 0 1 2 3 4 5 6 7 8 9 10 11 12 KILOMETERS

FIGURE 1 MAP SHOWING SEAFLOOR TOPOGRAPHY

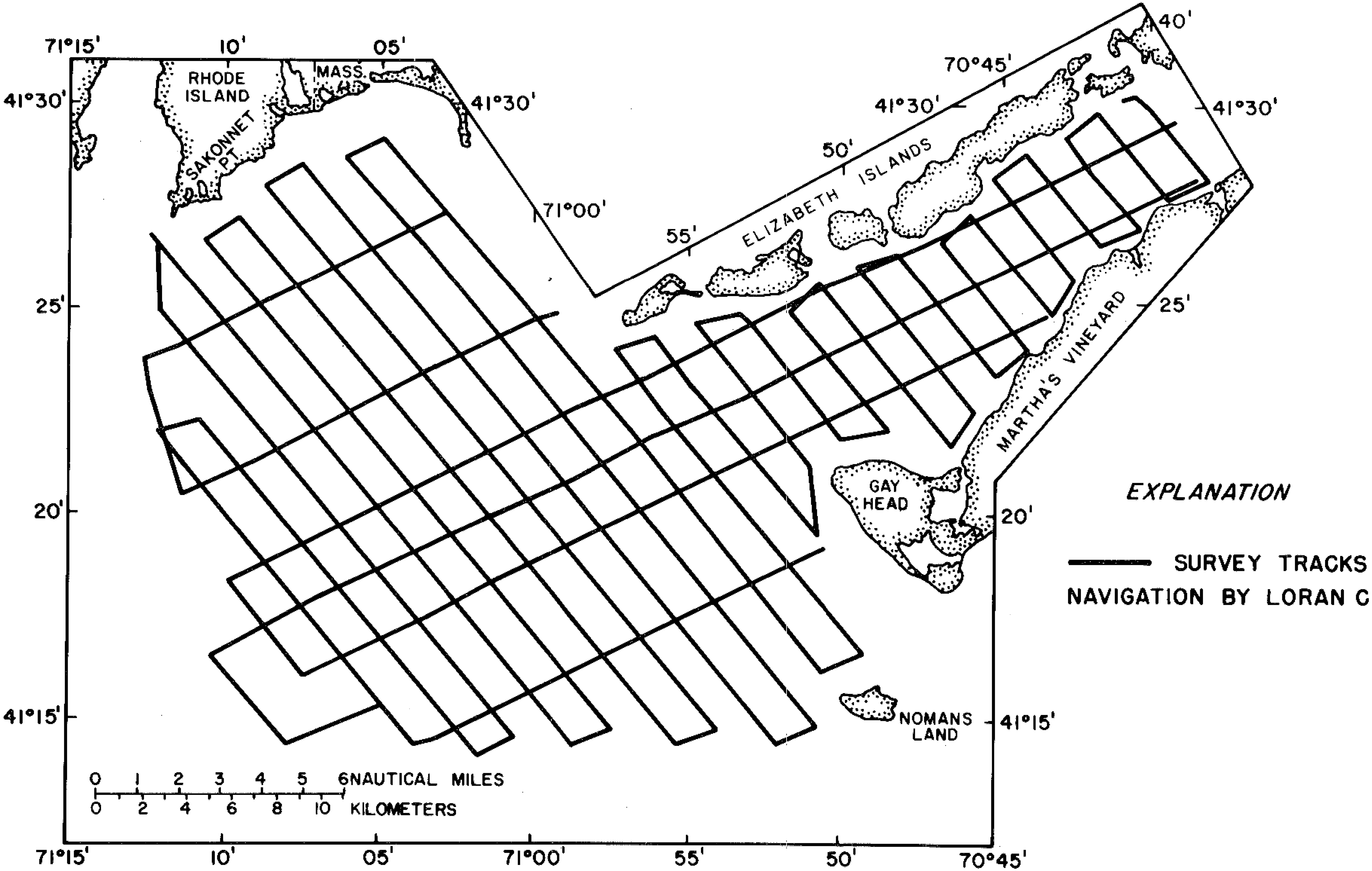


FIGURE 2 MAP SHOWING LOCATION OF HIGH-RESOLUTION SUBBOTTOM PROFILES

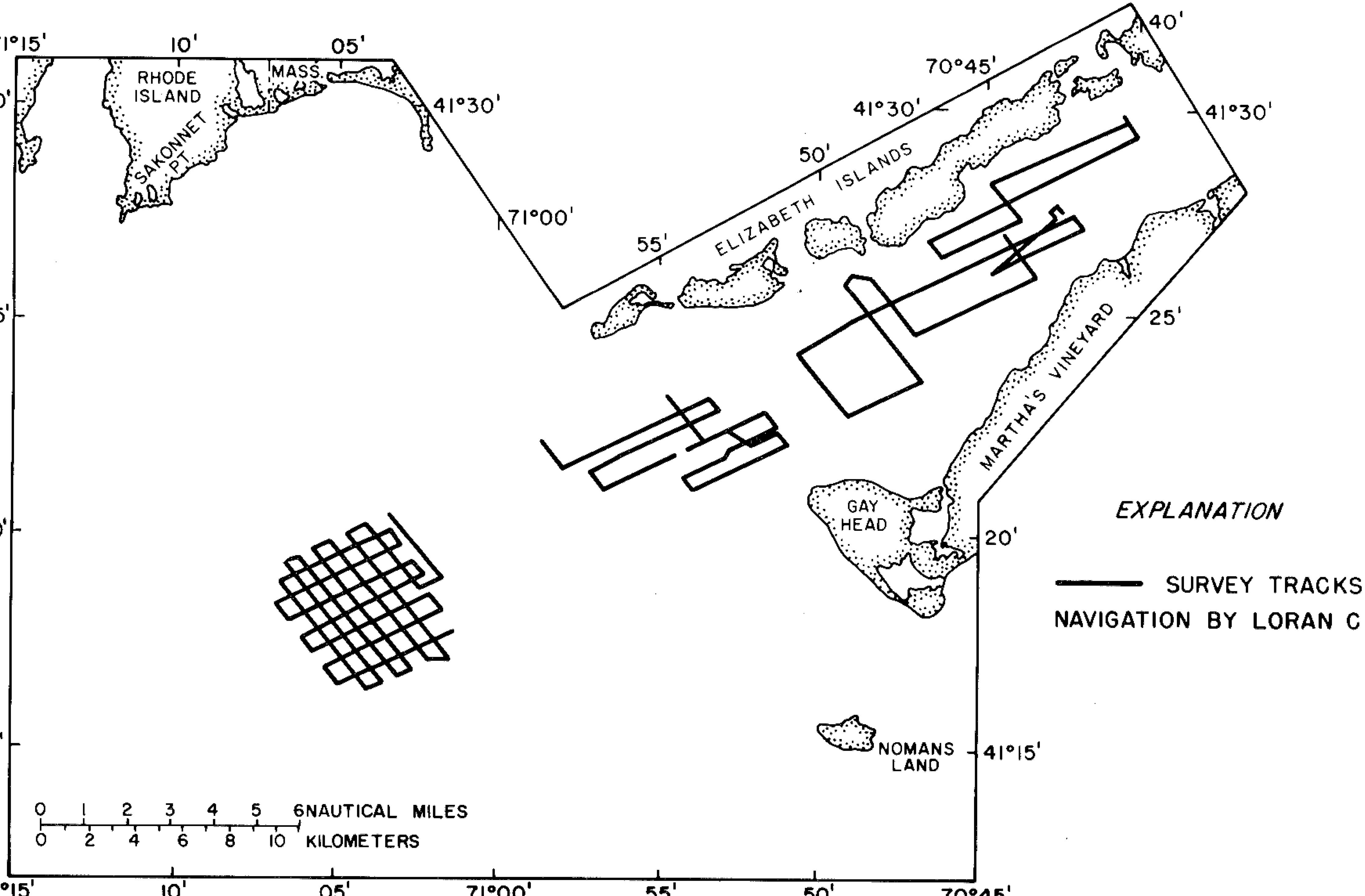
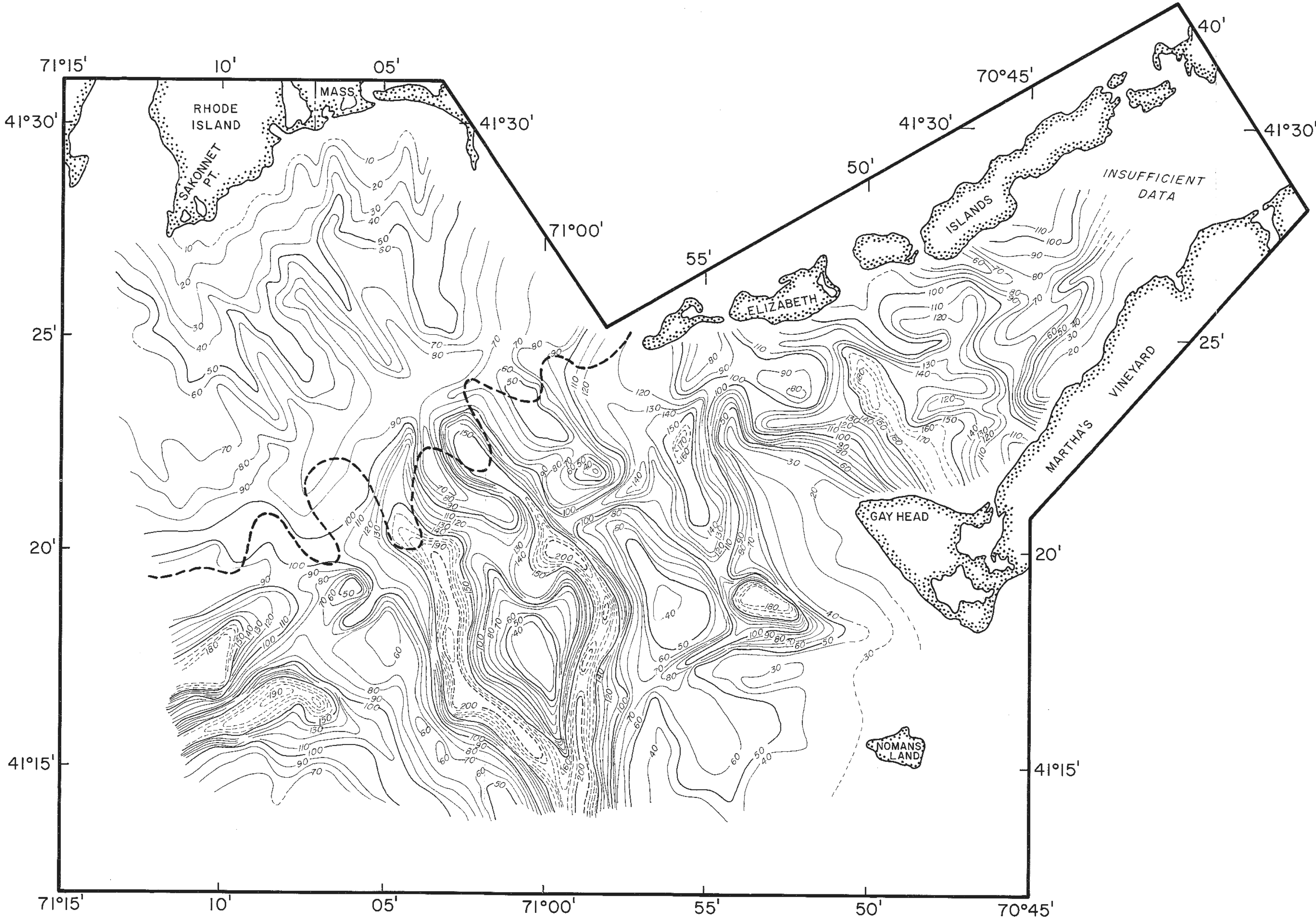


FIGURE 3 MAP SHOWING LOCATION OF SIDE-SCAN SONOGRAPHS



Base from Coast and Geodetic Survey Chart 0808N-51
Mercator projection

SCALE 1:125,000

1 0 1 2 3 4 5 NAUTICAL MILES

1 0 1 2 3 4 5 6 7 8 9 10 11 12 KILOMETERS

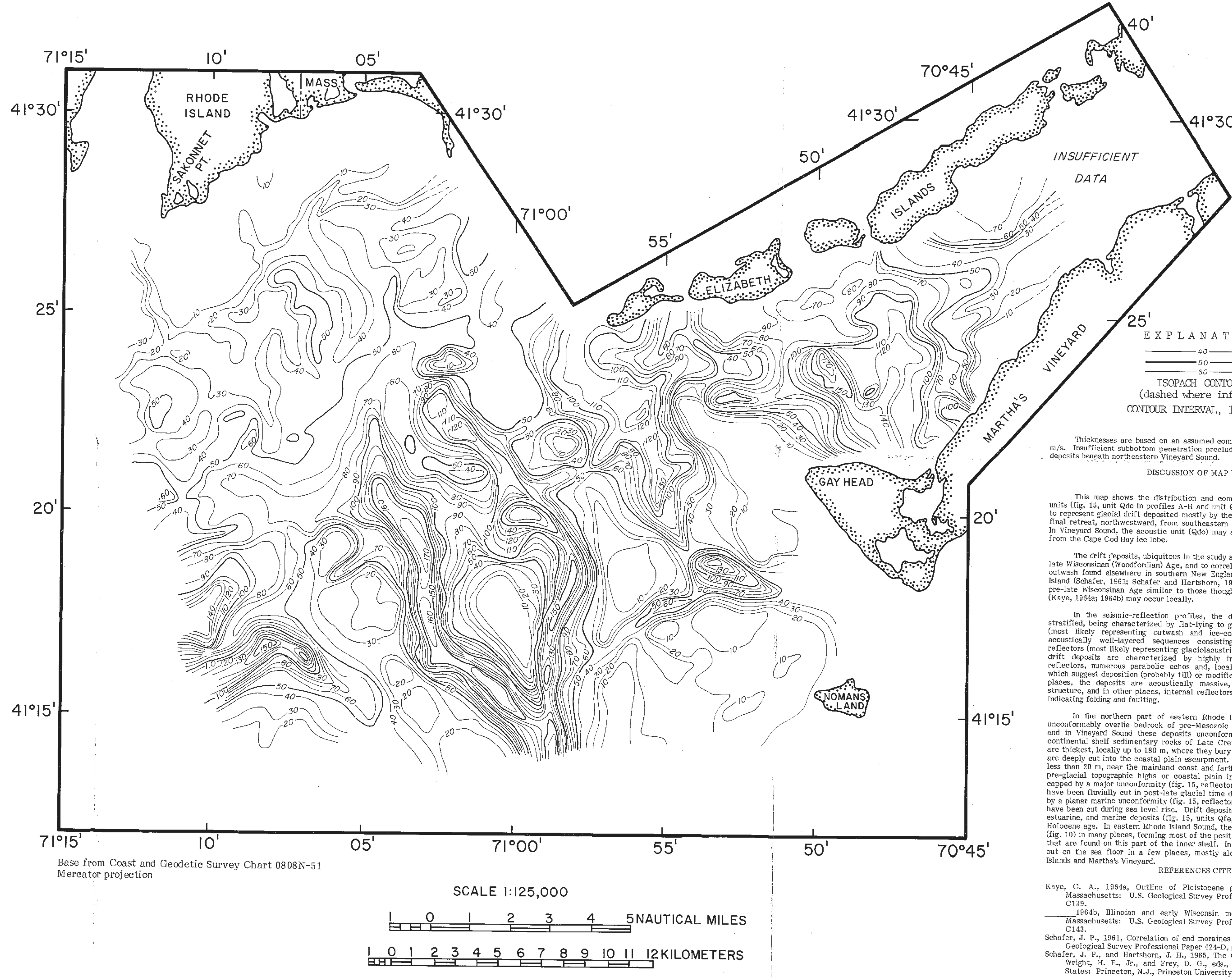
FIGURE 4 MAP SHOWING DEPTH TO BASEMENT AND SUBMERGED COASTAL PLAIN ROCKS

EXPLANATION

40
50
60

STRUCTURE CONTOURS
(dashed where inferred)
CONTOUR INTERVAL, 10 METERS - DATUM IS SEA LEVEL

APPROXIMATE NORTHERN LIMIT OF CUESTA UNDERLAIN BY SEAWARD DIPPING STRATA OF LATE CRETACEOUS AND TERTIARY(?) AGE



EXPLANATION

40
50
60

ISOPACH CONTOURS
(dashed where inferred)
CONTOUR INTERVAL, 10 METERS

FIGURE 5 MAP SHOWING THICKNESS OF GLACIAL DRIFT DEPOSITS

Thicknesses are based on an assumed compressional-wave velocity of 1800 m/s. Insufficient subbottom penetration precluded mapping the thickness of the deposits beneath northeastern Vineyard Sound.

DISCUSSION OF MAP UNITS

This map shows the distribution and combined thickness of the acoustic units (fig. 15, unit Qdo in profiles A-H and unit Qdm shown in profile C) believed to represent glacial drift deposited mostly by the Buzzards Bay ice lobe during its final retreat, northwestward, from southeastern Massachusetts and Rhode Island. In Vineyard Sound, the acoustic unit (Qdo) may also include glacial drift derived from the Cape Cod Bay ice lobe.

The drift deposits, ubiquitous in the study area, are inferred to be mostly of late Wisconsinan (Woodfordian) Age, and to correlate with moraines and proglacial outwash found elsewhere in southern New England and on Block Island and Long Island (Schafer, 1961; Schafer and Hartshorn, 1965). However, drift deposits of pre-late Wisconsinan Age similar to those thought to exist on Martha's Vineyard (Kaye, 1964a; 1964b) may occur locally.

In the seismic-reflection profiles, the drift deposits are largely well-stratified, being characterized by flat-lying to gently-dipping internal reflectors (most likely representing outwash and ice-contact stratified drift) and by acoustically well-layered sequences consisting of numerous closely-spaced reflectors (most likely representing glaciolacustrine deposits). In other areas, the drift deposits are characterized by highly irregular, discontinuous internal reflectors, numerous parabolic echos and, locally, imbricate reflectors, all of which suggest deposition (probably till) or modification by overriding ice. In some places, the deposits are acoustically massive, showing little or no internal structure, and in other places, internal reflectors are folded and steeply-dipping, indicating folding and faulting.

In the northern part of eastern Rhode Island Sound, the drift deposits unconformably overlie bedrock of pre-Mesozoic age, while in the southern part and in Vineyard Sound these deposits unconformably overlie coastal plain and continental shelf sedimentary rocks of Late Cretaceous age. The drift deposits are thickest, locally up to 180 m, where they bury bedrock valleys and valleys that are deeply cut into the coastal plain escarpment. Deposits are thinnest, generally less than 20 m, near the mainland coast and farther offshore where they cap the pre-glacial topographic highs or coastal plain interfluves. The glacial drift is capped by a major unconformity (fig. 15, reflector fu_1 in profiles A-H) inferred to have been fluvially cut in post-late glacial time during low sea-level and, locally, by a planar marine unconformity (fig. 15, reflector mu in profiles D-H) inferred to have been cut during sea level rise. Drift deposits are locally overlain by fluvial, estuarine, and marine deposits (fig. 15, units Qfe, Qb and Qm in profiles A-H) of Holocene age. In eastern Rhode Island Sound, the drift crops out on the sea floor (fig. 10) in many places, forming most of the positive bathymetric features (fig. 1) that are found on this part of the inner shelf. In Vineyard Sound, the drift crops out on the sea floor in a few places, mostly along the shores of the Elizabeth Islands and Martha's Vineyard.

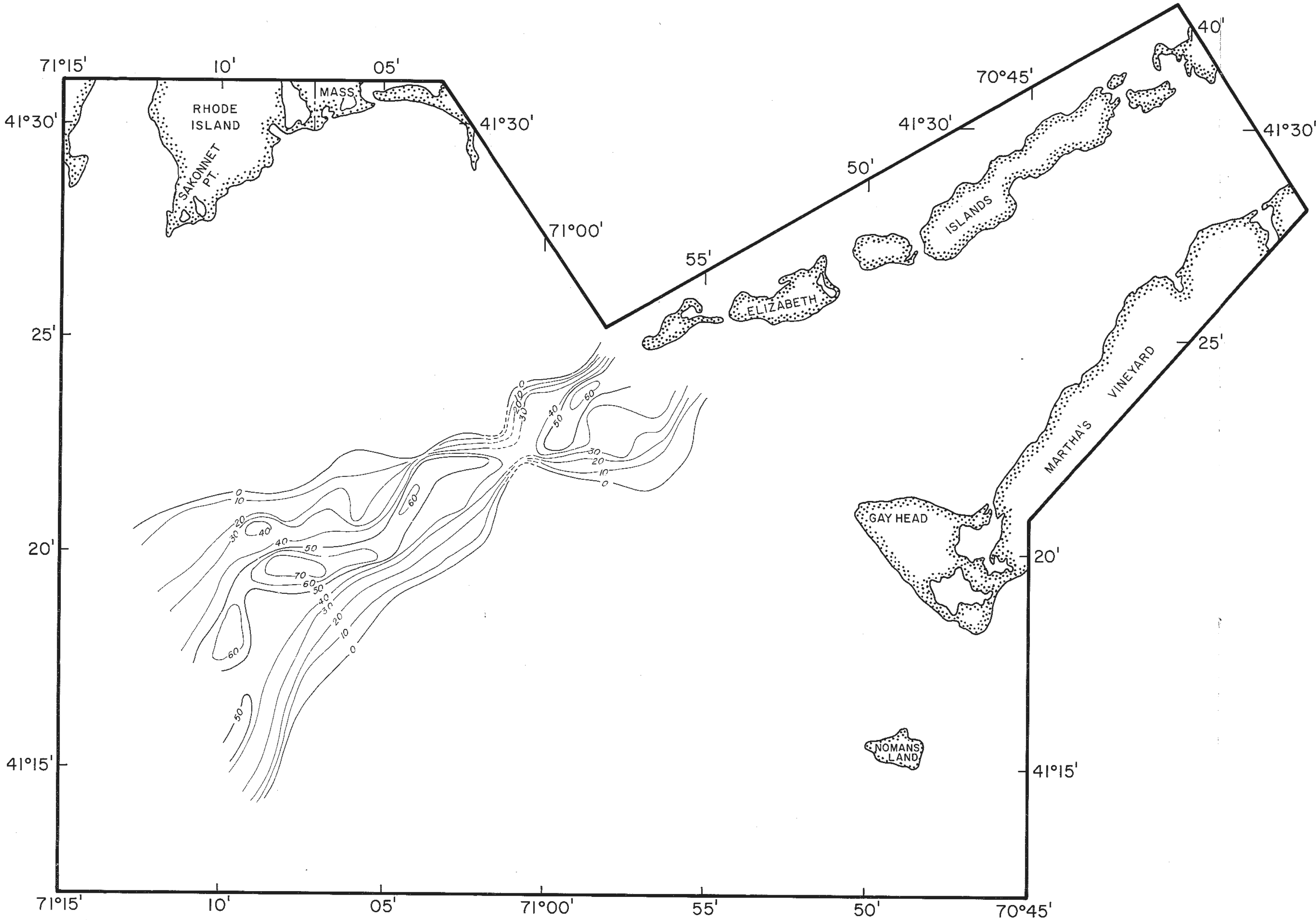
REFERENCES CITED

Kaye, C. A., 1964a, Outline of Pleistocene geology of Martha's Vineyard, Massachusetts: U.S. Geological Survey Professional Paper 501-C, p. C134-C139.

_______1964b, Illinoian and early Wisconsin moraines of Martha's Vineyard, Massachusetts: U.S. Geological Survey Professional Paper 501-C, p. C140-C143.

Schafer, J. P., 1961, Correlation of end moraines in southern Rhode Island: U.S. Geological Survey Professional Paper 424-D, p. D68-D70.

Schafer, J. P., and Hartshorn, J. H., 1965, The Quaternary of New England, in Wright, H. E., Jr., and Frey, D. G., eds., The Quaternary of the United States: Princeton, N.J., Princeton University Press, p. 113-128.



Base from Coast and Geodetic Survey Chart 0808N-51
Mercator projection

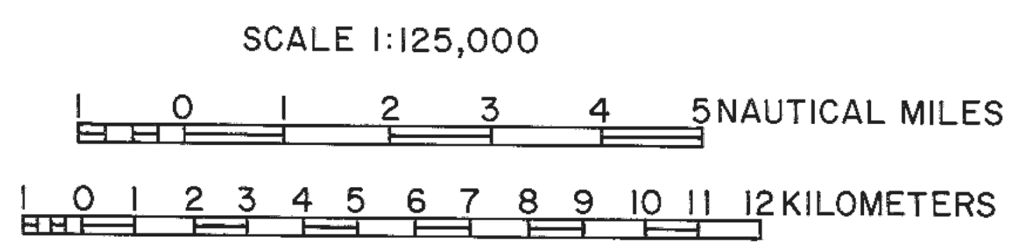


FIGURE 6 MAP SHOWING THICKNESS OF BUZZARDS BAY MORAINE DEPOSITS

EXPLANATION

40
50
60

ISOPACH CONTOURS
(dashed where inferred)

CONTOUR INTERVAL, 10 METERS

Thicknesses are based on an assumed compressional-wave velocity of 1800 m/s. Zero contours denote approximate limit of deposits inferred from the seismic-reflection profiles.

DISCUSSION OF MAP UNIT

This map shows the distribution and thickness of the acoustic unit (fig. 15, unit Qdm in profile C) in eastern Rhode Island Sound, thought to represent the submerged extension of the Buzzards Bay end-moraine deposits that form the Elizabeth Islands. The unit is inferred to be a glaciotectonic feature of late Wisconsinan (Woodfordian) Age and to consist mostly of ice-deformed and ice-thrusted stratified drift similar to that found on the islands. Recent field studies (Oldale and O'Hara, 1978) indicate that the moraine deposits forming the Elizabeth Islands are ice-thrust ridges composed of folded and faulted, steeply dipping, proglacial deltaic and lacustrine sediments. A thin cover of subglacial till caps these sediments in most places. The occurrence of well-stratified drift—the Elizabeth Islands—high up on the moraine front, unconformably overlain by basal till, as well as the anomalous up-ice dip and steepness of the beds (dip to northwest is 40° to near vertical) and the occurrence of local folding and faulting, together suggest that the outwash deposits were displaced both horizontally and vertically by overriding ice during a readvance of the ice front. Other nearby evidence for thrusting and deformation by glacial ice is found within the Nantucket moraine at Gay Head Cliffs on Martha's Vineyard (Kaye, 1964b) and in the adjacent offshore area (fig. 15, unit Ku in profile F). Morphologically similar ice-thrusted ridges composed of folded and faulted unconsolidated sediment have been noted in western Canada (Byers, 1959; Kupsch, 1962) and in northwestern Europe (Rutten, 1960). The structural nature of the Buzzards Bay end-moraine deposits suggests that deglaciation of southeastern Massachusetts was characterized by an oscillating ice front responding to short-term fluctuations of the Woodfordian glacial climate. Ice front retreat is thought to have involved stagnation zone retreat alternating with vigorous ice advance in a manner similar to that reported by Frye and Willman (1973) in Illinois, rather than a gradual and steady retreat in response to an ameliorating climate.

In the seismic-reflection profiles, the base of the acoustic unit is defined by a very prominent, continuous, and slightly irregular subbottom reflector (fig. 15, reflector at base of unit Qdm in profile C). This reflector dips northwestward and is truncated at or near the sea floor to the southeast. The upper surface of the unit is represented by an irregular sea-floor reflector and farther to the northwest by another prominent, continuous and more steeply northwest-dipping subbottom reflector (not shown in profile C) that merges at depth with the lowermost reflector. These two prominent up-ice dipping reflectors are thought to be basal tills that were deposited as the Buzzards Bay ice lobe readvanced over the ice-contact slope of its previously deposited outwash. Internal reflectors are mostly lacking, but where seen are generally irregular, discontinuous, and occasionally imbricated. The acoustically massive appearance of the unit in the seismic profiles may have been caused by attenuation of the high-frequency acoustic energy by the till cover, or it may have been caused by the homogeneity of the drift, which might preclude sufficient acoustic contrast to resolve any internal bedding or structure.

The isopach map shows an arcuate configuration in the distribution of the acoustic unit especially where it is greater than 50 m thick. The part of the unit shown by dashed contours may represent an inter-ridge low or an area where no ice thrusting occurred, perhaps similar in nature to the passageways that occur between the Elizabeth Islands.

Morphostratigraphically, the unit correlates with the morainal ridges that occur on western and northern Cape Cod, along the southern coast of Rhode Island, on Fishers Island, Plum Island, and along the northern part of Long Island (Schafer, 1961). In the study area, the moraine deposits are underlain in most places by older outwash deposits and in some places by coastal plain and continental shelf rocks of Late Cretaceous age. To the northwest the unit is overlain by younger outwash plain deposits, and to the southeast it crops out on the sea floor in a series of southwest-trending topographic ridges and inter-ridge lows (fig. 1) that deepen offshore. Side-scan sonar data (fig. 16, sonograph record SS-1) obtained in this study and submersible vessel observations made by the Army Corps of Engineers (Gib Chase, oral commun., 1977) indicate that these offshore ridges are capped by sand and gravel and large boulders that are thought to be lag from marine erosion of the till cover. In addition, small sand waves were found to occur atop some of these deeply submerged ridges.

REFERENCES CITED

Byers, A. R., 1959, Deformation of the Whitemud and Eastend Formations near Claybank, Saskatchewan: Transactions of the Royal Society of Canada, v. 53, p. 1-11.

Frye, J. C., and Willman, H. B., 1973, Wisconsinan climatic history interpreted from Lake Michigan lobe deposits and soils: Geological Society of America Memoir 136, p. 135-152.

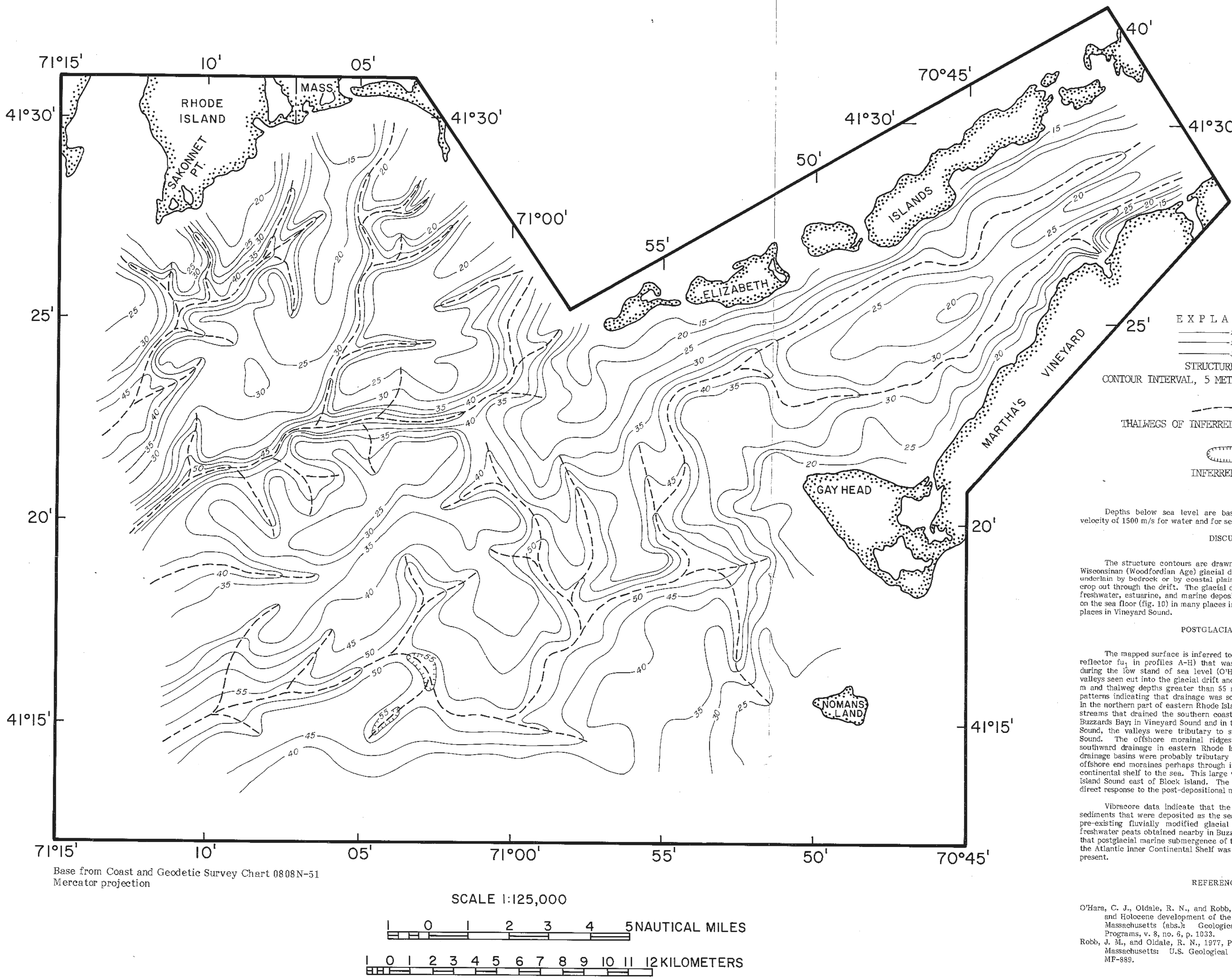
Kaye, C. A., 1964b, Illinoian and early Wisconsin moraines of Martha's Vineyard, Massachusetts: U.S. Geological Survey Professional Paper 501-C, p. C140-C143.

Kupsch, W. O., 1962, Ice-thrust ridges in western Canada: Journal of Geology, v. 70, p. 582-594.

Oldale, R. N., and O'Hara, C. J., 1978, Thrusted coastal end moraines and a Woodfordian fluctuating ice margin: evidence from Massachusetts onshore and offshore areas (abs.): Geological Society of America Abstracts with Programs, v. 10, no. 2, p. 78.

Rutten, M. G., 1960, Ice-pushed ridges, permafrost and drainage: American Journal of Science, v. 258, p. 293-297.

Schafer, J. P., 1961, Correlation of end moraines in southern Rhode Island: U.S. Geological Survey Professional Paper 424-D, p. D68-D70.



EXPLANATION

STRUCTURE CONTOURS
CONTOUR INTERVAL, 5 METERS - DATUM IS SEA LEVEL

THALWEGS OF INFERRED POSTGLACIAL STREAMS

INFERRED KETTLE

Depths below sea level are based on an assumed compressional-wave velocity of 1500 m/s for water and for sediments inferred to be of postglacial age.

DISCUSSION

The structure contours are drawn on a surface underlain by mostly upper Wisconsinan (Woodfordian Age) glacial drift. In some places, the surface may be underlain by bedrock or by coastal plain and continental shelf rocks where they crop out through the drift. The glacial drift surface is overlain in most places by freshwater, estuarine, and marine deposits of Holocene age, but it does crop out on the sea floor (fig. 10) in many places in eastern Rhode Island Sound and in a few places in Vineyard Sound.

POSTGLACIAL DRAINAGE

The mapped surface is inferred to represent a major unconformity (fig. 15, reflector fu_1 in profiles A-H) that was fluvially cut in post-late glacial time during the low stand of sea level (O'Hara and others, 1976). The postglacial valleys seen cut into the glacial drift and older deposits have local relief up to 20 m and thalweg depths greater than 55 m below sea level. They form dendritic patterns indicating that drainage was southwestward toward Block Island Sound. In the northern part of eastern Rhode Island Sound, these valleys were tributary to streams that drained the southern coast of Massachusetts and Rhode Island and Buzzards Bay; in Vineyard Sound and in the southern part of eastern Rhode Island Sound, the valleys were tributary to streams that drained western Nantucket Sound. The offshore morainal ridges were drainage divides that precluded southward drainage in eastern Rhode Island Sound. The major valleys of the drainage basins were probably tributary to a much larger river that breached the offshore end moraines perhaps through inter-ridge lows and continued across the continental shelf to the sea. This large valley may have existed in western Rhode Island Sound east of Block Island. The drainage network doubtless developed in direct response to the post-depositional morphology of the glacial drift deposits.

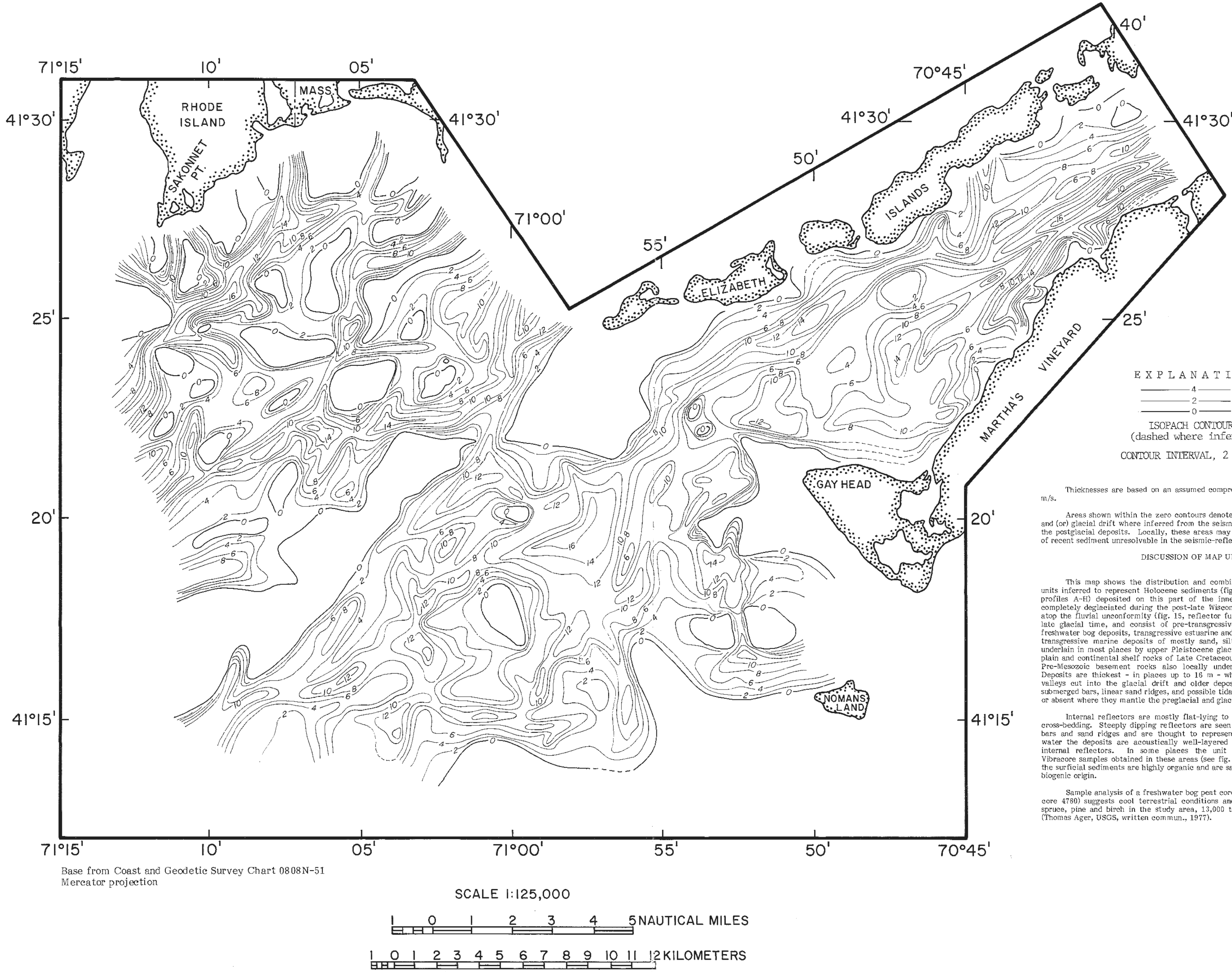
Vibracore data indicate that the valleys are filled with mostly estuarine sediments that were deposited as the sea transgressed and gradually drowned the pre-existing fluvially modified glacial drift surface. Radiocarbon dates on freshwater peats obtained nearby in Buzzards Bay (Robb and Oldale, 1977) suggest that postglacial marine submergence of the drift and older deposits on this part of the Atlantic Inner Continental Shelf was not complete prior to 5,000 years before present.

REFERENCES CITED

O'Hara, C. J., Oldale, R. N., and Robb, J. M., 1976, Late Tertiary, Pleistocene, and Holocene development of the Inner Continental Shelf off southeastern Massachusetts (abs.): Geological Society of America Abstracts with Programs, v. 8, no. 6, p. 1033.

Robb, J. M., and Oldale, R. N., 1977, Preliminary geologic maps, Buzzards Bay, Massachusetts: U.S. Geological Survey Miscellaneous Field Studies Map MF-889.

FIGURE 7 MAP SHOWING STRUCTURE OF GLACIAL DRIFT SURFACE



Thicknesses are based on an assumed compressional-wave velocity of 1500 m/s.

Areas shown within the zero contours denote bedrock, coastal plain strata, and (or) glacial drift where inferred from the seismic profiles to crop out through the postglacial deposits. Locally, these areas may be blanketed by a thin mantle of recent sediment unresolvable in the seismic-reflection records.

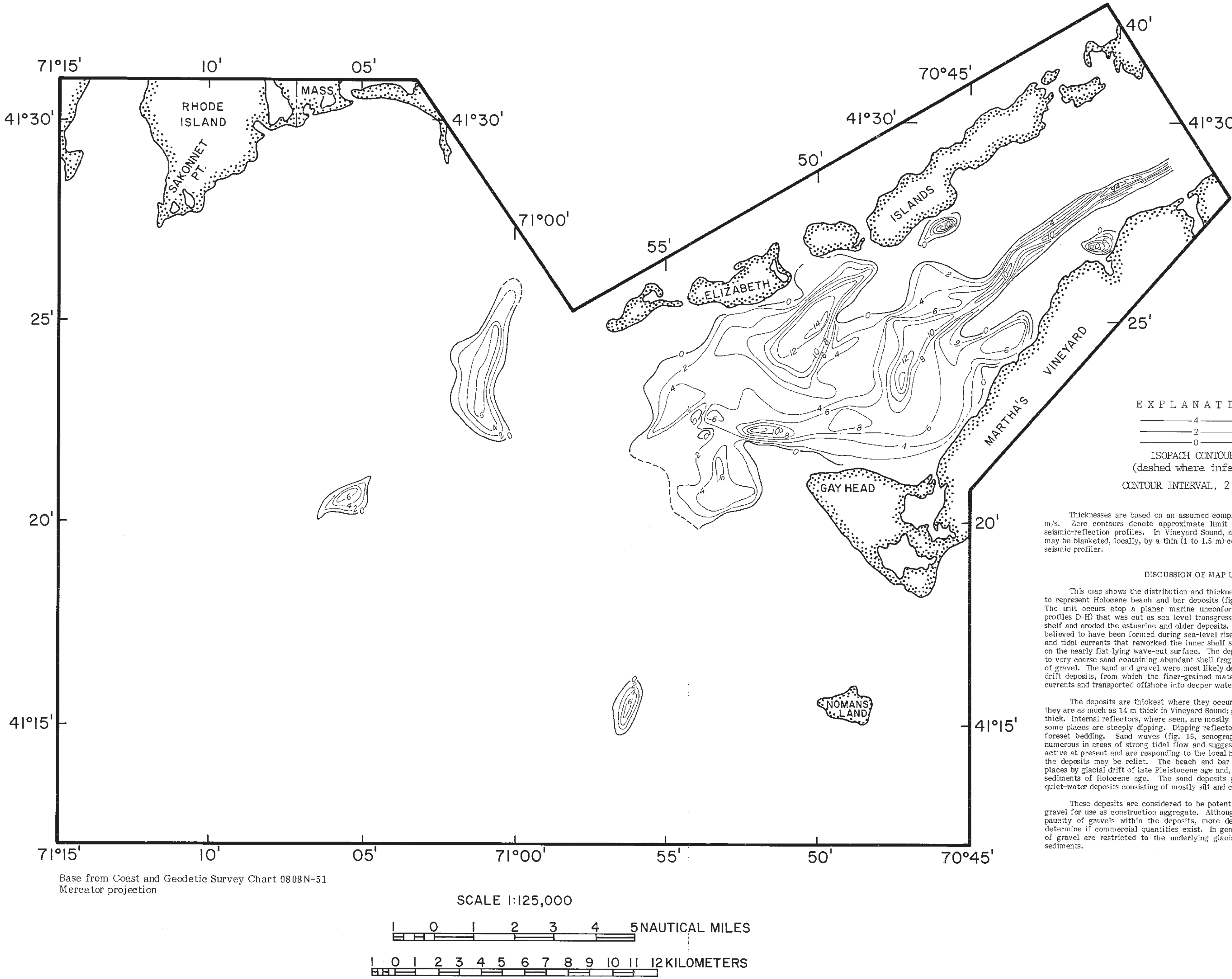
DISCUSSION OF MAP UNIT

This map shows the distribution and combined thickness of the acoustic units inferred to represent Holocene sediments (fig. 15, units Qfe, Qb and Qm in profiles A-H) deposited on this part of the inner shelf after the region was completely deglaciated during the post-late Wisconsinan. These sediments occur atop the fluvial unconformity (fig. 15, reflector fu_1 in profiles A-H) cut in post-late glacial time, and consist of pre-transgressive fluvial sand and gravel and freshwater bog deposits, transgressive estuarine and salt marsh deposits, and post-transgressive marine deposits of mostly sand, silt and clay. The deposits are underlain in most places by upper Pleistocene glacial drift and locally by coastal plain and continental shelf rocks of Late Cretaceous to early Pleistocene (?) age. Pre-Mesozoic basement rocks also locally underlie the Holocene sediments. Deposits are thickest - in places up to 16 m - where they bury the postglacial valleys cut into the glacial drift and older deposits, and where they occur as submerged bars, linear sand ridges, and possible tidal deltas. Deposits are thinnest or absent where they mantle the preglacial and glacial topographic highs.

Internal reflectors are mostly flat-lying to gently dipping and show local cross-bedding. Steeply dipping reflectors are seen in some parts of the offshore bars and sand ridges and are thought to represent foreset bedding. In deeper water the deposits are acoustically well-layered with numerous closely-spaced internal reflectors. In some places the unit is acoustically impenetrable. Vibracore samples obtained in these areas (see fig. 12 for locations) indicate that the surficial sediments are highly organic and are saturated with gases of probable biogenic origin.

Sample analysis of a freshwater bog peat cored from these deposits (fig. 14, core 4760) suggests cool terrestrial conditions and boreal forests dominated by spruce, pine and birch in the study area, 13,000 to 14,000 years before present (Thomas Ager, USGS, written commun., 1977).

FIGURE 8 MAP SHOWING THICKNESS OF POSTGLACIAL (HOLOCENE) DEPOSITS



Thicknesses are based on an assumed compressional-wave velocity of 1500 m/s. Zero contours denote approximate limit of deposits as defined in the seismic-reflection profiles. In Vineyard Sound, areas outside the zero contours may be blanketed, locally, by a thin (1 to 1.5 m) cover of sand not resolved by the seismic profiler.

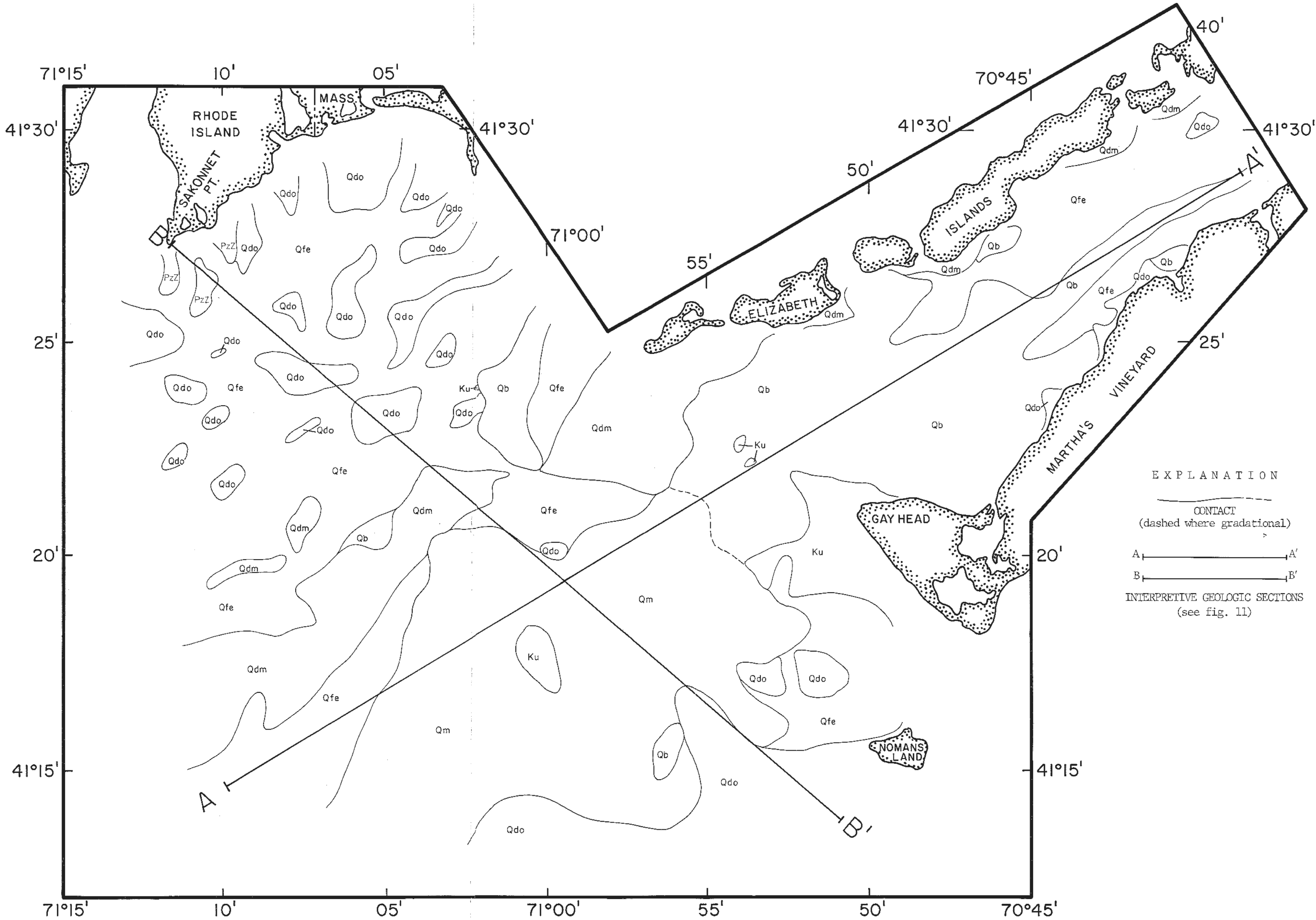
DISCUSSION OF MAP UNIT

This map shows the distribution and thickness of the acoustic unit inferred to represent Holocene beach and bar deposits (fig. 15, unit Qb in profiles F-H). The unit occurs atop a planar marine unconformity (fig. 15, reflector mu in profiles D-H) that was cut as sea level transgressed across this part of the inner shelf and eroded the estuarine and older deposits. The beach and bar deposits are believed to have been formed during sea-level rise by wave action and by littoral and tidal currents that reworked the inner shelf sediments and redeposited them on the nearly flat-lying wave-cut surface. The deposits consist mostly of medium to very coarse sand containing abundant shell fragments and, locally, small lenses of gravel. The sand and gravel were most likely derived from the adjacent glacial drift deposits, from which the finer-grained material probably was winnowed by currents and transported offshore into deeper water.

The deposits are thickest where they occur as linear sand ridges. Locally they are as much as 14 m thick in Vineyard Sound; generally they are less than 8 m thick. Internal reflectors, where seen, are mostly flat-lying and continuous, but in some places are steeply dipping. Dipping reflectors are thought to indicate local foreset bedding. Sand waves (fig. 16, sonograph records SS-3 and SS-4) are numerous in areas of strong tidal flow and suggest that the deposits, in part, are active at present and are responding to the local hydraulic regime; in other areas, the deposits may be relict. The beach and bar deposits are underlain in most places by glacial drift of late Pleistocene age and, locally, by fluvial and estuarine sediments of Holocene age. The sand deposits grade offshore to finer-grained quiet-water deposits consisting of mostly silt and clay.

These deposits are considered to be potential sources of sand and possibly gravel for use as construction aggregate. Although the vibracore data indicate a paucity of gravels within the deposits, more detailed sampling is required to determine if commercial quantities exist. In general, significant concentrations of gravel are restricted to the underlying glacial drift and postglacial fluvial sediments.

FIGURE 9 MAP SHOWING THICKNESS OF BEACH AND BAR DEPOSITS



Base from Coast and Geodetic Survey Chart 0808N-51
Mercator projection

SCALE 1:125,000

1 0 1 2 3 4 5 NAUTICAL MILES

1 0 1 2 3 4 5 6 7 8 9 10 11 12 KILOMETERS

FIGURE 10 MAP SHOWING SURFICIAL GEOLOGY

DESCRIPTION AND CORRELATION OF MAP UNITS

NOTE: The distribution and lithology of the geologic map units are based, in part, on the acoustic nature of the reflection seismic data and, in part, on the vibracore data. In places, the map units may be overlain by younger sediments too thin to be resolved by the seismic profiler.

Qm

QUIET-WATER MARINE DEPOSITS

Recent marine deposits consisting mostly of silt and clay with some shells, shell fragments, and local lenses of fine to very fine sand. Shells are predominantly *Mercenaria mercenaria* and *Crassostrea virginica* (Arthur Merrill, NMFS, oral commun., 1978). Bedding is mostly flat-lying and continuous. Offshore in deeper water, the unit thickens to 12 m. It grades onshore into coarser-grained beach and bar deposits. Deposits are thought to be largely locally derived by marine reworking of the adjacent glacial drift sediments.

Qb

MARINE BEACH AND BAR DEPOSITS

Recent marine deposits consisting of fine to very coarse sand containing minor amounts of gravel. Grades offshore to finer-grained quiet-water deposits. Sand is mostly quartz, and has abundant shells and shell fragments scattered throughout. Shells are predominantly *Mercenaria mercenaria* and *Crassostrea virginica* (Arthur Merrill, NMFS, oral commun., 1978). Bedding is mostly flat-lying and continuous but in some places is steeply dipping, indicating foresets. Unit is locally up to 14 m thick. Sand waves are commonly associated with these deposits and, therefore, are thought to be active presently. Deposits are considered a potential source of sand and possibly gravel. Sands and gravels are thought to be mostly derived from the adjacent glacial drift sediments.

UNCONFORMITY

Qfe

FLUVIAL AND ESTUARINE DEPOSITS

Recent fluvial sands and gravels and fine-grained estuarine muds. Sands and gravels are medium-to-well sorted. Estuarine deposits are mostly silts and clays with abundant shells and shell fragments and occasional lenses of sand. In places, the unit contains remnant organic material from freshwater bog, pond, and salt-marsh environments. Internal stratification is predominantly flat-lying to cross-bedded; some places may be foreset bedded. Unit generally is 8-10 m thick. Top of unit is truncated by the marine planation surface formed during last sea-level rise. The unit occurs in the shallow subsurface of the inner shelf and crops out on the sea floor in many places. The fluvial deposits are considered to be potential sources of sand and gravel.

UNCONFORMITY

Qdo

GLACIAL DRIFT DEPOSITS

Ice-contact stratified drift, outwash plain, and proglacial lake sediments deposited by glacial meltwater streams. Deposits are derived mostly from the Buzzards Bay ice lobe and locally may include glacial drift derived from the Cape Cod Bay ice lobe. Unit is inferred to be mostly of late Wisconsinan Age, but in places it may include pre-upper Wisconsinan drift. Deposits consist predominantly of moderately-to-well sorted outwash sands and gravels and glacio-lacustrine silts and clays. Locally, unit is thought to include ice-contact fluvial and deltaic deposits and subglacial tills. Outwash sands and gravels are largely flat-lying, but probably are cross-bedded locally. Glacial lake deposits are well stratified, thin bedded to laminated. Unit thickness is highly variable, in places up to 150 m. Locally the deposits may be folded and faulted. The upper surface of the unit represents an unconformity that formed during the low stand of sea level in post-late glacial time. Most of the gravels encountered in the vibracores are associated with the unit. Glacial lake sediments recovered in the cores were unfossiliferous (Jack McLane, USGS, oral commun., 1977).

Qdm

BUZZARDS BAY MORAINE DEPOSITS

Inferred to represent glacial outwash deposits that were glaciotectonically folded and thrust-faulted by overriding ice during a readvance of the Buzzards Bay ice lobe. Unit is thought to be of late Wisconsinan (Woodfordian) Age and to correlate with the Buzzards Bay end-moraine deposits that form the Elizabeth Islands. Although internal structure and lithology of unit are unknown, unit is inferred to consist of ice-thrusted blocks of proglacial drift which are locally capped by basal till. Drift is believed to consist of deltaic sands and glacio-lacustrine silts and clays. Thickness of unit is variable, locally up to 70 m. Unit crops out on the sea floor as ridges or ledges that trend southwestward toward Block Island Sound. These ridges are blanketed by sand, gravel, and boulders. Atop some of the ridges sand waves and current ripples are common.

UNCONFORMITY

Ku

COASTAL PLAIN DEPOSITS

Coastal plain and continental shelf sedimentary rocks inferred to be mostly of Late Cretaceous age and to consist of unconsolidated to semi-consolidated sands, gravels, silts, and clays. Deposits occur offshore beneath a deeply-eroded cuesta and thicken seaward. Internal bedding is mostly continuous, flat-lying to gently seaward-dipping. Locally the strata are folded and faulted. Top of unit is an unconformity, having local relief of up to 130 m, that is inferred to have formed during the late Tertiary or early Pleistocene. Locally, unit may include continental shelf strata of Tertiary and early Pleistocene age.

UNCONFORMITY

PzZ

BEDROCK

Inferred to represent igneous, metamorphic, and consolidated sedimentary rocks of Proterozoic Z to early Paleozoic age.

Holocene

QUATERNARY

Pleistocene (upper Wisconsinan)

Upper Cretaceous (possibly including some Tertiary and pre-upper Wisconsinan deposits)

PRE-QUATERNARY

Lower Paleozoic to Proterozoic Z

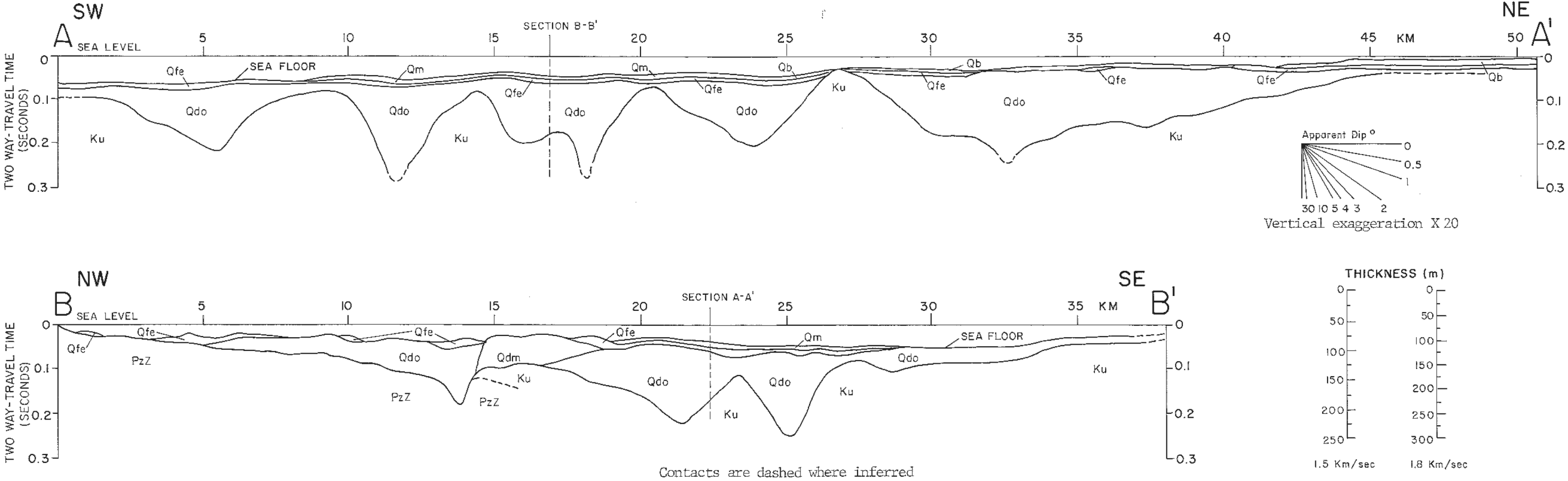


FIGURE 11 INTERPRETIVE GEOLOGIC SECTIONS A-A′ AND B-B′ FROM FIGURE 10

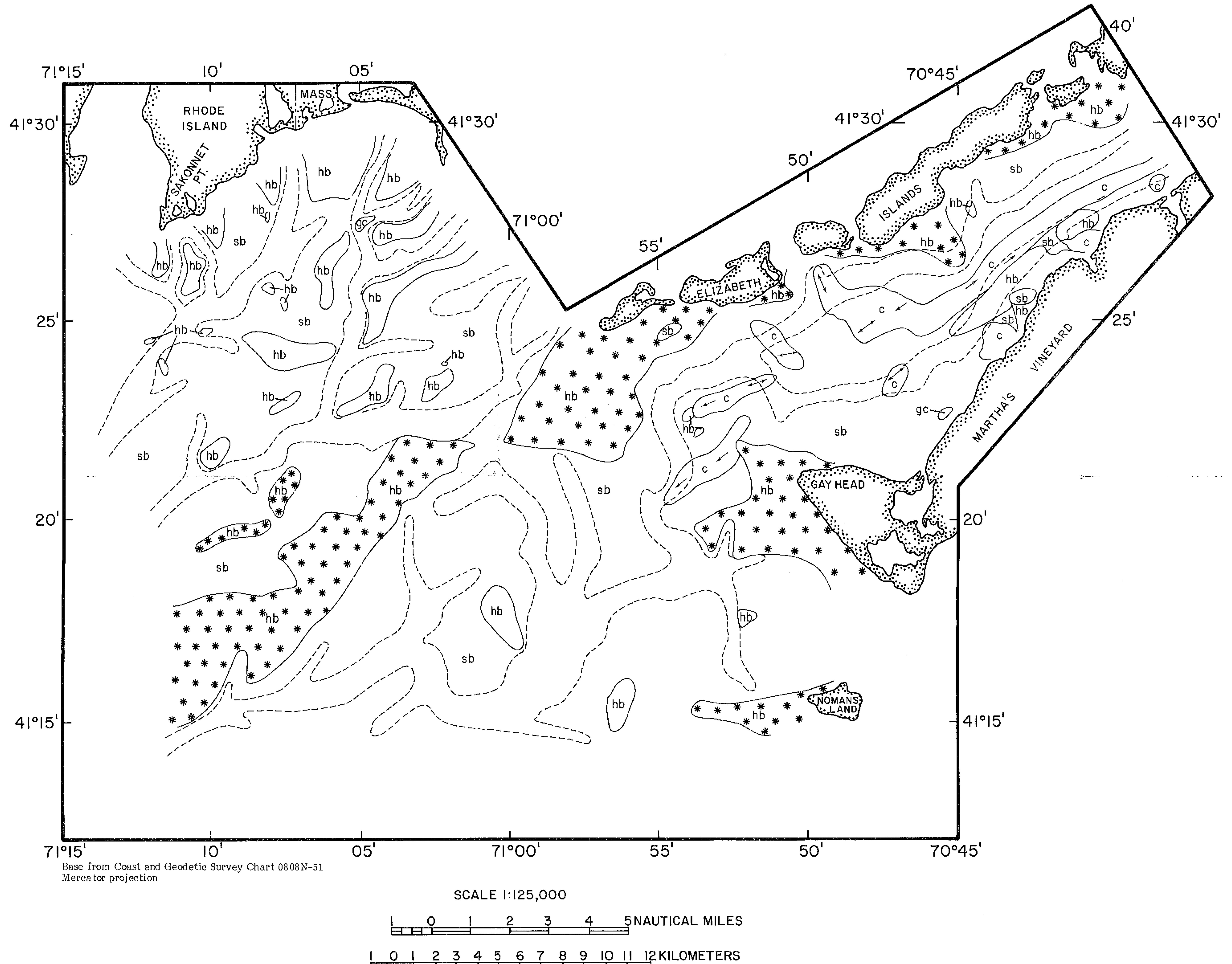


FIGURE 12 MAP SHOWING POTENTIAL GEOLOGIC HAZARDS

E X P L A N A T I O N

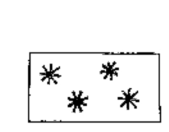
This map is intended to serve as a guide to future engineering and environmental impact studies relating to offshore mining of sand and gravel deposits, offshore disposal of solid waste and harbor dredge-spoil materials, and possible oil and gas pipeline construction beneath the seabed.

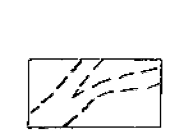
Inferences regarding potential geologic hazards are based on the morphology of the sea floor, on the lithology and internal structure of the shallow (upper 10m) subbottom sediments, and on the geology and geological development of the region deduced from the seismic-reflection, side-scan sonar, and vibracore data. More detailed information on the nature, distribution and thickness of the unconsolidated sediments and the structural configuration of the major seismic horizons that occur on this part of the shelf can be found in figures 4 through 9.

hb — Irregular sea floor with hummocky relief. Surficial sediments are mostly sand and gravel and, locally, till. Bedrock is exposed or thinly covered off Sakonnet Point, R. I. (figs. 4 and 10). These areas, thought to be presently undergoing erosion by wave action and bottom currents especially during major coastal storms, are considered unsuitable as containment sites for disposal of solid waste and dredge-spoil materials.

sb — Smooth sea floor of little or no relief. Predominantly sand in shallower water and silt and clay in deeper water. These areas are thought to be undergoing mostly deposition. Areas in deeper water (southern part of eastern Rhode Island Sound) are most likely suitable as containment sites for disposal of solid waste and dredge-spoil materials.

gc — Acoustically turbid, gas-charged sediments. Deposits are highly organic muds saturated with gases probably of biogenic origin. These areas may not be suitable for emplacement of any type of sea-floor structures because of the presence of interstitial gas and resultant sediment instability.

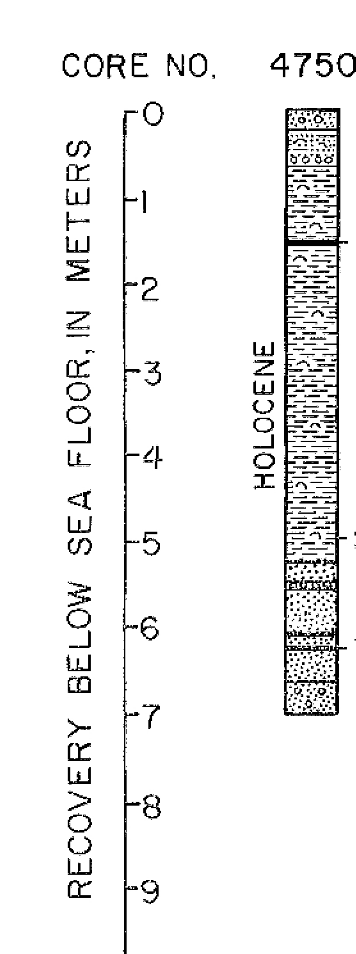

Presence of boulders on the sea floor. Boulders could hamper dredging of sand and gravel resources and may preclude emplacement of any sea-floor structures or buried pipelines.


Extent of major buried channel deposits. Deposits occur in the shallow subsurface of the shelf and consist of sand, gravel, and fine-grained mud. In some places, thick deposits of fresh and salt marsh peats may occur. Texture is highly variable. The fine-grained sediments and peats may be poorly compacted, and some settling could occur under the weight of any sea-floor structure.

c — Areas of intense bottom sediment movement as shown by the presence of large sand waves and megaripples. Bedforms are thought presently to be actively migrating in response to strong tidal-driven bottom currents. These areas are considered unsuitable as containment sites for disposal of solid waste and fine-grained dredge-spoil materials, but may be acceptable for clean sand spoil. Also, these areas are thought to be unacceptable for emplacement of buried pipelines. Bedform migration over a period of time could result in exposure of sections of pipe on the sea floor.

Location of observed asymmetrical sand waves, showing apparent direction of net bottom current flow.

Location of observed symmetrical sand waves (oscillatory bottom currents).



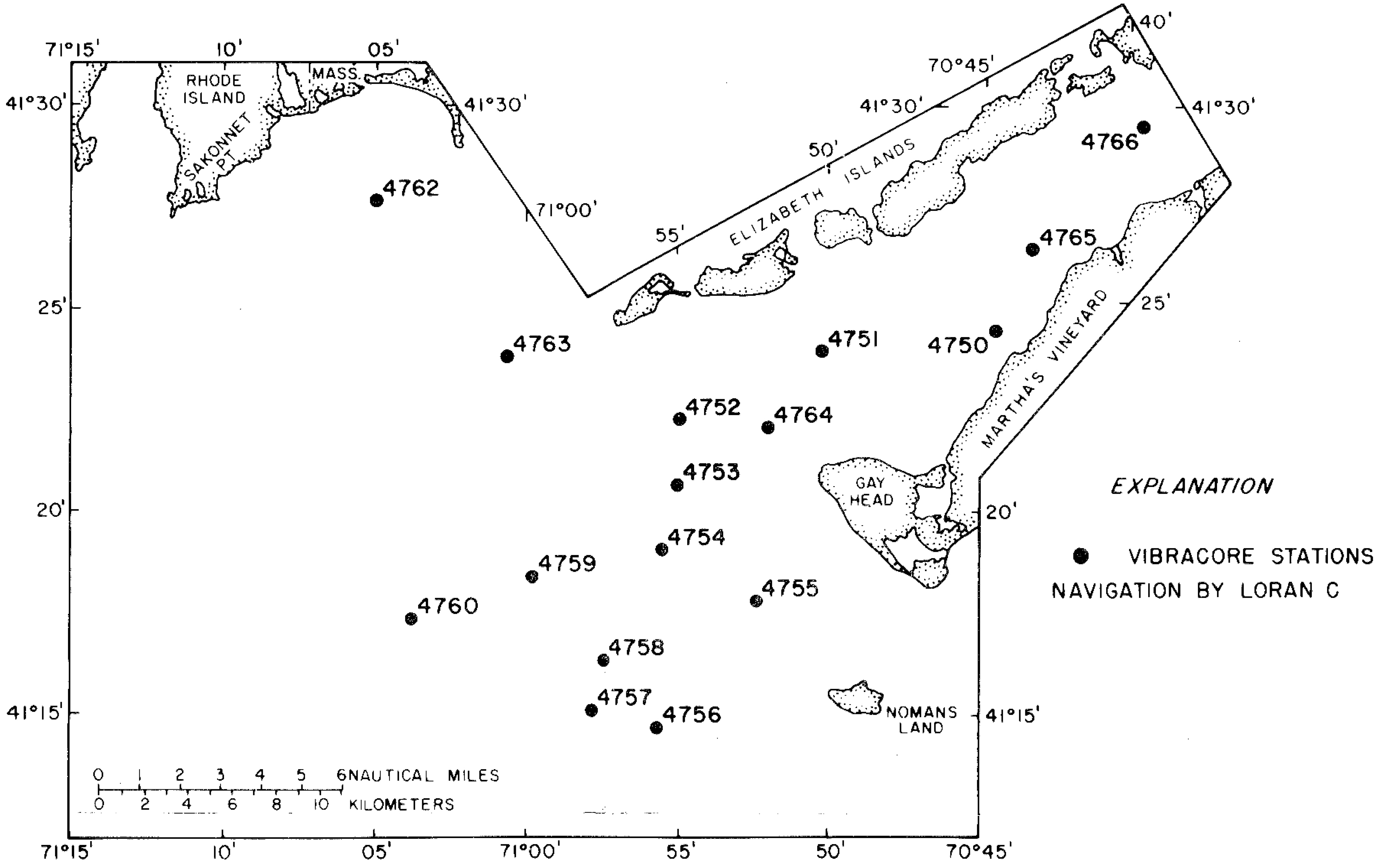


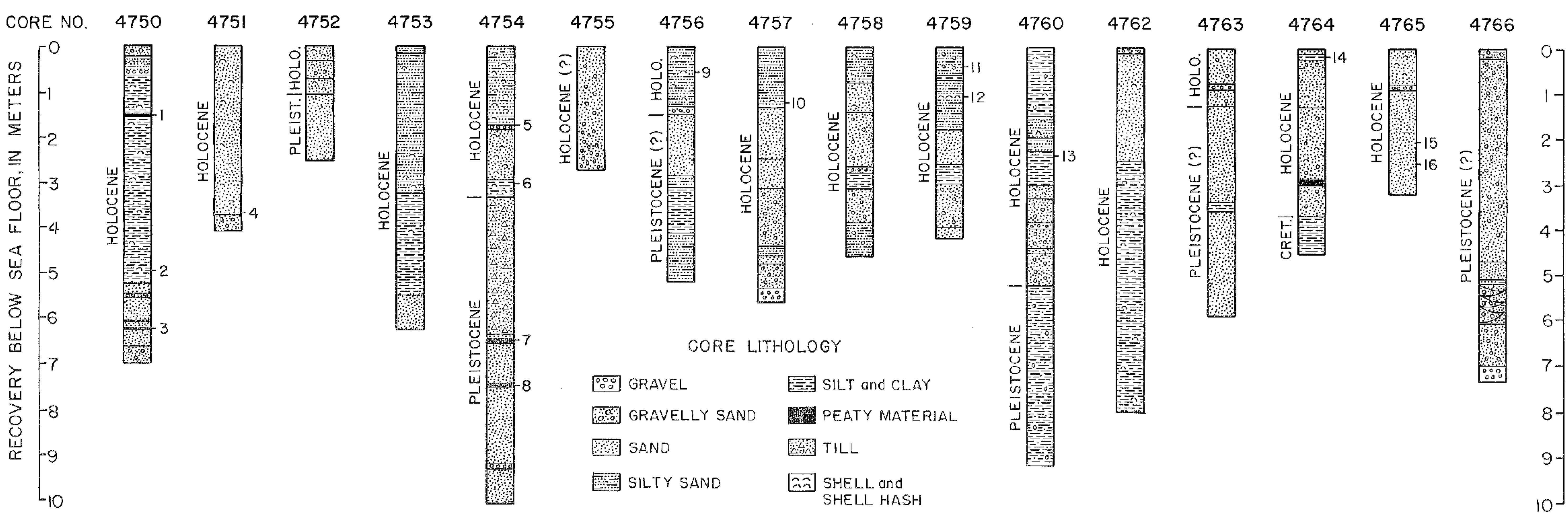
FIGURE 13 MAP SHOWING LOCATION OF VIBRACORES

Sample number	Core number	Sample depth below sea level (meters)	Sample description	Laboratory number	Age (years B.P.)
1	4750	23.4	Peat	W-3788	13,500 ± 1000*
2	4750	27.0	Shells	W-3786	8,620 ± 250*
3	4750	30.0	Peat	W-3716	13,300 ± 300*
4	4751	19.5	Shells	W-3789	7,570 ± 250*
5	4754	33.7	Shells	W-3766	5,150 ± 200*
6	4754	35.1	Shells	W-3764	9,710 ± 300*
7	4754	38.5	Peat***	W-3720	>35,000*
8	4754	39.5	Peat***	W-3713	>35,000*
9	4756	31.5	Shells	W-3782	1,340 ± 200*
10	4757	39.3	Shells	W-3778	10,000 ± 1500
11	4759	32.4	Shells	W-3764	9,470 ± 500*
12	4759	33.1	Shells	W-3763	9,740 ± 250*
13	4760	39.2	Shells	W-3777	9,300 ± 350*
14	4764	26.1	Shells	W-3787	4,470 ± 500*
15	4765	14.0	Shells	I-9945	3,560 ± 95**
16	4765	14.5	Shells	I-9944	3,710 ± 80**

*Radiocarbon (^{14}C) dates are by U.S. Geological Survey, Reston, Va., and are based on the Libby half-life of 5570 years and referenced to the year A.D. 1950.

**Radiocarbon (^{14}C) dates are by Teledyne Isotopes, Westwood, N.J., and are based on a Libby half-life of 5568 years and referenced to the year A.D. 1950.

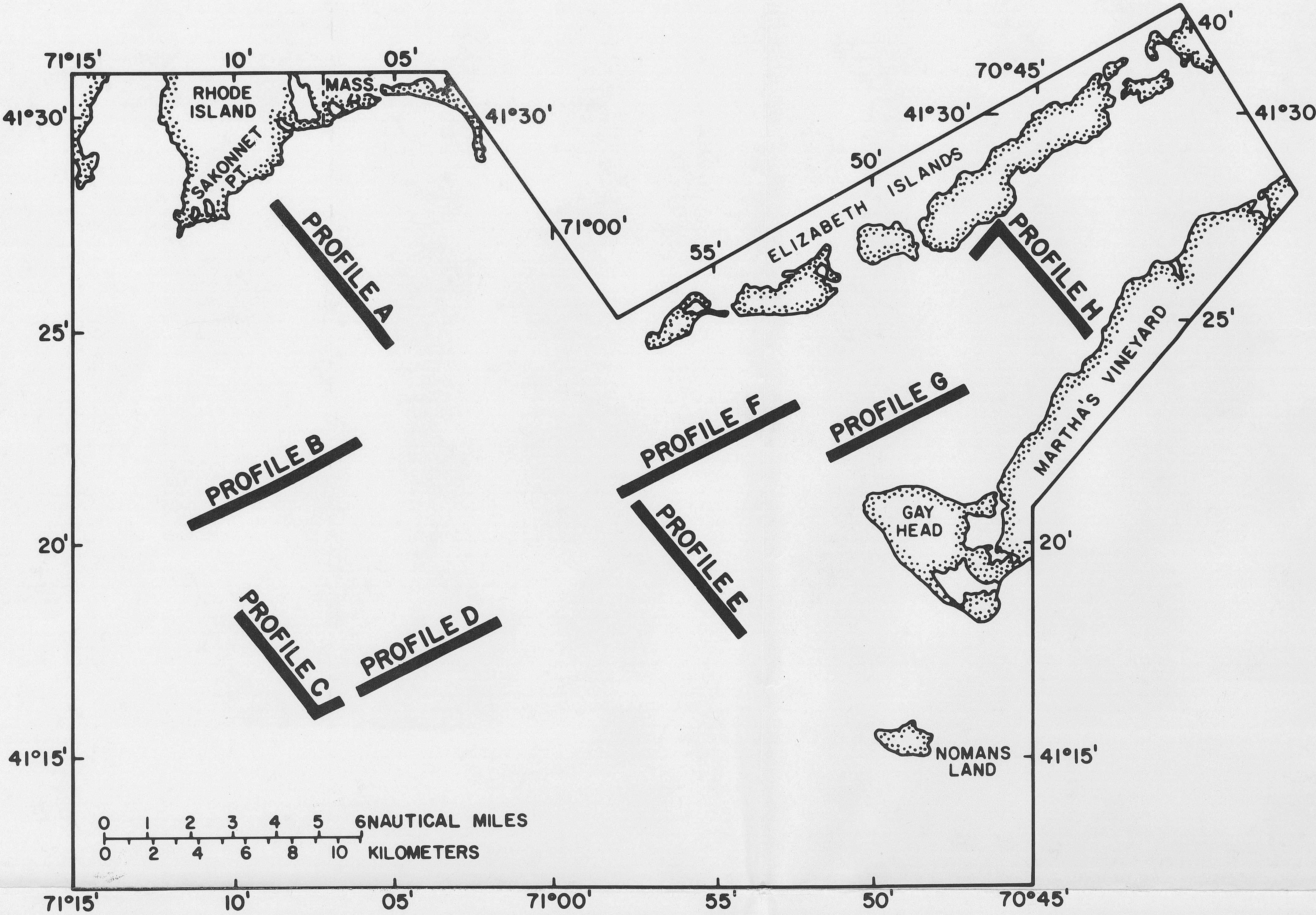
***Samples were cored in glacial drift deposits. Palynological age determinations suggest that they are lignites of Late Cretaceous age (Ray Christopher, USGS, written commun., 1977).



Lithologic descriptions are based on megascopic examination of split sections of cores. Sediments shown at the top of some of the cores may not be representative of the surficial bottom sediments that occur at the core sites because some material may have washed out during coring and retrieval.

Inferred ages are based on lithology, radiocarbon dates, megafossils, palynology, and stratigraphic position indicated by the seismic-reflection data. Numbers along side of columns indicate location of radiocarbon dated samples (see table).

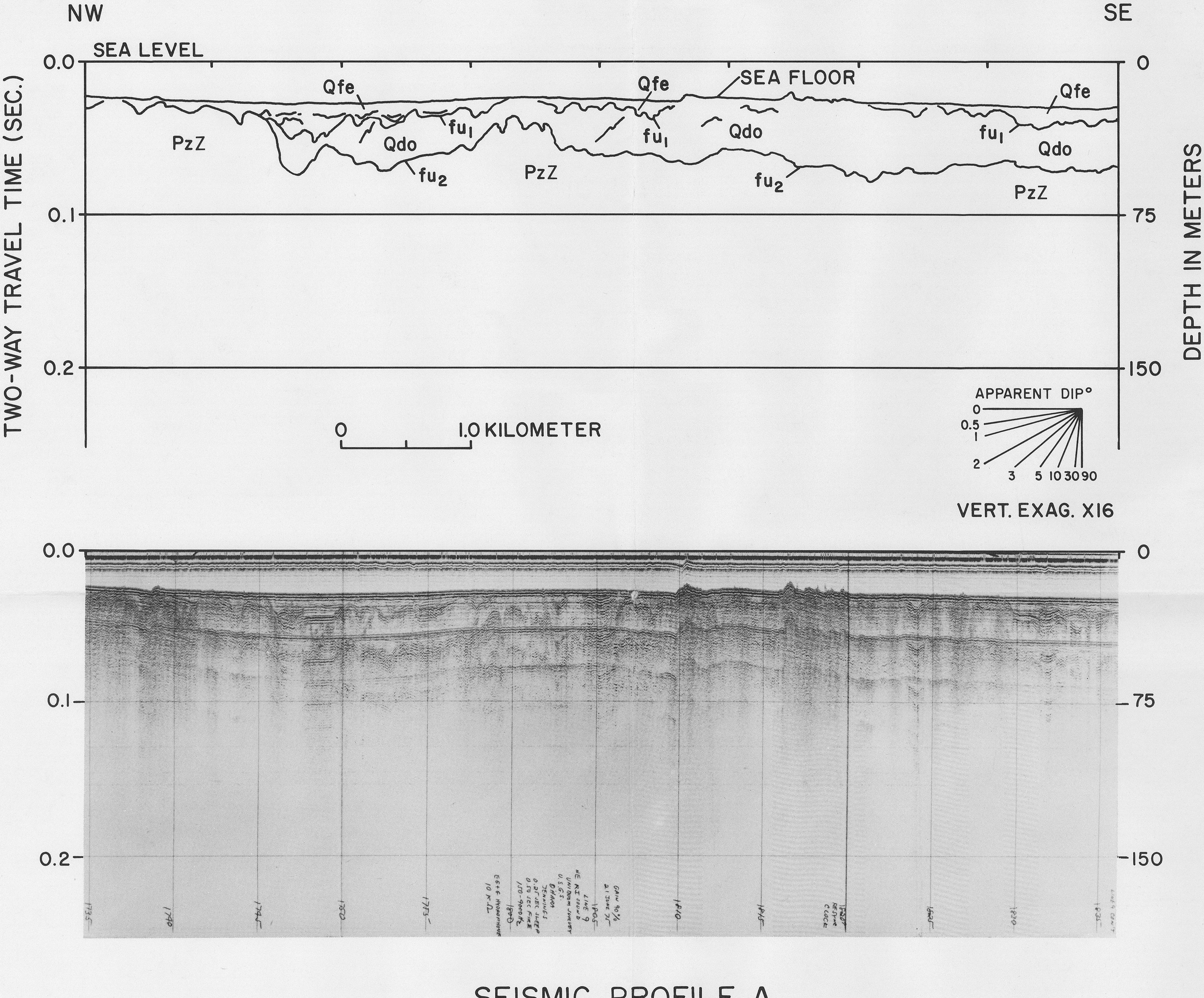
FIGURE 14 LITHOLOGIC AND STRATIGRAPHIC COLUMNS OF VIBRACORES, INCLUDING TABLE SHOWING RADIOCARBON AGE DETERMINATIONS



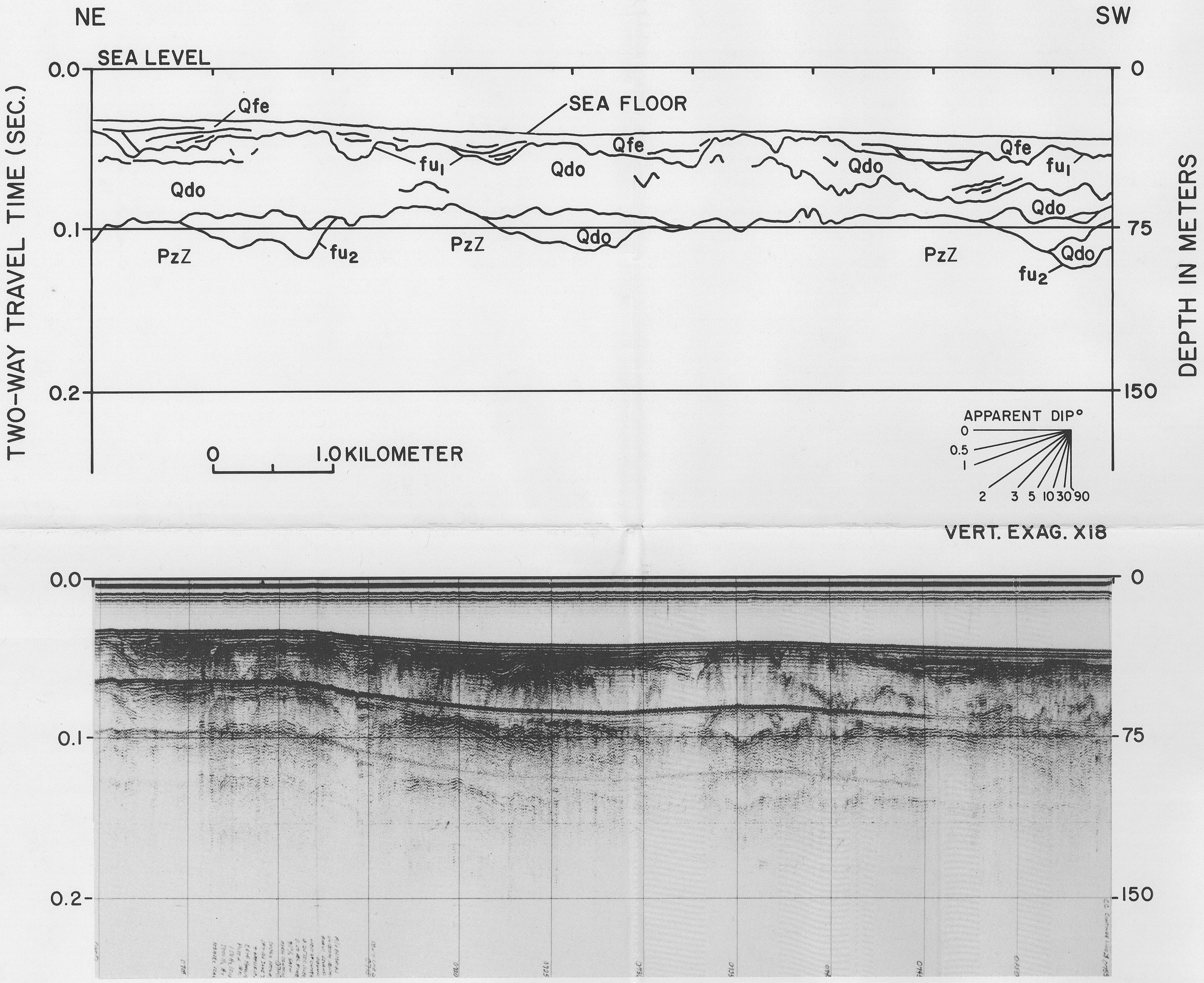
LOCATION MAP

KEY TO ACOUSTIC UNITS AND MAJOR UNCONFORMITIES

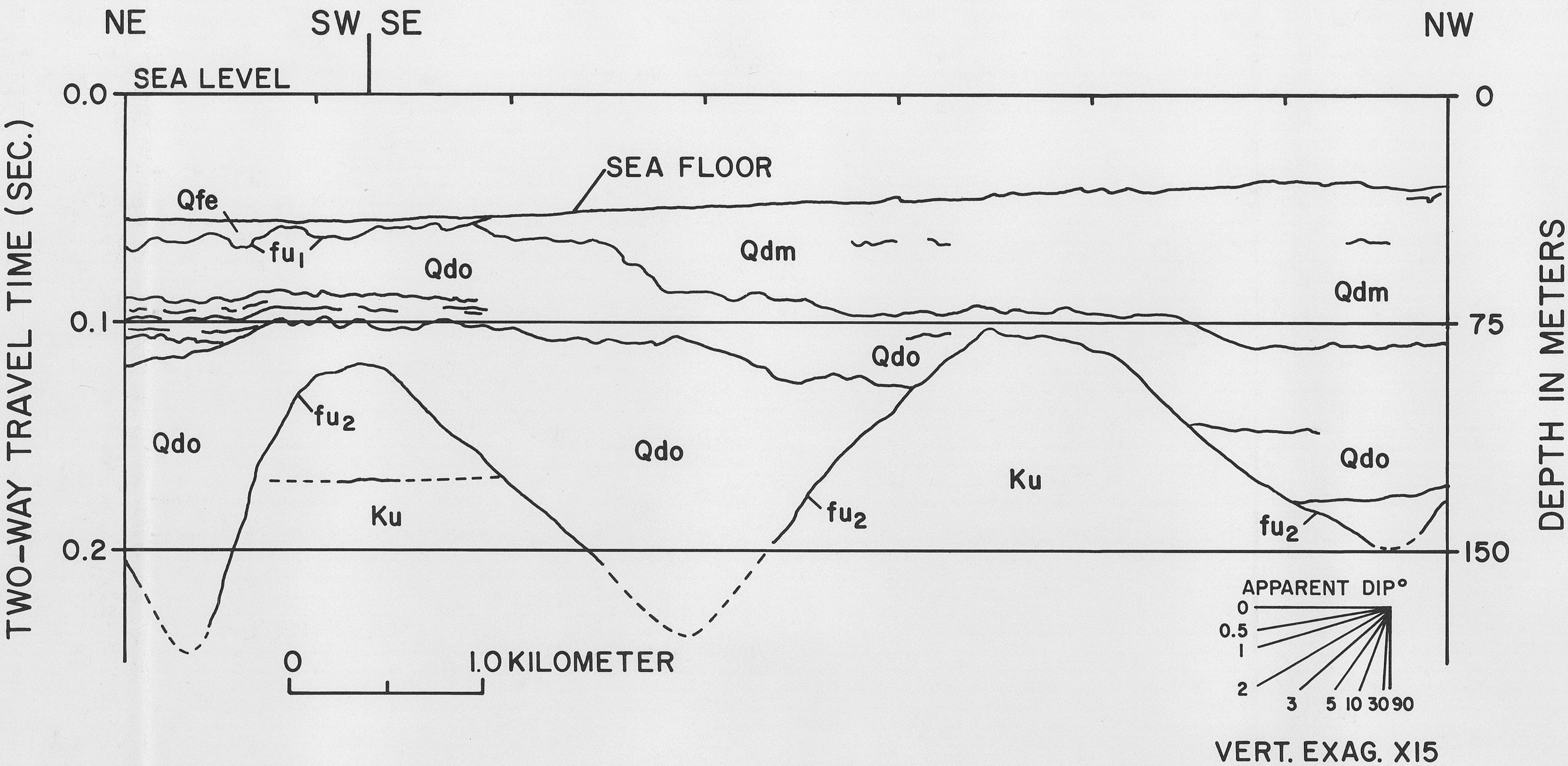
Qm	Quiet-water marine deposits	Qdo	Glacial drift deposits
Qb	Marine beach and bar deposits	Qdm	Buzzards Bay moraine deposits
mu	Marine unconformity	fu_2	Late Tertiary-early Pleistocene fluvial unconformity
Qfe	Fluvial and estuarine deposits	Ku	Coastal plain deposits
fu_1	Postglacial fluvial unconformity	PzZ	Bedrock

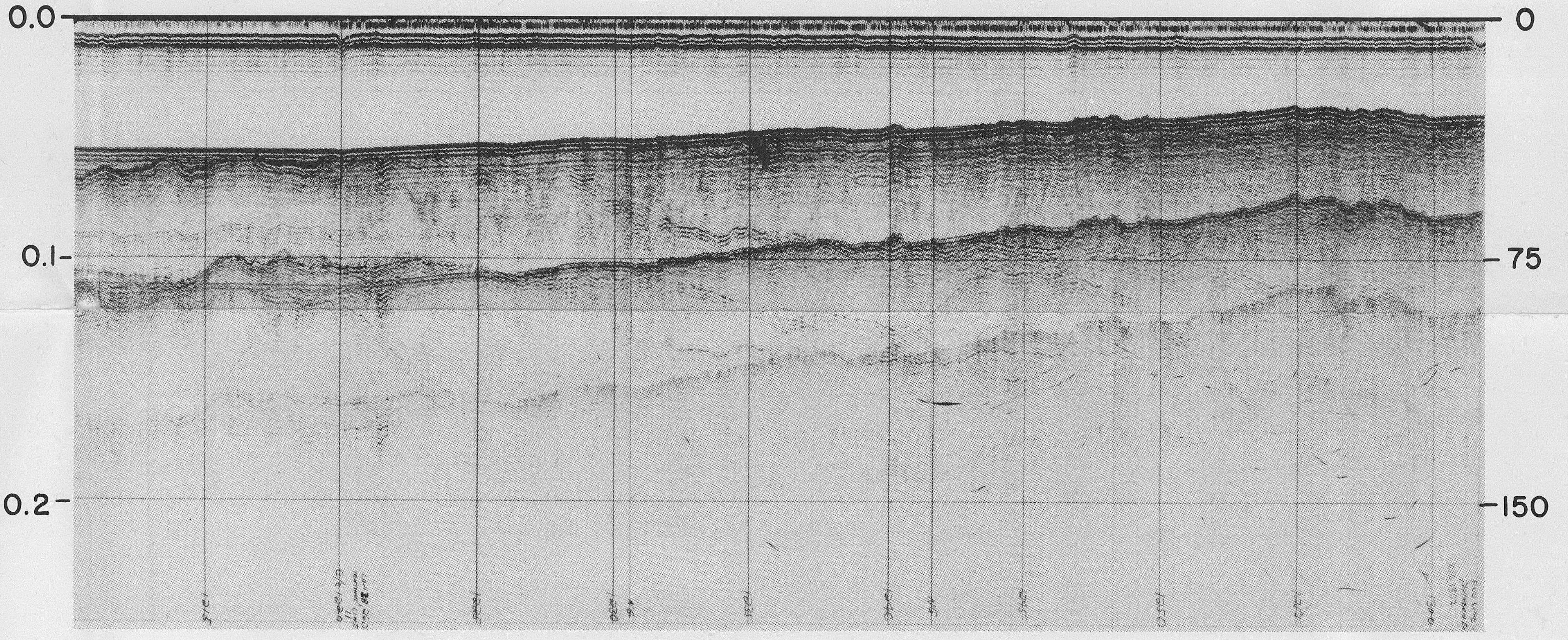


SEISMIC PROFILE A

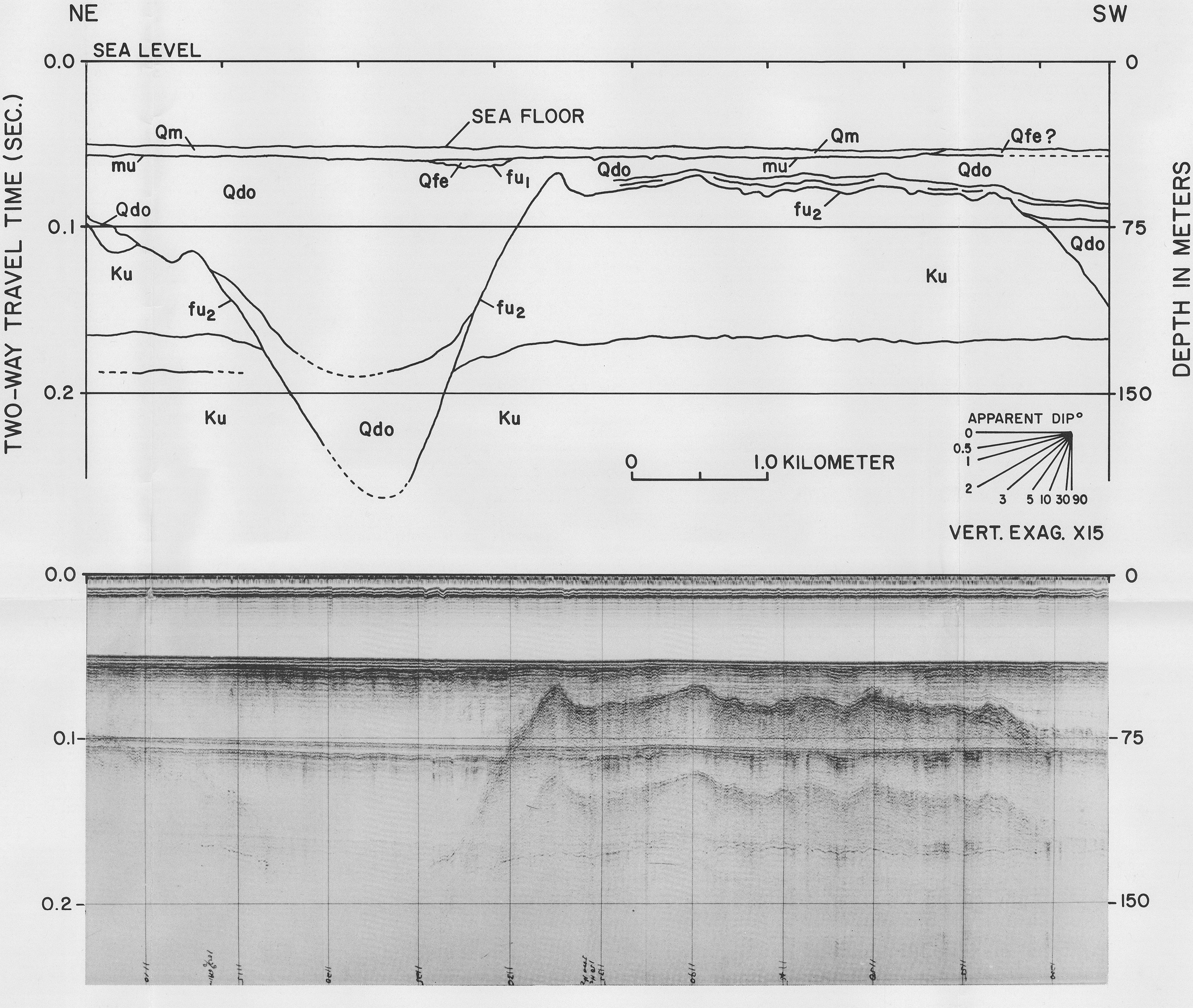


SEISMIC PROFILE B

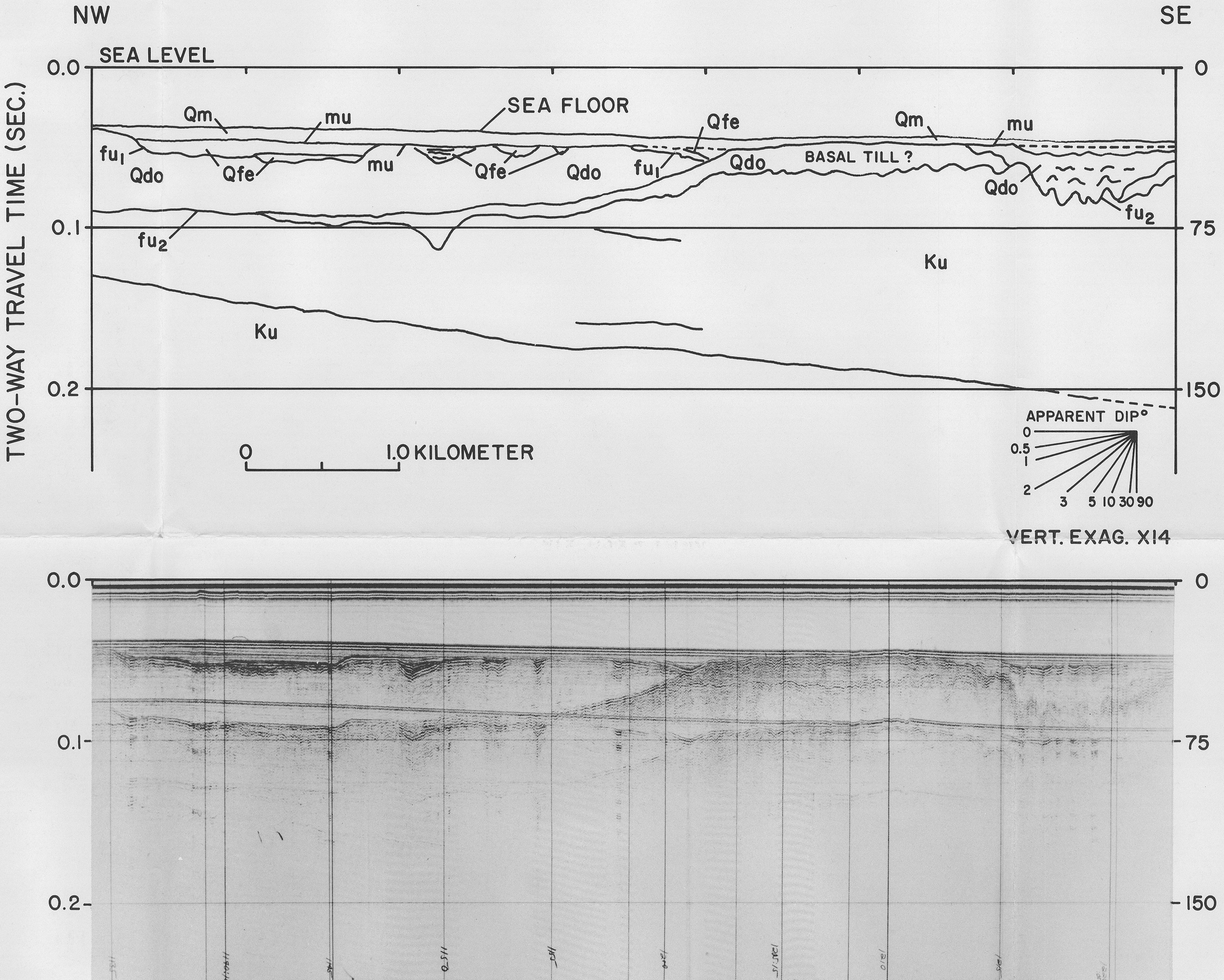




SEISMIC PROFILE C



SEISMIC PROFILE D

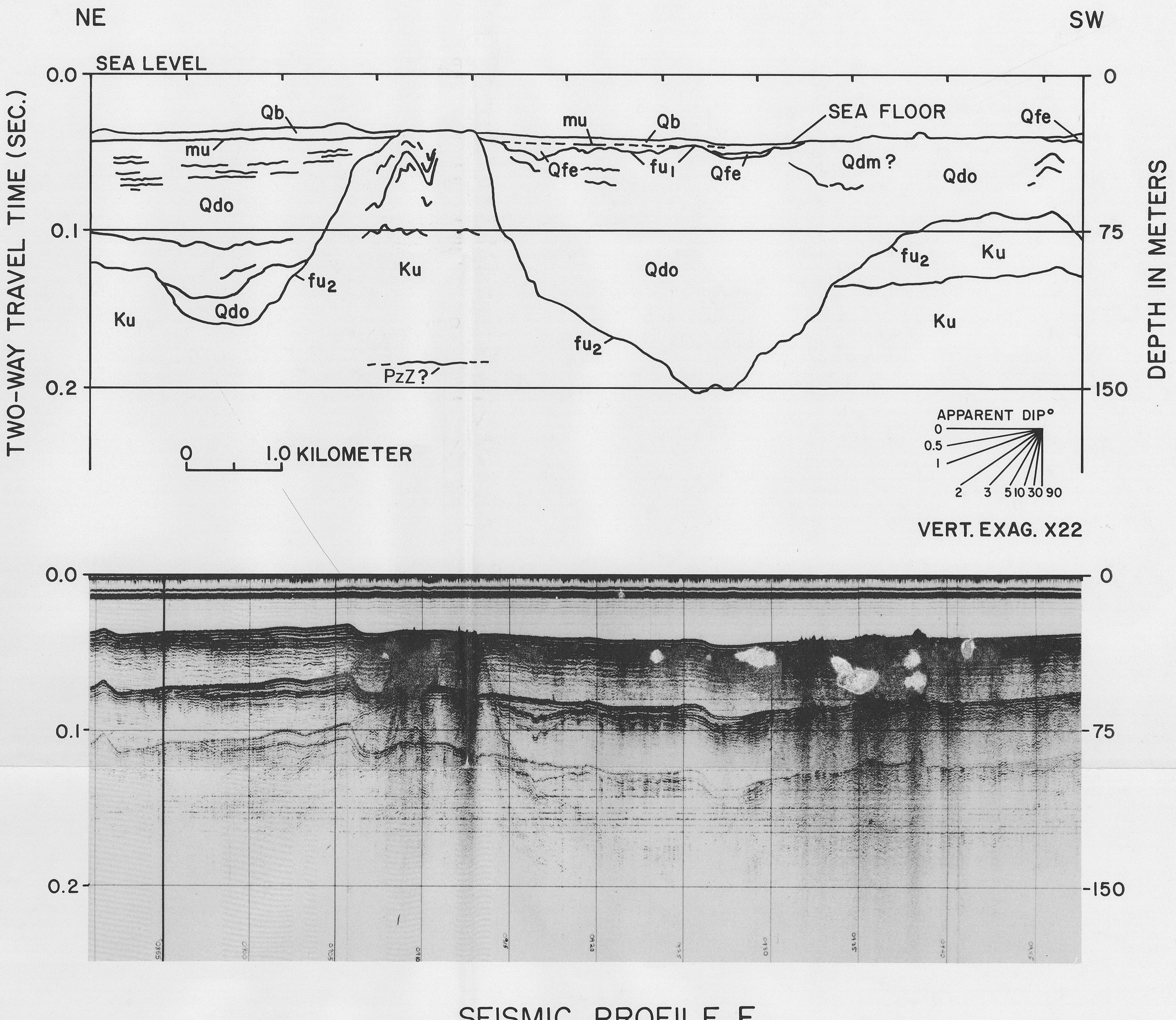


SEISMIC PROFILE E

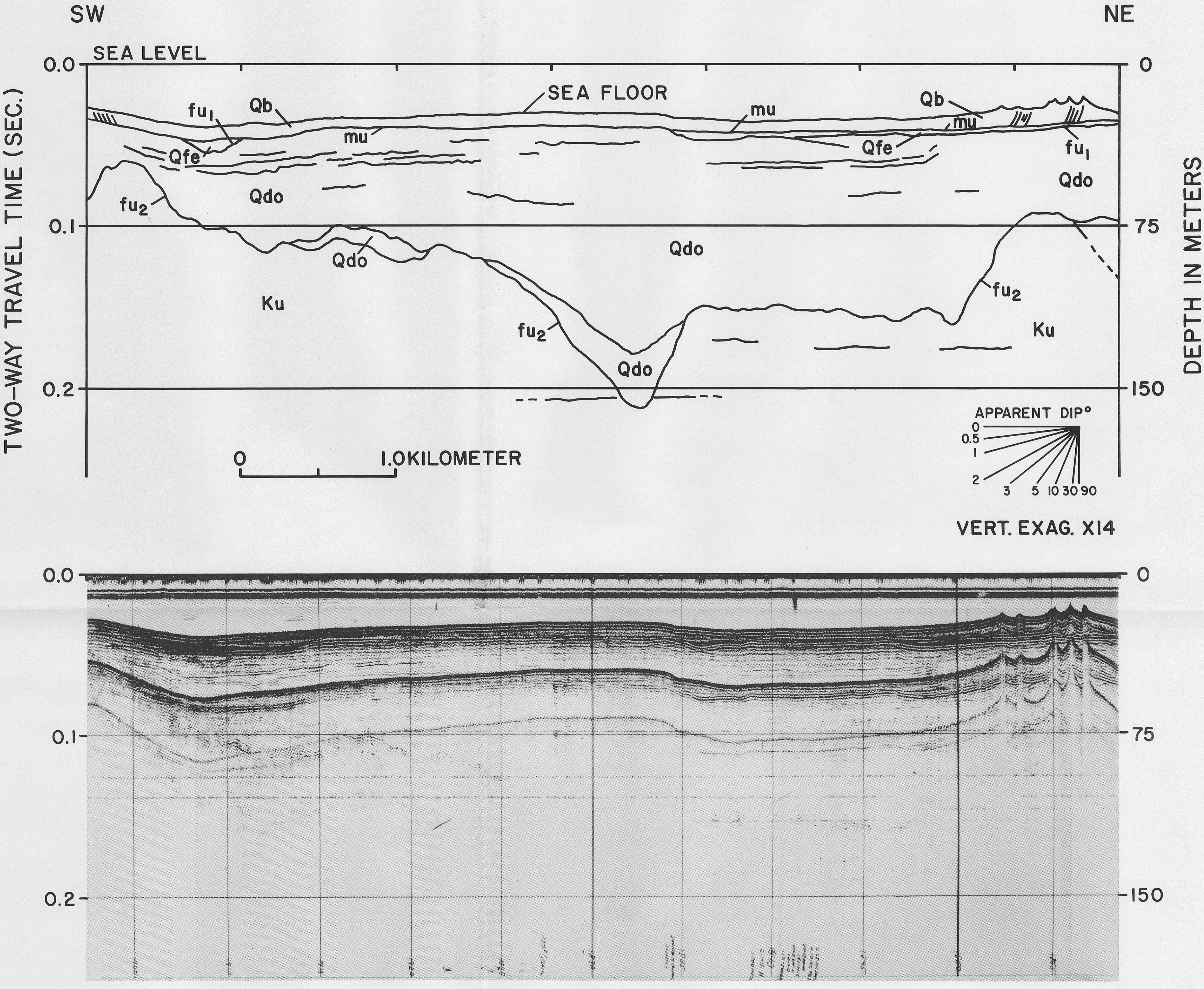
Horizontal scal

Vertical scales

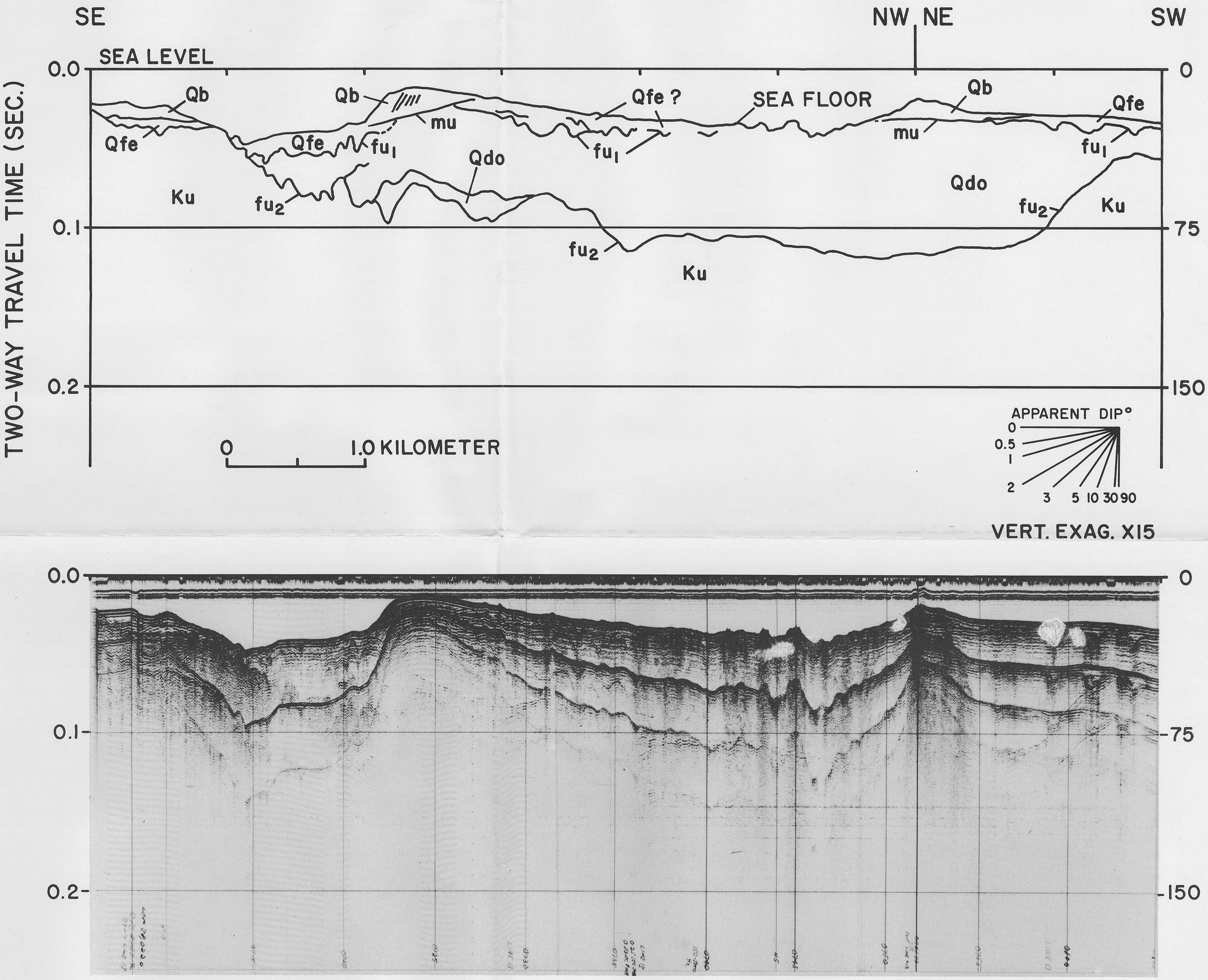
Reflectors are c



SEISMIC PROFILE F

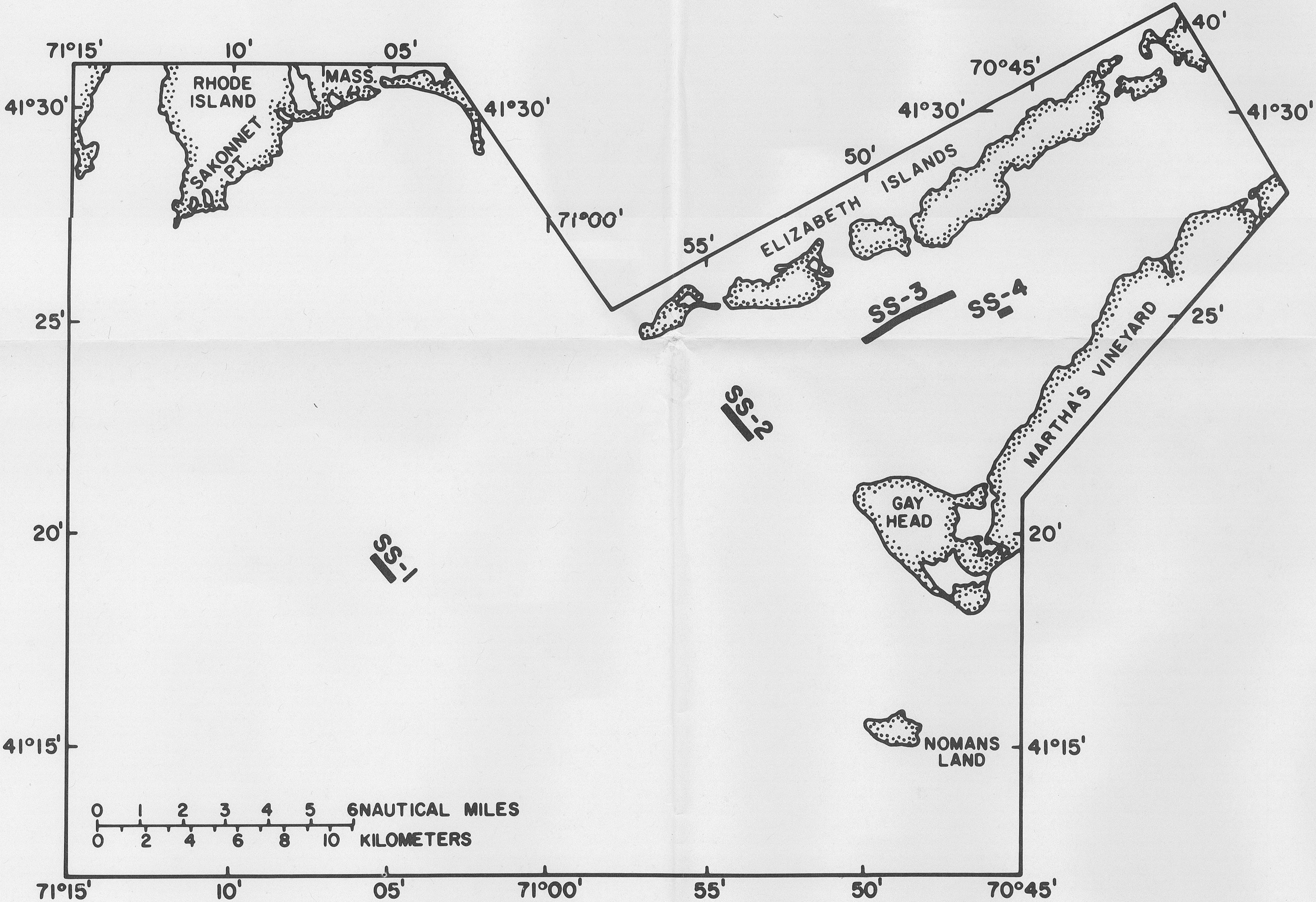


SEISMIC PROFILE G

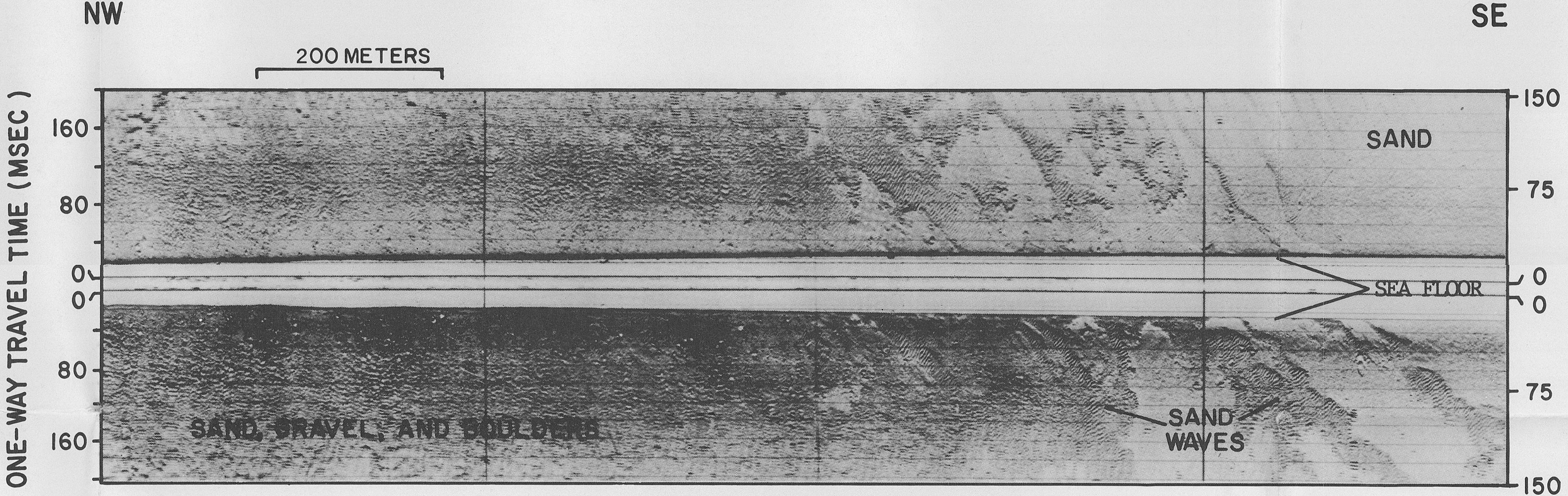


approximate.
ased on 1500 m/s.
where extrapolated

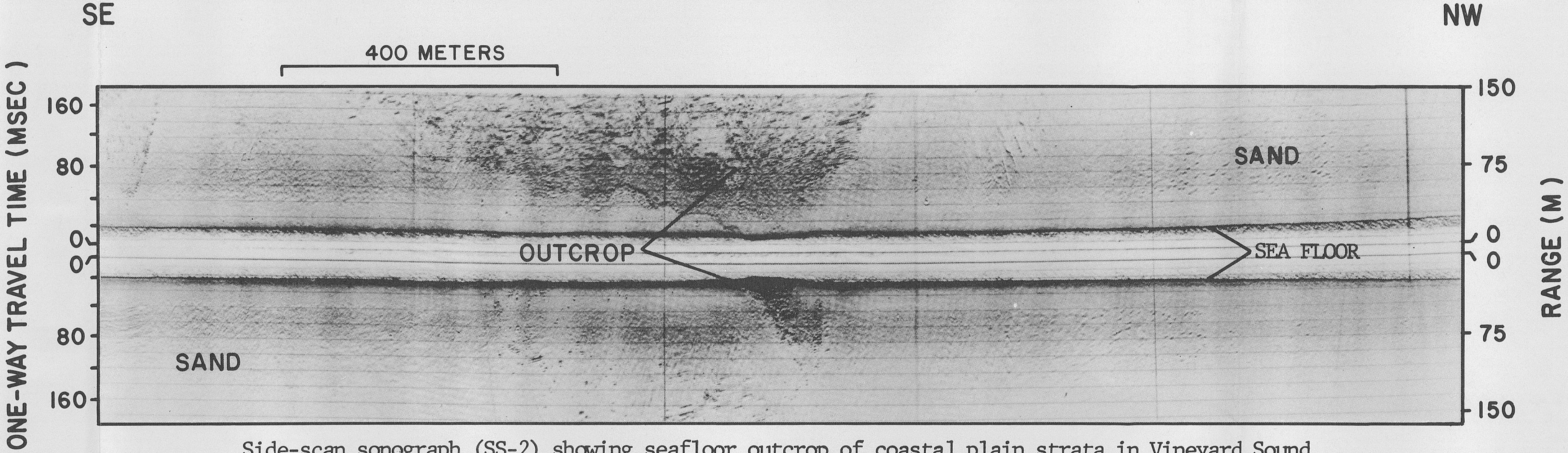
SEISMIC PROFILE H



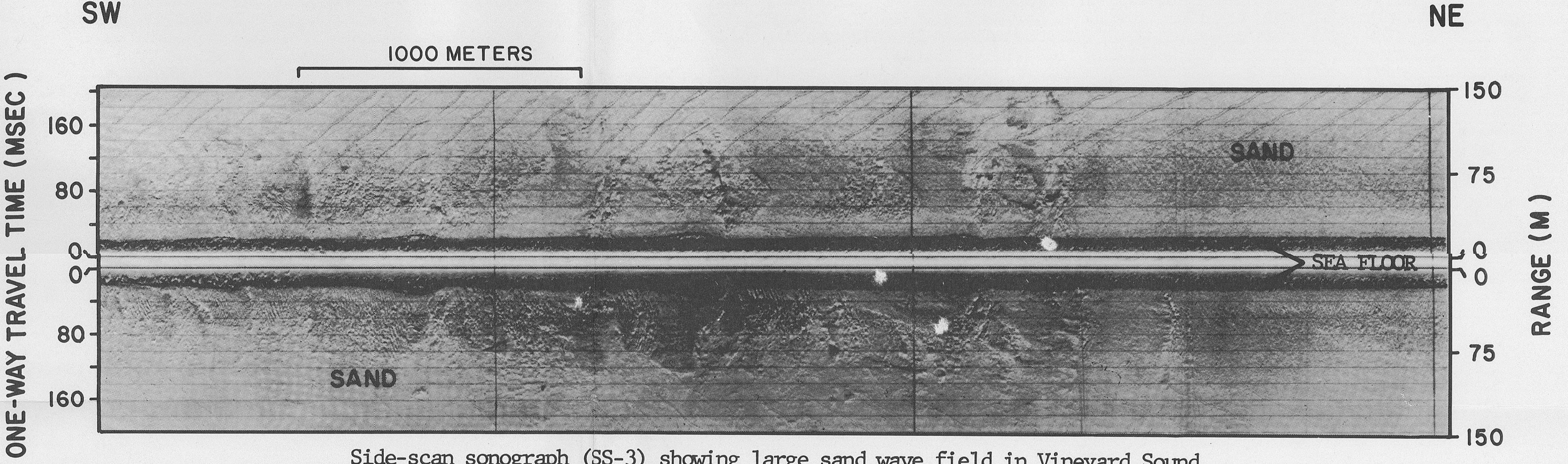
LOCATION MAP



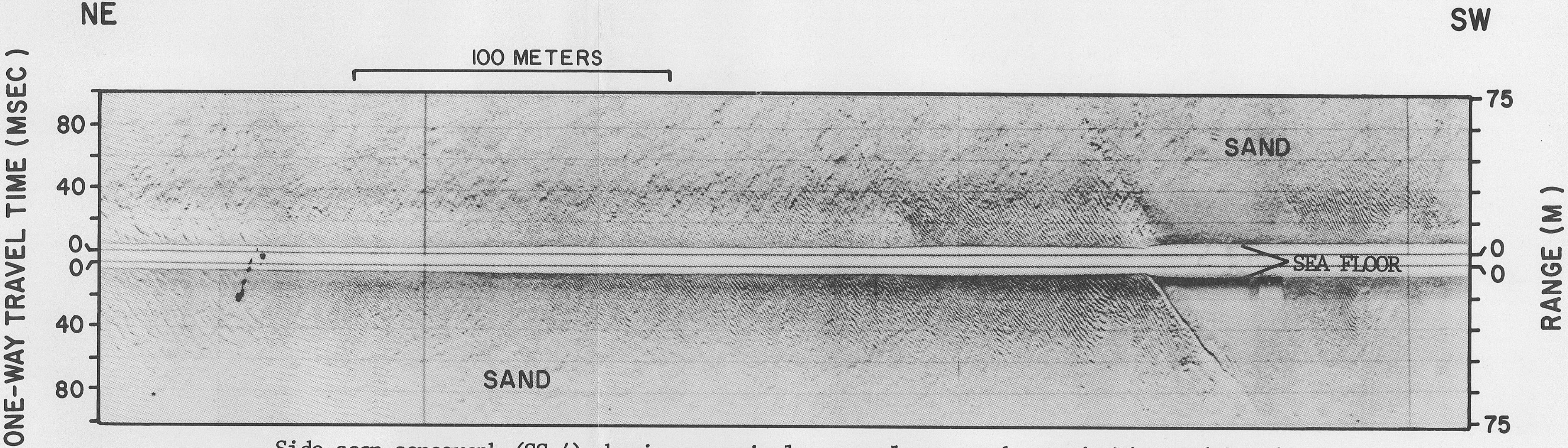
Side-scan sonograph (SS-1) showing sand and gravel, large boulders, and sand waves atop the Buzzards Bay morainal ridge in eastern Rhode Island Sound.



Side-scan sonograph (SS-2) showing seafloor outcrop of coastal plain strata in Vineyard Sound.



Side-scan sonograph (SS-3) showing large sand wave field in Vineyard Sound.



Side-scan sonograph (SS-4) showing megaripples atop large sand wave in Vineyard Sound.