DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

MISCELLANEOUS FIELD STUDIES
MAP MF-1397
SHEET 1 OF 2

DISCUSSION

The pre-Sangamonian and Wisconsinan glacial drift units and Sangamonian marine beds exposed in the Sankaty Head cliff (fig. 1) constitute a unique and important upper Pleistocene stratigraphic section in southern New England. Many workers have studied the section over the past 130 years, paying most attention to the fossiliferous Sankaty Sand. The earliest study was by Desor and Cabot (1849) followed by Verrill (1875), Cushman (1904), Wilson (1906), and Gustavson (1976). Currently the section at the cliff is well exposed as a result of erosion during a severe winter storm in 1978. The exposure allowed a detailed study of the section, and the results of the study are included in this report and three others (Oldale and others, 1981; Oldale, 1981; and Oldale and others, in press). The last report discusses the stratigraphy, structure, absolute age, and paleontology of the deposits at Sankaty Head. The southern part of the Sankaty Head cliff, where the most complete marine section is, has been stable and obscured by dense vegetation over many of the past 130 years. In the future, the cliff face could again become stabilized and overgrown, or continued erosion could destroy some of the beds now exposed. These photographs provide a record of how the cliff face, beds, and structures looked in 1979. Finally, the Sankaty Head section is relatively remote, and these photographs together with a geologic profile of the cliff shown by Oldale and others (1981) may substitute for field trips to the site, albeit a somewhat less satisfying experience.

Overlapping photographs of the Sankaty Head cliff from a point about 480 ft south of Sankaty Head light to the southern end of the exposure, about 1,340 ft south of the light, are shown in figure 18. Station numbers are the same as those used by Oldale and others (1981); they indicate distance, in feet, south of the south fence at Sankaty Head light, the only landmark visible from the beach (fig. 1). Most station numbers on the photographs are also locations of measured sections used to construct the geologic profile in Oldale and others (1981). Letter symbols identifying geologic units on the photographs are the same as those in the geologic profile in Oldale and others (1981), except the prefix "Q" has been dropped. A new symbol (ld) identifies undifferentiated older drift in some photographs. The photographs in figure 18 were taken from the beach by using a wide-angle (28-mm) lens, and they have considerable horizontal and vertical distortion, making them unsuitable for construction of a single panoramic view. Figures 2-17 are close-up photographs of beds and structures in the cliff face. Station number and elevation above the base of the cliff, a datum that probably approximates mean high tide, are given in the captions of figures 2-17 so that the reader can locate the site of the photograph on the geologic profile by Oldale and others (1981). Scales most often used include a sheath knife (handle about 10 cm long), trowel (handle about 11 cm long), and trenching shovel (handle about 45 cm long).

The lower drift section of pre-Sangamonian age is divided roughly in half by a massive stone-poor till (t) that appears oxidized near the top (to) (fig. 18H-J). North of the exposure of till (lower in the section) the drift is mostly stratified gravelly sand and silt (fig. 18M-P). A flowtill (ft, figs. 2, 18M-P) occurs within the gravelly sand in one place. South of the massive till exposure (higher in the section) the drift consists of deformed sand, silt, and till (st, figs. 18B, F-H), and a foreset-bedded gravelly sand (fs, figs. 18B, D-G), that interfingers with an obscurely bedded to thinly laminated, possibly varved clay and silt (lc, figs. 3, 18D).

A well-sorted ferruginous pebble gravel (mg, figs. 4, 18B) unconformably overlies the lower drift and marks the base of the lower marine unit of Sangamonian age (Oldale, 1981; Oldale and others, in press). The gravel is conformably overlain by a sequence of conformable beds including, from bottom to top, a crossbedded and planar-bedded sand (ms, figs. 5, 18B); a bioturbated sand (bt, figs. 8, 18A-C) that interfingers northward with a red sandy clay (re, figs. 5, 6, 18C-D) that in turn interfingers with a foreset-bedded sand and gravel (md, figs. 7, 18D); and the lower part of the Sankaty Sand, including a bed dominated by the oyster *Crassostrea virginica* and the hard-shell clam *Mercenaria mercenaria* (sl, figs. 8, 18A-C), and the serpulid bed (wt, figs. 9, 18A-C). The lower marine unit is unconformably overlain by the upper marine unit of Sangamonian age (Oldale, 1981; Oldale and others, in press), which includes the upper part of the Sankaty Sand (su, figs. 10, 18), containing abundant molluscan fossils including *Mercenaria campechiensis* and forming a marker bed traceable across most of the Sankaty Head cliff, and a fossiliferous sand (cf, figs. 11, 18C-D) that fills a minor channel cutting out the Sankaty Sand between stations 9+68 and 10+08. In many places the upper marine unit is involuted (fig. 12), and an unconformity, distinguished by a horizon of wind-polished stones (vu, figs. 13, 18) everywhere overlies it. The ventifact unconformity is overlain by a deposit of crossbedded and planar-bedded medium to very fine sand (s, fig. 18) as thick as 55 ft that locally shows contemporary deformation (figs. 14, 18I-J). The medium to very fine sand is the basal deposit of the upper drift of Wisconsinan Age. It is unconformably overlain by the surficial drift (sd, figs. 18H-L) composed of sand and gravel (fig. 15) and till that is discontinuous and poorly exposed.

Photographs in figure 18 clearly show the predominant southerly dip of the beds within the lower drift and marine beds. Although the medium to very fine sand deposit (s) above the ventifact unconformity appears to be nearly horizontal in the photographs, it actually dips into the cliff face and is structurally conformable with the underlying upper part of the Sankaty Sand. A minor thrust repeats the upper part of the upper marine unit, the ventifact unconformity, and the lower part of the overlying medium to very fine sand near station 9+60 (fig. 16). The normal fault (fig. 18G) cuts the lower drift, the marine beds, and the lower part of the medium to very fine sand of the upper drift. A narrow channel having nearly vertical walls cuts through the medium to very fine sand, Sankaty Sand, and into the lower drift near station 4+58. The channel is part of the unconformity atop the medium to very fine sand and is filled with sand and gravel of the surficial drift (sd). The contact along walls is sharp and there is no mixing of the channeled deposits and the surficial drift (fig. 17).

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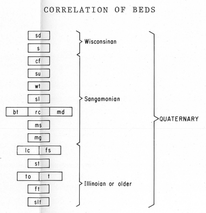
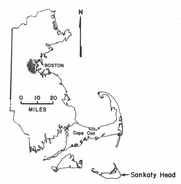
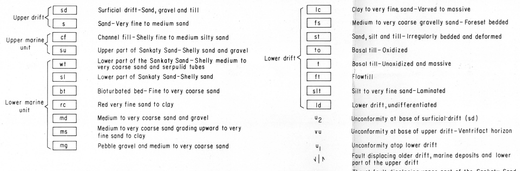
CORRELATION OF BEDS





INDEX MAP

EXPLANATION



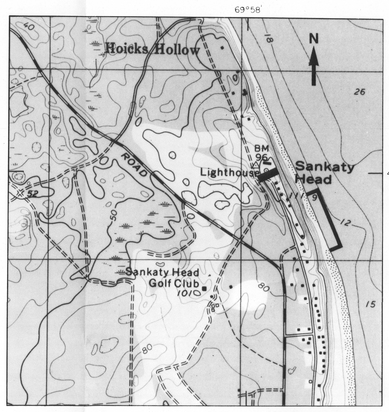


Figure 1.—A part of the Siasconset 7 ½-minute quadrangle showing the extent of the exposure at Sankaty Head (bracketed) described in this report and the location of the south fence (heavy bar) at Sankaty Head light.

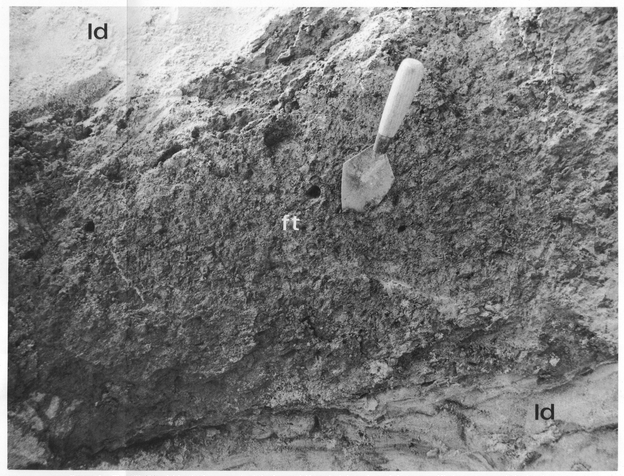


Figure 2.—Flowtill (ft) within the lower part of the lower drift underlain and overlain by stratified pebbly sand (ld). Station 5+53, elevation 41 ft.

Figure 3.—Obscurely bedded to thinly laminated, possibly varved clay to very fine sand (le) from the upper part of the lower drift. Clay interfingers with foreset-bedded pebbly sand (fs) seen in the uppermost part of the photograph. Station 9+50, elevation 4 ft.

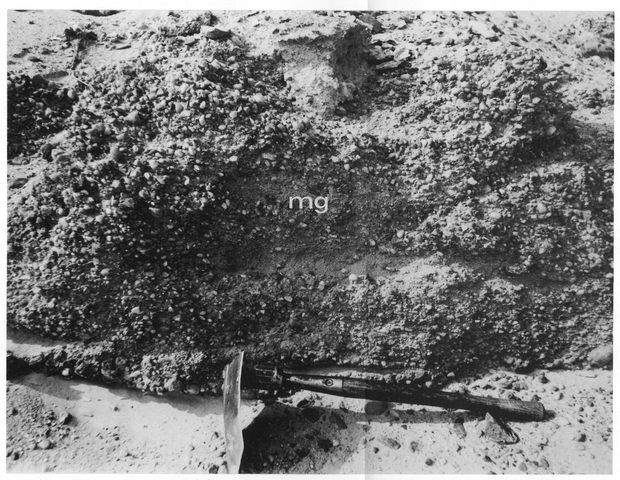


Figure 4.—Marine pebble gravel (mg) at the base of the lower marine unit. Underlain by foreset-bedded pebbly sand of the lower drift; shovel handle parallels contact. Station 10+30, elevation 10 ft.

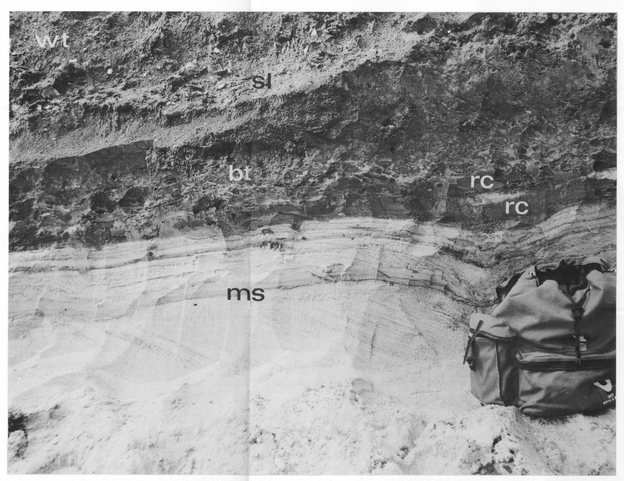


Figure 5.—Marine crossbedded and planar-bedded sand to silt (ms) overlain by bioturbated fine to very coarse sand (bt) that interfingers with red sandy clay (re) and is overlain by the shelly bed and the serpulid bed (wt) of the lower part of the Sankaty Sand (sj). Station 10+13, elevation 18 ft. Medium-size pack shows scale.

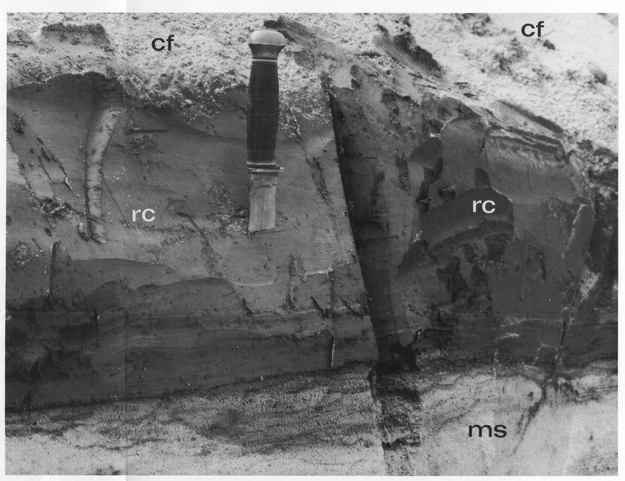


Figure 6.—Marine red sandy clay (re) underlain by the upper part of the marine sand (ms). Overlain by channel-fill deposit (cf) of the upper marine unit. Approximate station 9+90, approximate elevation 18 ft.

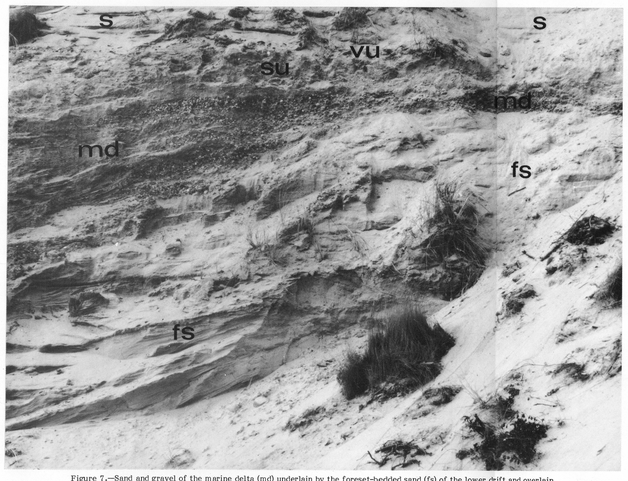


Figure 7.—Sand and gravel of the marine delta (md) underlain by the foreset-bedded sand (fs) of the lower drift and overlain by the upper part of the Sankaty Sand (su). The ventifact unconformity (vu) and silty sand (s) of the upper drift occur at top of photograph. Station 9+40, elevation 22 ft.

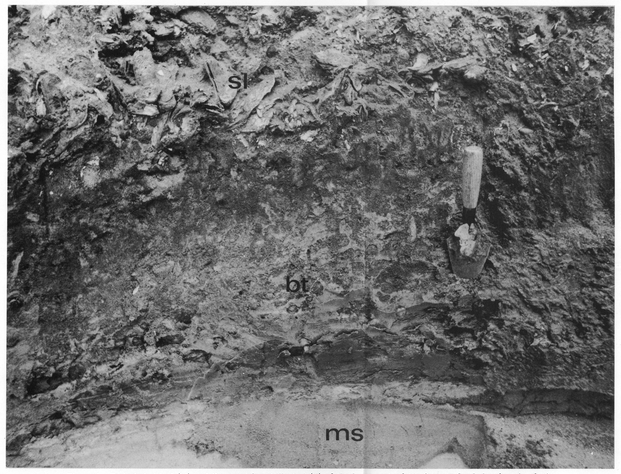


Figure 8.—Bioturbated bed (bt) and the overlying shelly bed (sl) of the lower part of the Sankaty Sand showing abundant shells of *Crassostrea virginica* with both valves articulated. Shells are mostly in growth position. Marine sand (ms) at base of photograph. Station 10+71, elevation 13 ft.

Figure 9.—Serpulid bed (wt) of the lower part of the Sankaty Sand containing scattered *Mercenaria mercenaria* shells with both valves articulated. Unconformable contact with the upper part of the Sankaty Sand (su) in upper left-hand corner of the photograph. Station 10+71, elevation 18 ft.

Figure 10.—Shelly sand and gravel of the upper part of the Sankaty Sand (su). Most of the shell fragments in the photograph are *Mercenaria campechiensis*. The bed becomes mostly sand near the top and contains finely divided fragments of *Mytilus edulis*. Station 10+71, elevation 20 ft.

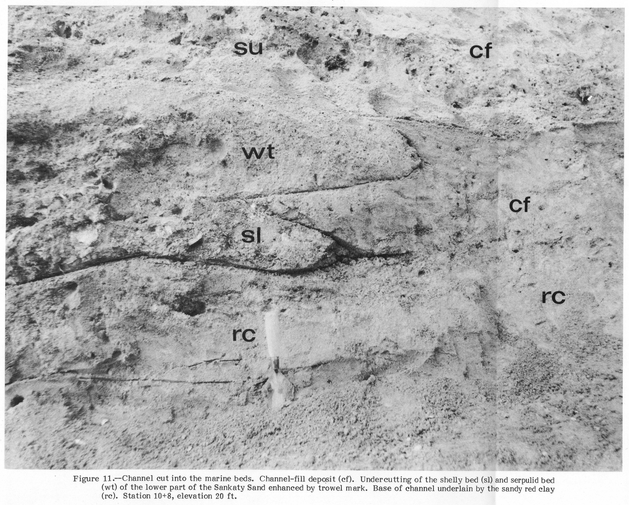


Figure 11.—Channel cut into the marine beds. Channel-fill deposit (cf). Undercutting of the shelly bed (sl) and serpulid bed (wt) of the lower part of the Sankaty Sand enhanced by trowel mark. Base of channel underlain by the sandy red clay (re). Station 10+8, elevation 20 ft.

Figure 12.—Involutions within the upper part of the Sankaty Sand (su) and the marine delta gravel (md). The ventifact unconformity (vu) cuts across the involutions and is overlain by the medium to very fine sand (s) of the upper drift. Station 8+60, elevation 33 ft.

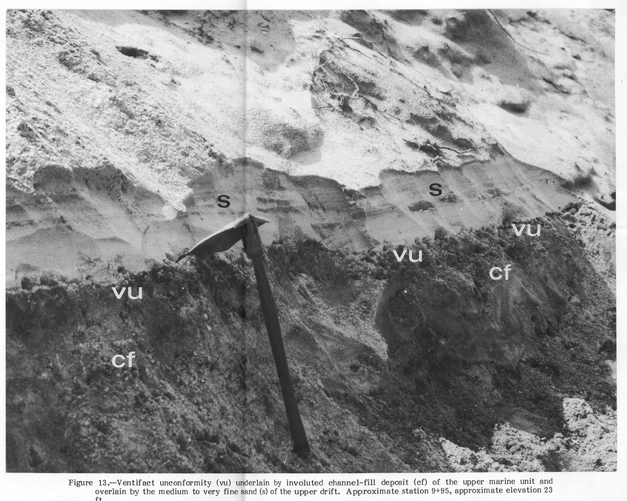


Figure 13.—Ventifact unconformity (vu) underlain by involuted channel-fill deposit (cf) of the upper marine unit and overlain by the medium to very fine sand (s) of the upper drift. Approximate station 9+95, approximate elevation 23 ft.

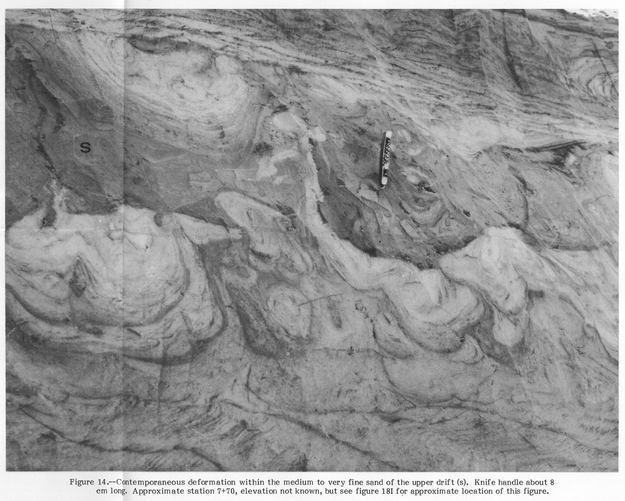


Figure 14.—Contemporaneous deformation within the medium to very fine sand of the upper drift (s). Knife handle about 8 cm long. Approximate station 7+70, elevation not known, but see figure 18I for approximate location of this figure.

PHOTOGRAPHS OF THE UPPER PLEISTOCENE SECTION AT SANKATY HEAD CLIFF, NANTUCKET ISLAND, MASSACHUSETTS

By
Robert N. Oldale

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