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**SURFICIAL GEOLOGY OF THE
SOUTHWEST HARBOR, MAINE 7.5' QUADRANGLE**

**A PROGRESS REPORT SUBMITTED TO THE
MAINE GEOLOGICAL SURVEY**

by

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Setting

The Southwest Harbor, Maine Quadrangle is located on a 7.5' sheet having 44° 15' latitude and 68°22'30" longitude at its southwest corner. It lies at the southeast quarter of the Mount Desert 15' quadrangle and is located in Hancock County. All of the area of the sheet is on Mount Desert Island or on adjacent islands.

Topography

The Southwest Harbor quadrangle has pronounced topography. Several high hills, up to 420 m (1379 ft.), trend northeast to southwest across the center of the area. These are cut by a series of north-south trending valleys that extend to near or, in the case of Somes Sound, below present sea level. Somes Sound is reported to be 46 m below sea level and forms a fiord. In the text below these hills will be referred to as the central hills for geographical reference. Marine waters cover the southeast and central areas with four islands southeast of Somes Sound. Lakes cover the floors of the other valleys.

Glacial deposits control drainage from the lakes with the two lakes west of the sound draining to the north and most of the lakes east of the sound draining to the south. Otherwise fluvial drainage systems are limited. The longest stream is Marshal which drains into Bass Harbor Marsh.

Bedrock

Gilman and Chapman (1986) have made the latest study of the rocks within the Southwest Harbor area; the description that follows is from that report. The Somesville granite, a medium-grained, pink biotite rock, covers the northwestern portion of the study area. The northern portion of the outcrop area is finer grained than elsewhere and has been quarried around Hall Quarry. Across the central areas the Cadillac Mountain granite forms the predominant uplands or central hills. This rock is coarse-grained, pink and equigranular. The primary mineral is hornblende with apatite, zircon, and magnetite.

The southwest portion of the map sheet is the "shatter zone contact" between the Cadillac granite and the Southwest Harbor granite which is fine-grained, tan to pink and contains biotite. The extreme southern portions of the map area are rocks of the Cranberry Island Series and are felsites and flows on the mainland and tuffs or basic volcanic rocks on the

islands. Limited amounts of the Bar Harbor Formation composed of metamorphic siltstones and sandstones crop out at the present coastline in the southeast portions of the study area.

Prior Work

Prior work on Mount Desert Island began in the late 1800's with Shalers' (1889) report, which established a tradition of considering all of Mount Desert Island rather than specific quadrangles.

In general, the Quaternary story of Mount Desert Island involves glacial erosion acting on bedrock weaknesses to produce the sharp relief that is characteristic of the island today. Deglaciation came about as rising sea levels forced the ice margin back. Marine shells from a locality just west of Southwest Harbor are dated to $12,250 \pm 160$ (Y-2241, Stuiver and Borns, 1975). Many details of this story are still unknown.

Lowell (1988) reported on the interaction of ice tongues and sea level and noted that the relative sequence of events in each valley is different because of the floors of the valleys are all different elevations.

Borns (1974) mapped the Mount Desert 15' quadrangle and reported predominantly bedrock uplands with till or emerged marine deposits on the valley floors. He noted several moraines at the southern end of Long Pond, Echo Lake and south of the Hadlock Ponds. A second set of moraines also occurs north of the bedrock upland at the head of Somes Sound.

Timson (1976) described the various tidal environments along the coastline. The average tidal range of 3 m (10 ft) results in the emergence of several tidal flats at low tide.

Map Units

The map units utilized in this report follow the guidelines of the Maine Geological Survey. At this time only a tentative description and correlation (Fig. 1) can be made of these units. As observed in the Southwest Harbor Quadrangle the units are:

af - This unit is limited to along roadways and infill for buildings.

Hls - Limited deposits along the shores of lakes. Only one deposit at the south end of Echo Lake is large enough to map.

Hms - Several extensive deposits of cobble to boulder sized material lie between rock headlands on the present coastline. Limited evidence suggests these deposits are transgressing.

Hwm - Wet areas of mixed marsh grass; may be 2-3 meters thick in places.

Hws - Wet areas of mixed forest and wetland cover, generally very thin and overlie bedrock. Small areas of this result from beaver dams.

Hwsm - Only present at the heads of Bass Harbor and Somes Sound. Tidal organic accumulations of unknown thickness, but believed to be generally thin.

Pem - Several large moraines lie at the southern ends of the trough valleys. These are generally composed to sandy diamictons and poorly to well stratified materials. Several small moraine crests line the shore of Long Pond and occur to the northwest of Somesville. Small moraines are difficult to detect south of the central hills for they are commonly covered with Pmn units.

Pmd - One small delta that formed in conjunction with the Pmf unit.

Pmf - A large deposit at the Southwest Harbor transfer station. This deposit is in part a moraine that underlies stratified deposits.

Pmn - A major unit that is extensive north and south of the central hills. Generally a few decimeters up to two meters thick and composed

of coarse poorly sorted gravel. This unit may overlie bedrock, a moraine, and several other units.

Pms - Several small deposits ring the southern ends of the central hills. Comprised mostly of boulder lag deposits. Elevations up to 65 m. Many unmappable occurrences at lower elevations.

Pmv - A major unit that is difficult to separate from Pms as the surface expression is similar and depth information is rare. This unit is mapped where bedrock knobs extend through the unit; Pms is mapped where a blanket deposit exists.

Pp - Limited surface distribution. Outcrops rare and generally overlain with Pmn.

Pt - A unit with surface expression limited to the north flank of Carter Nubble. Generally a very sandy texture and occasionally difficult to separate from stratified deposits. Virtually nothing is know about the thickness of this unit.

Qfu - Two small occurrences north of the town of Southwest Harbor. Most likely related to falling sea level.

Qta - Extensive deposits especially along the eastern flanks of the central hills. Some of the deposits are more than 10 m thick and at least one deposit extends below present sea level.

rk - The primary map unit which consists of either continuous outcrop or of thin soil material that supports vegetation. This unit is almost continuous above 65 m elevation but is also common at lower elevations.

Geologic History

A tentative correlation of these units (Fig. 1) reflects the depositional history of the island. However, all deposits are relatively thin and rare, so a more complete history of the map sheet must include elements of ice flow, deglaciation, marine transgression, and recent activity. Erosion, both former (glacial) and present (marine) is the dominate process acting in the Quaternary.

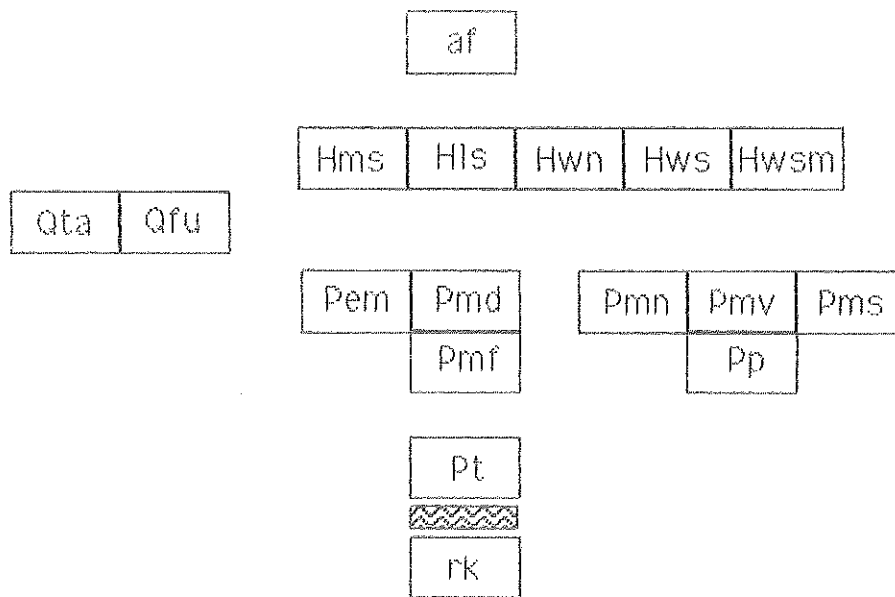


Figure 1. Tentative Correlation of surficial units expressed in the Southwest Harbor Quadrangle.

Ice Flow

Ice flow across the Southwest Harbor area can be reconstructed from striations and, to a lesser extent, from friction cracks and morphology of the bedrock hills. Striations are best displayed along the present shoreline where extreme high wave action has exposed bedrock but has not yet eroded the striations. These outcrops commonly are extensive and small variations (5-10°) can be traced across the planer surfaces.

A second concentration of striations can be found on the exposed areas of the hills. Striations here are much more subtle than along the coast and are usually restricted in number and length. Road cuts offer a third source of striation information. Friction cracks can be found at all three settings, but are most common on north sloping surfaces or where a plucked bedrock face is located just to the north.

The bedrock hills show a distinct south and a subtle southeast asymmetry. Perhaps the best example of a roche moutonnée is Carters Nubble. Higher mountains have a rounder upper surface with steep cliffs partway down their southern sides. The eastern side of the hills are always steeper than the western sides.

These ice-flow indicators record a southerly ice flow. Variations range a few degrees from the south with a slight preference toward the

east. Multiple striation sets have not been found and thus all of these striations are tentatively assigned to one erosive episode. Several outcrops along the northeastern side of Somes Sound show a southwest preference suggesting some streaming of the ice flow.

Three outcrops on Great Cranberry Island show striations trending 120 to 130°. These appear to reflect a eastward shift in flow directions but how these relate to the dominate southern flow patterns awaits further data collection on the off-shore islands. The ice flow seemed to be dominantly erosive in nature with little evidence of deposition during this time.

Deglaciation

Deglaciation occurred during the late Pleistocene marine transgression. The exact timing of deglaciation of the individual valleys is unknown but relationships of moraines and shoreline features suggest that the uplands and higher through valleys deglaciated before the lower valleys. Several moraines and other ice marginal features at the south ends of the central hills indicate that deglaciation halted at that position long enough to make extensive surficial deposits. It is unlikely that period was very long, however.

The only radiocarbon date known in the map area comes from Sargent Mountain Pond at 335 m elevation (Lowell, 1980). A moss mat prevented an undisturbed sample from being recovered and a date of $13,230 \pm 360$ (SI-4042) comes from the total carbon content of gravel 9.8 m below the sediment-water interface. Total water depth is 3.5 m.

The date must be used with caution because of its nature. It is two thousand years younger than SI-4043 ($11,355 \pm 125$, Lowell, 1980), obtained from The Bowl Pond some 5 km due east of Sargent Mountain Pond at a much lower elevation (122 m) and different stratigraphic setting (total carbon vs. gyttja). The Sargent Mountain date may reflect a early period of hill top exposure or a lower stratigraphic position. Consideration of both dates leads to the suggestion that the hill tops emerged from beneath ice cover some 12 to 13,000 years ago, about the time of marine deposition ($12,250 \pm 160$, Y-2241, Stuiver and Borns, 1975).

Marine Transgression

The marine transgression produced most of the deposits in the map area either from reworking of the glacial deposits or from primary erosion of the bedrock. This activity is especially pronounced in the low areas south of the central hills; nearly every deposit below 65 m has been modified by wave action.

Relic beaches on Mansell Mountain and Valley Peak have elevations of 67 and 55 m respectively. The small delta south of Long Lake has a surface elevation of 64 m. The Mansell Mountain beach formed on a moraine crest indicating a rise in relative sea level after the moraine formed. This complex interaction is still being studied.

Recent Activity

The recent activity is limited to mass movement adjustments of the steep slopes, fluvial adjustment of the drainage system, and marine shorelines forming during the current transgression.

Some of the talus slopes are active but most are not. Accumulations probably were most active just after deglaciation and slowed subsequently.

Streams have cut through a few moraine crests but are generally ineffective in eroding the landscape. In several places wetlands are common, reflecting a poorly adjusted system.

The marine shorelines are very active. Between Long Ledge and Long Point on Great Cranberry Island erosion has destroyed a neck of land turning it into a point bar in the last 50 years. Changes such as this are most pronounced on the Islands. Water depths suggest that Great Cranberry Island was connected to Mount Desert Island only a few thousand years ago.

Outstanding Questions/Future Mapping Efforts

Mapping during the 1988 season will focus on the following areas and questions.

What is the nature and origin of the minor moraines in the Somesville-Southwest Valley area?

What is the highest sea level recorded in areas west of Somes Sound?

What evidence of sea level is present north of the central hills? If present how did marine waters in that area interact with deglaciation?

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