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Surficial materials of the Belgrade quadrangle, Open-File 04-36

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Surficial Geology of the Belgrade 7.5-Minute Quadrangle, Kennebec County, Maine

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INTRODUCTION

This report describes the surficial geology and Quaternary history of the Belgrade quadrangle in southwestern Maine. Surficial earth materials include unconsolidated sediments (sand, gravel, etc.) of glacial and nonglacial origin. Most of these deposits formed during and after the latest episode of glaciation in Maine, called the Wisconsinan glaciation, during the last 25,000 years.

Surficial sediments cover the bedrock over most of the quadrangle and are subject to many uses and environmental considerations. These include sand and gravel extraction, development and protection of ground-`water supplies, siting of waste disposal facilities, and agriculture.

The fieldwork for this study was carried out in 2003 for the STATEMAP cooperative between the Maine Geological Survey and the U.S. Geological Survey (USGS). Two maps are associated with this report. The *surficial geologic map* (Hildreth, 2004a) shows the distribution of sedimentary units and indicates their age, composition, and known or inferred origin. It also includes information on the geologic history of the quadrangle, such as features indicating the flow direction of glacial ice. This map provides the basis for the following discussion of glacial and postglacial history.

The *materials map* (Hildreth and others, 2004) shows specific data used to help construct the surficial geologic map. These data include observations from gravel pits, shovel and auger holes, construction sites, and natural exposures along stream banks. The materials map also shows boring and well logs.

Geographic Setting

The Belgrade 7.5-minute quadrangle has an area of about 133 km^2 (52 mi^2). It is located in southwestern Maine, in the southern part of the New England Central Upland physiographic province. It includes parts of the towns of Belgrade, Sidney, Manchester, and Augusta. Altitudes range from190 feet (58 m) along Bog Brook east of Bacons Corner at the east edge of the map, to over 620 feet (188 m) on Lord Hill near the northwest edge of the quadrangle. Thus, maximum relief is about 430 feet (130 m).

A few till hills in the Belgrade quadrangle were shaped by glacial ice flowing south to southeast and have been elongated in that direction. Most of these streamlined hills are not true drumlins; the majority are bedrock-cored hills that were plastered by till, particularly on their north and northwest sides. The major trend in the topography, however, especially that of stream valleys, is controlled by structures in the underlying bedrock, which generally strike north-northeast to northeast.

Great Pond at the northwest edge of the map is fed by north-flowing Bog Brook, which debauches into Austin Bog at the southern end of Great Pond, the pond in turn has its west-draining outlet at the village of Belgrade Lakes about 2 miles north of the quadrangle; there, Great Pond drains into Long Pond, which is drained southward into the east-flowing Belgrade Stream in the Readfield quadrangle. The southwest part of the quadrangle is drained northward by Sanford Brook, which joins the southeast-flowing Belgrade Stream near the west edge of the map; there, Belgrade Stream bends sharply northeast and debauches into Belgrade Bog thence into Messalonskee Lake, whose outlet drains northward to Messalonskee Stream, which joins the Kennebec River just south of Waterville. The southern part of the Belgrade quadrangle is drained southward by the headwaters of Spring, Sidney Bog, and Stone Brooks, all of which are tributaries of Bond Brook, which joins the Kennebec River in Augusta, several miles south of the quadrangle border. In the southeastern part of the quadrangle, Great Sidney Bog drains both south (via Sidney Bog Brook as previously stated) and north via Bog Brook (also known as Hammond Brook), which leaves the quadrangle east of Bacons Corner and shortly joins the east-flowing Goff Brook that meets the Kennebec about 2 miles east of the quadrangle border. The southeast corner of the map area contains several other small unnamed northeast- to east-flowing streams that shortly join the Kennebec in the Vassalboro quadrangle. Mills, Bangs, Ellis and many unnamed brooks drain the watershed of Messalonskee Lake.

Bedrock Geology

Most of the quadrangle is underlain by nearly vertical, tightly isoclinal-folded, north-northeast-trending, high-grade metasedimentary rocks of Silurian age. The axial traces of the folds trend about 40^{o} azimuth; "the fold patterns are symmetrical and elongated indicating upright folds with gentle plunges" (Osberg, 1968). The Sangerville Formation consists of interbedded metapelite and metalimestone or metadolostone, including its Patch Mountain Member, which has thin interbeds of calc-silicate assemblages and biotite granofels (Creasy, 1979); outcrops and detached fragments of this rock unit weather unevenly, producing a distinctive ribbed surface ("ribbon rock"). The Waterville Formation consists of interbeds of metapelite and metasandstone, including thin intercalations of its Limestone Member. The northwestern part of the quadrangle is underlain by the Lower Devonian Rome pluton composed of binary quartz monzonite (Osberg, 1968; Osberg and others, 1985).

PREVIOUS AND CURRENT WORK

Early work on the surficial geology in this part of Maine was done generally at a reconnaissance level and at a smaller scale (Thompson, 1977; Thompson and Borns, 1985). The soil survey of Kennebec County (Faust and LaFlamme, 1978), significant sand and gravel aquifer map (Neil and Locke, 1999), and the recent surficial materials map (Locke, 1999), all facilitated the present author's fieldwork. Surficial geologic mapping at 1:24,000 scale has been completed in the Winthrop (Thompson, 2004b), Augusta (Thompson, 2004a) and Readfield quadrangles (Hildreth, 2004b).

GLACIAL HISTORY AND LATE-GLACIAL HISTORY

Southwestern Maine probably experienced several episodes of glaciation during the Pleistocene Ice Age, but virtually all evidence of previous glaciations in the Belgrade area was obliterated during the last (late Wisconsinan) episode, when the Laurentide ice sheet advanced from the northwest to a terminal position on the continental shelf.

Evidence of glacial erosion within this area is noticeable mainly as southeast- to south-trending glacial striations on freshly exposed bedrock surfaces. Further, more detailed, investigations of these striations, in this and adjoining areas, may help in efforts to decipher the changes in glacial flow more precisely during the last stages of glaciation in this part of Maine.

In the Belgrade area there are few, if any, true drumlins. However, several streamlined hills are composed of till overlying bedrock and are elongated in a southeast- to south-trending direction. Some of these have glacially plucked bedrock outcrops on the south to southeast end. Examples include Lord Hill and a few unnamed hills between Great Pond and Messalonskee Lake in the northern part of the map area.

After reaching its terminal position on the continental shelf, the late Wisconsinan ice sheet began to recede between 15,000 and 17,000 years ago. Shells collected from glaciomarine sediments deformed by ice shove in the Freeport area (about 20 miles [12 km] south-southwest of Belgrade) have a radiocarbon age of 14,045 yr B.P. (Weddle and others, 1993). The ice sheet terminus is inferred to have reached the Belgrade area a short time after that. As the ice sheet melted northward, sea level rose and inundated the entire Maine coastal zone, including much of the area in the Belgrade quadrangle lying below a current elevation of approximately 350 feet (160 m) above sea level, which is the approximate limit of marine submergence for this part of Maine. The ice-front in the Belgrade area therefore terminated in the late-glacial sea and meltwater streams flowing out of ice tunnels into the sea deposited a wide variety of stratified deposits that represent time-transgressive englacial to proglacial marine environments during glacier retreat through the area. As summarized by Thompson and Borns (1985), the marine submergence reached its maximum extent at about 13,000 yr B.P., and regressed from the area somewhat before 11,450 yr B.P. (Smith, 1985; Thompson and Borns, 1985), based on shells that indicate the approximate offlap of the late-Wisconsinan sea at Little Falls, Gorham, about 35 miles (56 km) southwest of the Belgrade quadrangle.

A radiocarbon date of 13,300 ± 50 yr B.P. (OS-4419) on *Mytilus edulis* from nearshore deposits in a pit at approximately 200 feet (61 m) asl in the North Pownal quadrangle records the earliest date for marine regression in the state. A younger date (12,820 ± 120 yr B.P., SI-7017) on in-situ intertidal fauna is reported by Retelle and Bither (1989) from nearshore deposits at an elevation of 152 feet (46 m) asl in a gravel pit in Topsham, in the Brunswick 7.5-minute quadrangle. An uncorrected date of 13,315 ± 90 yr B.P. (AA10162: Weddle and others, 1993), from the same pit in Topsham on *Portlandica arctica* shells found in Presumpscot Formation mud approximately one meter below the nearshore deposits containing the interidal fauna, supports the older offlap dates (Weddle, 1997, p. 8).

As the glacier melted northward through the Belgrade area, the sea kept apace, lapping against the ice front; here, meltwater streams flowing out of the glacier deposited englacial eskers and proglacial ice-contact esker-fed marine deltas, ice-contact esker-fed subaqueous marine fans, and marine bottom sediments (Presumpscot Formation of Bloom, 1960).

Elevations above sea level (asl) of topset-foreset bedding contacts for two ice-contact deltas in the Belgrade quadrangle have been measured: one in the Summerhaven delta at 356 ft (108.5 m) asl; and the other in the Belgrade delta at 359 ft (109.4

m) asl (Thompson and others, 1989). These record a minimum elevation for sea level at the time of their deposition. Elevations of glaciomarine deltas in southwestern Maine indicate that the land surface rose following their deposition, and was tilted at an average slope of 2.82 ft/mi (0.53 m/km), higher to the northwest (Thompson and others, 1989, p. 58). The rise in the land surface was due to glacial rebound of the lithosphere following the gradual relief of the great weight of the glacier as it melted northward. Concomitant with rebound of the land surface, relative sea level gradually fell and appears to have reached the modern-day shoreline by about 11,000 years ago.

As sea level dropped, many of the materials deposited below the level of the late-glacial sea in the Belgrade area became reworked by wave action as their surfaces passed through the swash zone; they formed characteristic nearshore and shoreline deposits (Pmn) in places. Further lowering of sea level led to downcutting of earlier outwash and glaciomarine deposits by the late-glacial Belgrade Stream and its tributaries. At approximately the same time, and probably somewhat later, the now-exposed fine-grained marine bottom sediments became eroded by wind action, which transported and sorted them into various dune and loess deposits, which are too thin to map in the Belgrade area.

Esker-deltas and end moraines in the Kennebec Valley

The most distinctive deposits in the Belgrade quadrangle are the eskers (Pge) that extend north to south for nearly the full length of the quadrangle. Caldwell and others (1985) described this complex system, especially in relation to associated end moraines and marine deltas. Because their information is integral to the present work, much of their description and interpretation is given below, along with data gathered since then, including interpretations and comments of the present author. The term "esker-delta" is one used by Caldwell and others (1985).

"In contrast to the coastal zone, there are relatively few end moraines in the part of the Kennebec River Valley north of Augusta. However, scattered clusters of small end moraines exist nearly as far inland as Skowhegan… Both the end moraines and a succession of esker-deltas mark the northerly retreat of the ice margin in this part of Maine" (Caldwell and others, 1985). In particular, the esker system in the Belgrade quadrangle starts "in Augusta and extends north to Norridgewock, and thence up the Kennebec Valley. Six ice-contact deltas occur along a DeGeer-type portion of this esker between Augusta and Smithfield [Figure 1]. Each delta and its associated esker segment constitute a morphosequence deposited from a particular position of the ice front. The orientations of nearby end moraines confirm the geographic pattern of deglaciation indicated by the deltas, and these moraines also suggest the presence of active ice in the marginal zone of the glacier" (Caldwell and others, 1985, p. 48).

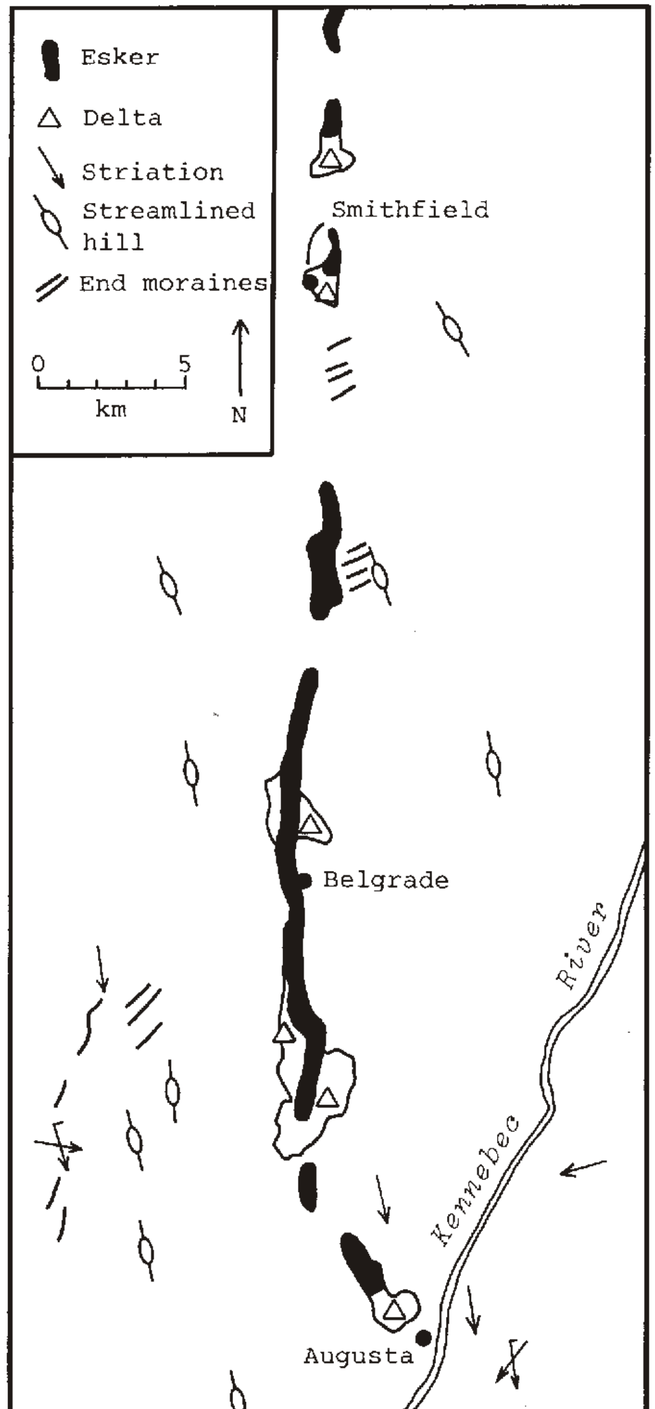

Figure 1. Map showing the DeGeer esker, associated glaciomarine deltas, and indicators of ice-flow patterns in the Augusta-Smithfield area [Flagged striations are older] (from Caldwell and others, 1985, Figure 3).

The present author has identified as end moraines variously boulder-strewn, hummocky ridges primarily composed of till and poorly sorted stratified diamicton that in places are aligned with and/or actually connected with relatively coarse-grained ice-contact collapsed heads of stratified outwash (either proximal slopes of marine deltas or submarine fan deposits). These till ridge deposits are not subdivided as a separate Pt unit on the map, but are instead marked by a symbol that identifies the ridge as part of an ice-marginal position. As stated by Caldwell and others (1985), above, these ridges suggest ice was active during their and the associated stratified unit deposition.

It should also be noted at this point that the present work distinguishes both marine deltas and submarine fan deposits associated with the eskers and herein suggests that the fan deposits have similar relations to the eskers and end moraines as the deltas do. At the north edge of the map area, submarine fan deposits arching southwestward from the esker into the west embayment of Great Pond are aligned with an east-west boulder-strewn hummocky ridge of till and coarse-grained stratified deposits extending westward over 1 km (1/2 mi) uphill from the shore. Also, similar southward-arching deposits identified as marking an ice-margin position west of the esker near the south end of Bog Brook appear to mirror (although slightly skewed) the mapped ice-contact head of the Belgrade glaciomarine delta (Pmdb) east of the esker and are therefore inferred to be contemporaneous deposits. Only a few inconclusive low ridges that may be poorly developed end moraines were found on the till slopes east of this marine delta.

In between the previous two ice-margin positions lies a similar south-arching set of ridges associated with the esker; in the lowest part of one ridge, where it crosses Austin Bog, Route 27 traverses the approximate ridge crest and continues along it westward for about a kilometer (1/2 mi). This ridge is also interpreted as an ice-margin position in which the low-lying parts have been buried by later submarine fan deposits (Pmf) and marine bottom deposits (Pp). The buried ridge deposits here might even be DeGeer-type submarine moraine deposits (Smith, 1982 and 1985); future excavations and detailed studies in this area may provide needed evidence for this hypothesis. Further south, the Summerhaven submarine fan deposits (Pmfs) appear to have similar relations with the esker deposits and with end-moraine till deposits (mapped as ice-margin position area in unit Pt) on the margins of the valley adjacent to Pmfs; also, the mapped head of outwash of this submarine fan is marked by a distinct string of moderately large kettle holes; these may represent a stagnant zone of ice ("dead ice") separating part of the esker from the receding active ice margin to the north and open water to the southeast, into which the Summerhaven fan was deposited as suggested below by Caldwell and others (1985, p. 48). The Summerhaven delta (Pmds) near the south end of the quadrangle is located between till hills at a narrow part of the valley, where it appears to be fed by the esker at its north end; the till hills on the margins of the delta here do not appear to have end-moraine characteristics, however. More detailed study of all these deposits would help in distinguishing their precise relations.

"While ice recession was generally in a northward to north-westward direction, the patterns of both end moraines and striation trends show that an embayment of the ice margin developed in the Kennebec Valley south of Skowhegan. The ice flow apparently converged on this embayment from either side. In contrast to the earlier regional flow direction of 160-170^{o}, the azimuths of the latest flow directions recorded by striations in the Augusta area are 210-255^{o} on the east side of the valley and 105-120^{o} on the west side…" (Caldwell and others, 1985, p. 48). (see Figure 1). One striation measured for the present report in the northwest part of the Belgrade quadrangle has striations with a133^{o} azimuth, whereas others have the usual south-southeast orientation.

"Although end moraines occur adjacent to the esker system mentioned above, the exact chronological relationship between the moraines and the esker is uncertain. Smith (1982) has demonstrated that esker and end-moraine deposition were essentially contemporaneous in the Waldoboro Moraine complex of central coastal Maine. Short esker segments in this moraine complex have been deformed by ice-shove, and the esker gravels are overlain by lodgment till. Each of the esker segments north of Augusta, on the other hand, appears to have been deposited after the stagnation of the ice in its vicinity. The esker segments associated with the deltas range in length from about 2 km to as much as 11 km. These distances may be the approximate widths of successive stagnant zones separating the deltas from the receding active ice margin" (Caldwell and others, 1985, p. 48).

"In the Augusta-Smithfield area [Figure 1], both the deposition of the deltas and the style of ice stagnation were controlled by the topography of the region. With one exception (at Smithfield Village), the deltas are situated in gaps between hills to the east and west. The gaps occupied by the deltas in Augusta and Belgrade are located on northeast-trending, bedrock-controlled ridges. Thinning of the ice sheet over these ridges isolated successive zones of stagnant ice between them, within which the esker segments were deposited. The former locations of the stagnant ice bodies are now indicated in part by the numerous lakes and low, swampy terrain of the area. Each mass of dead ice, in its time was flanked to the southeast by open water, into which a delta was deposited where the esker stream reached a low point on the intervening ridge" (Caldwell and others, 1985, p. 48-49).

Esker segments in the Belgrade quadrangle include two sections of multiple parallel to sub-parallel esker ridges separated by narrow valleys and in some locations, by elongate kettle ponds, such as Hammond, Penny, and Gould Ponds. This peculiar arrangement of multiple esker ridges occupies roughly two sub-segments, each about 2 miles (3.2 km) long, that may be related to stagnant zones as suggested above by Caldwell and others (1985). However, given that there is some evidence for active ice in the form of end moraines associated with esker-delta and submarine fan ice-margin positions in the Belgrade quadrangle, stagnant zones for these particular deposits do not seem to fit that data. No further conclusions can be drawn from present investigations at this time. More detailed study and excavations in the area may elucidate the specific origin of the multiple eskers.

GLACIAL AND POSTGLACIAL DEPOSITS

As the ice sheet melted in the Belgrade area, it dropped much of the debris incorporated within it in the form of till. At the same time and somewhat later, glacial meltwaters took some of the debris within the glacier, sorted it, carried it some distance, and finally deposited it as stratified sediments in various physiographic settings within the quadrangle. These settings are referred to as environments of deposition. Most of the deposits delineated on the map (Pleistocene and Holocene) are characterized on that basis. A few deposits are distinguished by the agent of deposition, such as till (Pt), for which glacial ice was the agent of deposition. Postglacial deposits include materials laid down since the glacier melted north of the Belgrade area and the sea receded from southern Maine. These Holocene deposits are commonly referred to as recent or modern deposits; they were laid down within the last 12,000 years and most are still in the process of deposition.

The succession of Pleistocene and Holocene surficial deposits in the Belgrade area is given in the correlation chart (Figure 2), showing the relative ages of the map units.

Till (unit Pt)

Till occurs throughout the Belgrade area. Its thickness is variable, as is its composition. The till was deposited from the glacial ice sheet and forms a blanket over the underlying bedrock; it is inferred to underlie younger deposits throughout the area. In most exposures in the quadrangle, this till is light olive-gray, sandy, stony, and moderately compact, showing weathering only in the uppermost few feet.

Relatively narrow, hummocky, boulder strewn, short ridges composed mostly of till are found in several locations in the area. Many are associated with the margins and heads of outwash of adjacent stratified deposits. The till ridges are interpreted as end-moraine segments, but are identified on the map as unit Pt marked by an ice-margin position symbol.

Some drumlins are found in the area, but most hills that are drumlin-shaped (and oriented in the expected direction for drumlins relative to the direction of striations in the area) have bedrock cores that have been plastered with till. Many more of these rock-cored hills exist in the quadrangle than do true drumlins. Though most till is less than 6 meters (20 ft) thick in the area, several wells in the West Sidney area penetrated more than 21 meters (70 feet) of probable till.

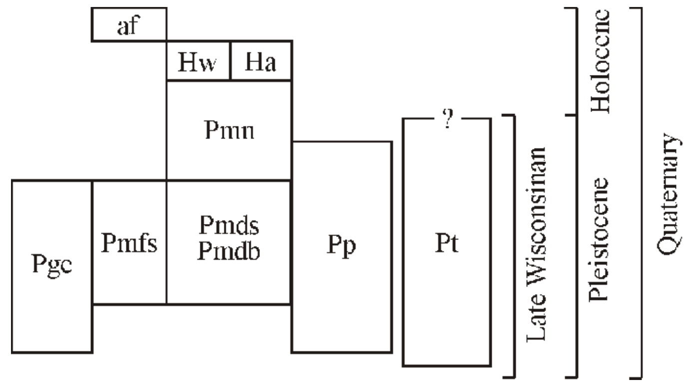

Figure 2. Correlation of map units, Belgrade quadrangle, Maine.

Glaciomarine bottom deposits (Presumpscot Formation) (unit Pp)

Materials consisting of predominantly silt and clay with locally sandy beds and intercalations are interpreted here as late-glacial submarine fine-grained (marine mud) bottom deposits of the Presumpscot Formation (Bloom, 1960). These deposits were derived from glacial meltwaters and laid down at the bottom of the late-glacial sea following the retreat of the ice sheet from the area and prior to uplift of the area above the sea. The silt and clay deposits commonly lie below about the 300-foot contour—and in many places, beneath units Ha, Hw, and Pmn in the quadrangle. Subsuface data and exposures indicate that Pp overlies Pt, bedrock, fans, and end moraines and can be interbedded with coarser glaciomarine sediments. It is generally thin (less than 10 feet [3 m] thick) in this quadrangle, which is near the upper limit of marine submergence. In places throughout the map area, Pp is overlain by thin unmapped dune or loess deposits.

Glaciomarine ice-contact delta deposits (Pmd)

At least two glaciomarine ice-contact deltas were graded to the late-glacial sea level in the Belgrade quadrangle. These were fed by glacial streams that deposited associated esker (Pge) segments and are contemporaneous with some of the nearby glaciomarine fan (Pmf) deposits. These deltas are distinguished by (a) topographic features such as flat tops (variably pockmarked by kettle holes), collapsed ice-contact proximal slopes, and steep distal foreset and/or wave-cut slopes; and (b) internal features such as foreset and topset beds. The contact between the topset and foreset beds represents minimum sea level at the time of deposition. The present-day elevations for two of these deltas were measured (Thompson and others, 1989). Near the south edge of the map, the Summerhaven delta (Pmds) topset-foreset contact was found to be 348 feet above sea level (asl). In the north part of the map area, the Belgrade delta (Pmdb) topset-foreset contact was found to be 359 feet asl. Over 200 feet (60 m) of unconsolidated materials have been identified beneath the southern delta (Neil and Locke, 1999; Hildreth and others, 2004); of this thickness, probably less than half is coarse-grained sand and gravel delta sediments which generally overlie variable thicknesses of bottomset silt and clay of the Presumpscot Formation (Pp), which in turn overlies variable thicknesses of till (Pt) over bedrock. For the most part, the underlying silt and clay (Pp) is not exposed except in stream valleys that have cut down through the overlying sands, or in man-made excavations. In places, unit Pmd may be overlain by unmapped thin loess and dune deposits. Parts of these marine deltas also have been eroded by streams during offlap of the sea. In general, delta deposits in this area are less than 100 feet (30 m) thick.

Delta deposits are useful as sources of sand and gravel.

Esker and/or ice-channel filling deposits (unit Pge)

Distinctive undulating narrow ridges of sand and gravel were deposited by meltwater streams flowing south-southeast in a tunnel or tunnels in the bottom of the last ice sheet. Two branches of a complex esker system are identified at the north edge of the map area. These esker deposits extend southward, join in the subsurface south of Great Pond, and feed into ice-contact marine delta deposits (Pmd) and subaqueous marine fan deposits (Pmf) -- all of which represent time-transgressive glacial meltwater deposits. Much of the esker unit (Pge) in the Belgrade quadrangle is actually more complex than most eskers elsewhere in Maine, in that much of the Pge unit here consists of several parallel to sub-parallel ridges, rather than just one ridge; where the tunnel(s) opened out at the snout of the glacier, meltwaters deposited either an ice-contact marine delta and/or marine subaqueous fan deposits contemporaneous with the esker deposit. In places, the esker ridge is bordered by depressions (kettles) left when detached masses of glacial ice melted. Low segments of the esker deposit are buried by younger deposits in the area. There is debate over whether meltwater flowed simultaneously through the entire tunnel system, but other esker systems in Maine apparently formed progressively from south to north when the tunnel became clogged with sediment as the glacier melted (Caldwell and others, 1985; see also "Esker-deltas and end moraines in the Kennebec Valley" section, above). Esker deposits tend to be less than 70 feet (21 m) thick, though some are thicker.

Submarine fan deposits (unit Pmf)

Triangular- to fan-shaped deposits consisting mostly of sand and silt and some gravel were deposited in glacial submarine fans. The apex of each fan typically is located at either side of the associated esker, where meltwater streams exiting the ice tunnel spread out onto the late-glacial sea floor. Some marine fan deposits contain abundant kettle holes and they may include esker (Pge) or bottom deposits (Pp). Most fan deposits were laid down in the late-glacial sea directly in contact with or just beyond the ice front by streams that deposited the associated adjacent eskers in tunnels in the ice ‘upstream’ of the fan deposits. The fans consist mainly of inclined sandy to gravelly foreset beds of an incomplete delta (one which has not aggraded to sea level). Although the apexes of most fans were deposited in contact with the ice, the margin away from the esker may have been deposited in contact with ice or it may have been deposited in open water; deposits containing internal collapsed bedding would signify an ice-contact setting.

Some fan deposits may be delineated as individual units. Only one, however, was given a unique geographic name; the Summerhaven fan deposit (Pmfs) is graded to south-flowing channels through the top of the Summerhaven glaciomarine delta. Its ice-proximal margin is characterized by a string of moderate-sized kettle holes, including Lily Pond, Lower and Upper Silver Lakes, and Emery and Bean Ponds (See the section "Esker-deltas and end moraines," above, for a discussion on their origin).

Some of the marine fan deposits are also found as distal fan deposits associated with Pmd marine-delta deposits. Marine fan deposits in the Belgrade quadrangle range in thickness from 0 to over 30 m (0-100 ft).

Marine nearshore deposits (unit Pmn)

Certain materials consisting of waterlaid sediments that range from clay to gravel are inferred to have been deposited as a result of wave action in nearshore and shallow marine environments. Pmn deposits are thin (commonly less than 10 feet [3 m] thick) and generally overlie till, marine fan, or bottom deposits; some Pmn materials are associated with or overlain by unmapped thin dune or loess deposits.

Wetland deposits (unit Hw)

Freshwater swamp deposits characterized by accumulations of fine-grained organic-rich sediments, deposited in low, flat, poorly drained areas are scattered throughout the quadrangle. Little information is available on the thickness of these deposits in the Belgrade area, though Cameron and others (1984) report that peat deposits in southwestern Maine generally average less than 20 ft (6 m) in thickness. In places the unit is indistinguishable from, grades into, or is interbedded with alluvium (Ha). It should be noted that both swamp (Hw) and alluvial deposits (Ha) may be coincident along some stretches of flood plains in this area.

Stream alluvium (unit Ha)

Sand, gravel, silt, and organic material deposited by modern streams in their flood plains are mapped as stream alluvium. The extent of alluvium indicates areas that flooded in the past that may be subject to flooding in the future. In places the unit is indistinguishable from, grades into, or is interbedded with wetland deposits (Hw). Swamp (Hw) and alluvial deposits (Ha) may be coincident along some stretches of flood plains in this area.

Artificial fill (unit af)

Areas where the original ground surface is covered by a substantial thickness of imported material, both man-made and natural, are mapped as artificial fill (unit af). The thickness varies, but usually doesn't exceed 20 ft (6 m).

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