

**DEPARTMENT OF CONSERVATION
Maine Geological Survey**

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OPEN-FILE NO. 03-5

Title: *Surficial Geology of the Speckled Mountain 7.5-minute Quadrangle, Oxford County, Maine*

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Date: *2003*

Financial Support: Funding for the preparation of this report was provided in part by the U.S. Geological Survey STATEMAP Program, Cooperative Agreement No. 01HQAG0090.

Associated Maps: Surficial geology of the Speckled Mountain quadrangle,
Open-File 02-144
Surficial materials of the Speckled Mountain quadrangle,
Open-File 02-103

Contents: 9 p. report

Surficial Geology of the Speckled Mountain 7.5-minute Quadrangle, Oxford County, Maine

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INTRODUCTION

This report describes the surficial geology and Quaternary history of the Speckled Mountain 7.5-minute 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, within the last 25,000 years. Surficial sediments cover the bedrock over much of the quadrangle, and are subject to various land-use considerations. These include sand and gravel extraction, development and protection of ground-water supplies, siting of waste disposal facilities, and agriculture.

The field work for this study was carried out in stages, first to gather data for the Maine Geological Survey's (MGS) sand-and-gravel aquifer mapping program (Williams and others, 1987) and later to complete the surficial geologic mapping of the Speckled Mountain quadrangle. Field work to update earlier observations, and preparation of the present report, were done in 2001-02 for the STATEMAP cooperative between the MGS and the U. S. Geological Survey (USGS).

Two maps are associated with this report. The *geologic map* (Thompson, 2002) 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, along with mapping done by the author in adjacent quadrangles, provides the basis for the discussion of glacial and postglacial history presented here. The *materials map* (Thompson and Locke, 2002) shows specific data used to help construct the geologic map. These data include observations from gravel pits, shovel and auger holes, construction sites, and natural exposures along stream banks. Sand and gravel aquifer mapping by the MGS provided some data on the thickness of surficial sediments (Neil, 1998).

Geographic setting

The Speckled Mountain quadrangle is located in the eastern White Mountains. The western boundary of the quadrangle is very close to the New Hampshire state line, which is less than a mile to the west in the Wild River quadrangle. The map area extends in latitude from 44°15'00" to 44°22'30" N, and in longitude from 70°52'30" to 71°00'00" W. It encompasses parts of the towns of Batchelders Grant, Mason, Stoneham, and Stow. Much of the quadrangle lies within the White Mountain National Forest, which includes the rugged peaks of the Caribou-Speckled Wilderness area. There are no distinct population centers in the quadrangle. Residential development is limited to areas outside the National Forest, mainly in the southeastern part of the map area.

Streams in the northern half of the Speckled Mountain quadrangle drain northward to the Androscoggin River. These include Wild River, Evans Brook, Bog Brook, West Branch Pleasant River, Miles Brook, and their tributaries. The numerous brooks in the southern part of the quadrangle drain southward and lie within the Saco River basin. Many of the smaller mountain streams have steep gradients and flow over bedrock in places. There are no major lakes and only a few small ponds in the map area.

The topography of the Speckled Mountain quadrangle is very mountainous. Elevations range from about 380 ft (116 m) above sea level (where Great Brook crosses its southern border) to 2906 ft (886 m) on the summit of Speckled Mountain. There are numerous other peaks above 2000 ft, and National Forest hiking trails provide access to some of the most scenic mountain tops. Glacial erosion produced spectacular cliffs such as those seen in Evans Notch and several peaks in the Caribou-Speckled Wilderness. The high and spectacular cliff on Red Rock Mountain is a good example of the steep southern slopes resulting from glacial plucking. Evans Notch and other smaller notches pro-

vide routes for roads and trails to penetrate this terrain. A few low hills and ridges in the eastern and southern parts of the quadrangle have been glacially streamlined in a south-southeasterly direction.

Bedrock geology

Quaternary sediments cover much of the bedrock at lower elevations in the Speckled Mountain quadrangle, but many extensive outcrops occur on the mountains. The bedrock includes a complex assortment of metasedimentary schists and gneisses of Silurian to lower Devonian age (Moench and others, 1995). In places these rocks have been partially melted to produce migmatites (intricate mixtures of metamorphic and igneous rocks). A large body of Devonian granitic bedrock (the Songo pluton) intrudes the metamorphic formations. Veins of granite pegmatite are found throughout the area. On Sugarloaf Mountain, pegmatites have been mined commercially for aquamarine beryl and other rare minerals such as beryllonite (for which this was the world's first known locality).

PREVIOUS WORK

Much of the study area is in the White Mountain National Forest, with rugged terrain and limited public road access, and very little previous geologic work has been done here. Stone (1899) conducted a reconnaissance of the region during his statewide USGS study of Maine's glacial gravel deposits, but he did not report on the uplands that comprise most of the Speckled Mountain quadrangle. Prescott (1980) carried out preliminary gravel aquifer mapping in this part of Maine, but included only minor information for the Speckled Mountain area. Thompson compiled an aquifer map that included the Speckled Mountain quadrangle, as part of the Significant Sand and Gravel Aquifer Project sponsored by the MGS, USGS, and Maine Department of Environmental Protection (Williams and others, 1987). This work was recently updated by Neil (1998). The U. S. Department of Agriculture's soil survey of Oxford County (Wilkinson, 1995) provided useful materials information for several sites that the present author did not visit in the field.

DESCRIPTION OF GEOLOGIC MAP UNITS

The surficial deposits represented on the geologic map have been classified on the basis of their age and origin. Map units are designated by letter symbols, such as "Pt". The first letter indicates the age of the unit:

- "P" - Pleistocene (Ice Age);
- "H" - Holocene (postglacial, i.e. formed during the last 10,000 years);
- "Q" - Quaternary (encompasses both the Pleistocene and Holocene epochs)

The Quaternary age is assigned to units which overlap the Pleistocene-Holocene boundary, or whose ages are uncertain. The other letters in the map symbol indicate the origin and/or assigned name of the unit, e.g. "t" for glacial till and "Pgog" for glacial outwash (go) deposited in the Great Brook valley (g). Surficial map units in the Speckled Mountain quadrangle are described below, starting with the older deposits that formed in contact with glacial ice.

Till (unit Pt)

Till is a glacially deposited sediment consisting of a more-or-less random mixture of sand, silt, and gravel-size rock debris. It may also include numerous boulders. Till blankets the sides of mountains in the quadrangle, although parts of it have been disturbed by mass movements and surface water runoff on the steeper slopes. Test borings in other areas of Maine show that till commonly extends beneath the younger waterlaid sediments in valleys.

Most exposures of till in the Speckled Mountain quadrangle are shallow cuts (3-6 ft) along woods roads. In a few places, excavated banks next to roads have revealed up to 15 ft (4.8 m) of till, and the thickness may be considerably greater beneath some of the lower valley sides. Till is thin or absent on the tops of many hills and mountains in the quadrangle, where bedrock is likely to be exposed. A ruled line pattern on the geologic map indicates areas where bedrock outcrops are common and/or the till thickness is inferred to be less than 10 ft (3 m).

Till is, by definition, a poorly sorted sediment (diamicton) in which there is a very wide range of rock and mineral particle sizes. However, the texture and structure of individual till deposits vary depending on their source and how they were formed. Till in the Speckled Mountain quadrangle may include a small percentage of clay, but it has a dominantly sandy or silty-sandy matrix as a consequence of having been eroded from coarse-grained bedrock. Till has little or no obvious stratification in some places. Elsewhere it is crudely stratified, with discontinuous lenses and laminae of silt, sand, and gravel resulting from sorting by meltwater during deposition (see Figure 4 on the geologic map). Stones are abundant in this unit, and boulders scattered across the ground surface often indicate the presence of till. Till stones in the Speckled Mountain quadrangle chiefly consist of coarse-grained igneous and metamorphic rocks that were glacially eroded from local bedrock sources. Most till stones are more-or-less angular, and some have smooth, flat, striated surfaces due to subglacial abrasion. These faceted surfaces are best developed on dense, fine-grained rocks such as basalt (basalt occurs as dikes cutting other rock types in southwestern Maine).

Varieties of till formed beneath a glacial ice sheet include lodgement and basal melt-out tills. Lodgement till was deposited under great pressure beneath the ice sheet. It may be very compact and difficult to excavate ("hardpan"), with a platy structure (fissility) evident in the upper, weathered zone. Basal

melt-out till is difficult to identify with certainty, but typically shows a crude stratification inherited from debris bands in the lower part of the glacier. Ablation till formed during the melting of the ice and tends to be loose-textured and stony, with numerous lenses of washed sediment. More than one of these till varieties may occur at a single locality. For example, a thin veneer of stony ablation till commonly overlies lodgement till.

Field evidence in southwestern Maine, together with studies elsewhere in New England (e.g. Koteff and Pessl, 1985; Thompson and Borns, 1985; Weddle and others, 1989), suggests that till deposits of two glaciations are present here. The “upper till” is clearly the product of the most recent, late Wisconsinan glaciation, which covered southern Maine between about 25,000 and 13,000 years ago. Exposures of the upper till can be seen in many shallow pits, road cuts, and temporary excavations. It is not weathered (except in the near-surface zone of modern soil formation) and is usually light olive-gray in color. The ablation variety of the upper till is most commonly seen in the Speckled Mountain quadrangle.

The “lower till” consists of compact, silty-sandy lodgement deposits. In southwestern Maine, as in other parts of New England, it is likely to be found in smooth, glacially streamlined hills where a considerable thickness of till has accumulated. These thick deposits often occur as “ramps” on the gentle northwest-facing slopes of hills, while bedrock is exposed on the steeper, glacially plucked southeast slopes.

The lower till is distinguished by its thick weathering profile, which may extend to a depth of 10 ft (3 m) or more. Within this weathered zone, the till is oxidized and has an olive-gray to dark olive-gray or dark grayish-brown color. Dark-brown iron/manganese oxide staining coats the surfaces of stones and joints. Probable equivalents of this till in southern New England are believed to have been deposited during an earlier glaciation in Illinoian time, prior to 130,000 years ago (Weddle and others, 1989).

No exposures of the lower till have been found in the Speckled Mountain quadrangle, but this may be due to the lack of deep excavations. The two tills have been observed together at a few localities in the region, including a section in the adjacent East Stoneham quadrangle. The contact between the tills is sharp and erosional; and fragments of the lower till occur in the basal part of the upper till (Thompson, 1986).

Great Brook deposits (unit Pgog)

Great Brook and its tributaries drain a sizable area of mountainous terrain in the southeastern part of the quadrangle. Glacial outwash deposits (Pgog) were mapped in the Great Brook valley and along Beaver Brook to the east and Willard Brook to the west (both of which empty into Great Brook). Postglacial stream erosion has removed portions of these deposits, with the result that unit Pgog now occurs as terraces that are slightly higher than the adjacent modern flood plain. Borrow pits in the Pgog terraces show materials ranging from sand or

pebbly sand to pebble-cobble gravel. Bedrock locally protrudes from this unit, or appears where streams have cut down through it, so the Pgog deposits are thin in some places. Elsewhere the topographic relief along streams suggests a thickness of 40 ft (12 m) or more.

Rattlesnake Brook fan (unit Pgfr)

Rattlesnake Brook is located in the southwestern part of the quadrangle. This stream drains the south side of Speckled Mountain. It has built a large gravelly fan (Pgfr) where it comes out of the hills and into the valley of Shell Pond Brook. Just above where it emerges onto the fan, Rattlesnake Brook passes through a narrow bedrock gorge about 15-20 ft (5-6 m) deep.

Unit Pgfr is believed to have originated as a glacial outwash fan. The gorge suggests intense erosion by a torrential glacial stream carrying a heavy sediment load. Additional gravel washed onto the fan from the small unnamed brook near the southwest corner of the quadrangle. The fan may have been enlarged in early postglacial time, when Rattlesnake Brook eroded freshly exposed, unvegetated sediments from the mountainside immediately following the recession of glacial ice from this area.

Ice-contact deposits (unit Pgi)

As the last glacial ice sheet receded northward from Evans Notch, sand and gravel (Pgi) washed out of the ice and was deposited in the headward part of the Evans Brook valley. The topography of these deposits is variable and includes mounds and ridges along Route 113, and a small flat-topped area southeast of the eastern pond shown on the map. The extent and composition of unit Pgi are poorly known because there is little exposure in this densely wooded region. Surface indications show materials ranging from sand to cobble gravel.

It is possible that a proglacial lake developed as the glacier margin receded from Evans Notch, and unit Pgi may be an ice-contact delta that formed in the lake. In this case, the delta top should have nearly the same elevation as the spillway at the notch. The elevation of unit Pgi reaches approximately 1380 ft, and the threshold at Evans Notch had a similar elevation before it was buried under postglacial fan deposits (unit Qfen, described below). Alternatively the Pgi sediments may have been deposited at least partly as a subglacial tunnel deposit (esker) while ice still remained in the area. In either case, the swampy depression and uneven topography associated with unit Pgi show that it was deposited in contact with remnant ice. The tremendous depth of the valley south of Evans Notch suggest much erosion by glacial meltwater pouring through the notch.

Glacial Lake Mason deposits (unit Plma)

This unit consists of coarse gravel and gravelly sand in the West Branch Pleasant River valley. Much of the gravel is bouldery and must have been deposited by high-energy stream flow.

The topographic relief of the unit on the north side of the river indicates a maximum thickness of at least 80 ft (24 m). Most of unit Plma was deposited by water issuing from tributary valleys north of the West Branch. The volume of gravel in this area suggests deposition by glacial meltwater, and not merely reworking of local till deposits by postglacial streams. The principal source may have been meltwater discharge through Tyler Notch to the north.

Unit Plma shows ice-contact topography in places, including a few small kettles on the terrace at 1040-1060 ft elevation on the north side of the West Branch, and a high conical mound (kame) that reaches 1000 ft on the hillside south of the river. There is presently no barrier in the West Branch valley that would have forced the glacial meltwater to such a high level. Thus, it is proposed that the receding ice margin temporarily dammed the lower end of the valley (in the adjacent East Stoneham quadrangle) and impounded a short-lived lake which is here named "glacial Lake Mason." The Plma sediments were deposited into the ice-dammed lake. At this time the ice margin probably extended across the northwest part of the East Stoneham quadrangle, forcing the lake to drain through a gap at about 990 ft on the ridge northeast of Bad Mountain. The author visited the latter site and found a deep ravine between two bedrock hills that was carved by glacial meltwater (Thompson, 2003). This was most likely the spillway for glacial Lake Mason, or at least was the drainage point controlling the elevation of the Plma deposits.

Stream terrace deposits (unit Qst)

Adjacent to the east end of unit Plma, there is a lower terrace (Qst) at about 920 ft in elevation. Small inactive borrow pits in this deposit reveal material ranging from gravelly sand to boulder gravel. This terrace probably formed by erosion of older Plma sediments soon after the termination of glacial Lake Mason. A slight retreat of the glacier margin from the original lake spillway mentioned above would have opened a lower drainage channel just 1500 ft (~450 m) to the north. The incipient West Branch then drained through this new channel, incising and regrading part of the Plma deposits. The head of the channel has an elevation of about 920 ft, which is the same as the Qst surface that is graded to it. Continued glacial recession soon resulted in further lowering of the river, and the West Branch was established in its present course.

Evergreen Valley fan (unit Qfev)

"Evergreen Valley" is the name of a broad portion of the Cold Brook basin, located midway across the southern border of the quadrangle. It is the site of a residential development and former ski area. This area is underlain by a fan deposit (Pgfe) built by streams issuing from the valleys of Cold Brook and an unnamed brook draining part of the Speckled Mountain region to the north. It may comprise both glacial and postglacial sediments, but the large size of the fan suggests that much of it

was deposited by glacial meltwater. Shallow exposures in the former ski area show loose, poorly-sorted sand, pebble-boulder gravel, and sandy diamicton with angular stones. Other fans in the mountains of western Maine are very coarse-grained, so it is assumed that gravel is the principal component of the Evergreen Valley fan. Since its age is uncertain, the map unit has a generalized "Quaternary" label.

Great Brook fan (unit Qfg)

The uppermost part of Great Brook has eroded the surrounding till deposits and locally cut down to bedrock. Farther down the valley, this stream flows alongside the lower portion of Shirley Brook. The two brooks have reduced gradients in this area, causing them to drop their coarsest sediments and deposit a bouldery alluvial fan (unit Qfg). The fan is distinguished by having a steeper slope than the alluvial sediments (unit Ha) farther down the Great Brook valley.

Evans Notch fan (unit Qfen)

Evans Notch is located on the drainage divide between the south-flowing Cold River and north-flowing Evans Brook. The heads of the two streams are within a few hundred feet of each other, and the northwest side of the notch is very high and steep. Postglacial drainage, and possibly landslides, on this slope have built a fan (Qfen) containing abundant boulders. The parking lot for the East Royce Trail is located on the fan. This deposit has obscured the earlier topography of the notch floor, which probably was a flat-bottomed channel that drained meltwater from glacial ice that lay to the north.

Evans Brook fan complex (unit Qfeb)

Evans Brook originates in Evans Notch and flows northward to join the Wild River in the northwestern part of the quadrangle. The tributary brooks that drain the surrounding high mountains have steep gradients. They have eroded sediment from the mountainsides during flood periods and built a series of large alluvial fans (Qfeb) where they empty into the Evans Brook valley. Shallow exposures in the fans reveal material ranging from sand to boulder gravel, with coarse gravel being most abundant. Individual fans, such as those near the mouths of Morrison Brook and Mud Brook, rise up to an apex in their respective source valleys. Despite the amount of deposition that has occurred, both of the latter streams have also cut down to bedrock in the vicinity of the fans.

The alluvial fans coalesce into a continuous gravelly deposit along Evans Brook. Unit Qfeb shows at least two levels of deposition: the lowest and most recent alluvial gravels along Evans Brook, and a flat-topped terrace that in places stands 15-20 ft (5-6 m) above the modern flood deposits. This terrace is largely concealed by the forest, but it is conspicuous in places along the east side of Route 113 when the leaves have fallen from

the trees. The large volume of gravel in this terrace at first suggested a glacial source, but the terrace surface slopes northward (down the valley). There is no evidence that an ice margin lay to the south and deposited outwash in this direction. On the contrary, the ice-contact deposits and meltwater channel at Evans Notch support a southward meltwater drainage. The distinct Qfeb fans at the mouths of several tributary valleys likewise indicate a postglacial alluvial origin. The timing of fan deposition is uncertain; they may have been most active immediately after deglaciation, when floods could have eroded much sediment from the freshly exposed mountainsides before establishment of a forest cover. Thus, the fan complex is assigned a general Quaternary age.

Wetland deposits (unit Hw)

Unit Hw consists of fine-grained and organic-rich sediments deposited in low, flat, poorly drained areas. In the Speckled Mountain quadrangle this unit occurs in a few small upland areas where there are reduced stream gradients, and around Little Pond near the south edge of the quadrangle. The boundaries of unit Hw were mapped partly from aerial photographs and thus are approximate.

Stream alluvium (units Qa and Ha)

Units Qa and Ha consist of alluvial sand, gravel, silt, and organic material deposited by late-glacial to modern streams. In the Speckled Mountain quadrangle these deposits occur principally along the larger streams, including the Wild River, Evans Brook, West Branch Pleasant River, and Great Brook. In the lower Evans Brook valley, the geologic map shows an arbitrary contact between the Qa deposits and the more steeply sloping alluvial fan complex (Qfeb) farther up the valley. Both of these map units were formed by postglacial stream activity, with the coarse fan gravels located where tributaries have discharged a lot of sediment into the central valley.

Downcutting by Evans Brook and the Wild River has incised their alluvial deposits. This process has created terraces along the sides of both valleys in the Hastings Campground area. Three terrace levels occur near the road junction at Hastings: the lowest and youngest along the main roads, an intermediate terrace in the vicinity of an old gravel pit south of the junction (see materials map), and a high terrace whose upper limit follows the 900-ft contour. Corresponding terraces can be seen along Highwater Trail and Hastings Trail on the west side of Wild River. Local terracing was also noted in the Qa deposits along Beaver Brook in the southeastern part of the quadrangle, and likewise has been observed along many other mountain streams in southwestern Maine. Some of these terraces are too narrow and discontinuous to show at the scale of the topographic maps, but they indicate a history of alluvial sedimentation followed by more recent erosion through postglacial time.

Units Qa and Ha range in composition from sand to pebble-boulder gravel. Sediment textures vary widely depending on the local depositional environment.

GLACIAL AND POSTGLACIAL GEOLOGIC HISTORY

The following reconstruction of the Quaternary history of the Speckled Mountain quadrangle is based on the author's interpretations of surficial earth materials described in this report, together with related topographic features. It is uncertain how many episodes of glaciation have affected the study area during the Pleistocene Ice Age. Till deposits in western Maine clearly record the most recent (late Wisconsinan) glaciation, and probably one earlier event. The deeply weathered lower till found elsewhere in central and southern New England has also been recognized in this part of the state (Thompson and Borns, 1985; Weddle and others, 1989). Although it is not well-dated, the lower till was deposited during the penultimate glaciation of probable Illinoian age.

The most recent (late Wisconsinan) glaciation began about 25,000 years ago (Stone and Borns, 1986). It produced a large portion of the stony till deposits that blanket the upland areas of the quadrangle. Glacial plucking on the lee sides of bedrock hills eroded steep southeast-facing slopes and cliffs. Many dramatic examples of these cliffs can be seen in the Speckled Mountain quadrangle, such as those on Blueberry Mountain, Red Rock Mountain, and Haystack Mountain-Caribou Mountain. Rocks torn from the hills were scattered in the direction of glacial transport.

Abrasion by rock debris dragged at the base of the glacier polished and striated the bedrock surface. In many places striations are not evident because they are either concealed beneath surficial sediments or have been destroyed by weathering at the ground surface. The best examples of striations and glacially polished ledges in the Speckled Mountain quadrangle usually are found on granite pegmatite veins. The geologic map shows sites in the quadrangle where striation trends have been recorded. Most data came from ledges along hiking trails on the mountains, and places where bedrock is exposed next to woods roads. Some of these occurrences are limited to small pods of quartz in otherwise weathered ledges, and the striations were visible only after rubbing a pencil across the rock surface (see Figure 2 on the geologic map).

Some of the striation data from the Speckled Mountain quadrangle indicate glacial flow directions ranging from east-southeast to south-southeast. This generally southeastward flow probably occurred during the maximum phase of late Wisconsinan glaciation, when glacially streamlined hills in this region of Maine were sculpted with the same orientation. However, numerous places in the southern and southeastern parts of the quadrangle record ice flow between south and south-southwest (180-206°). Multiple striation sets on Red Rock Mountain and

the south spur of Speckled Mountain indicate that the latter flow is younger than the southeast trend. This shift in flow direction has been recognized over much of southwestern Maine. It is believed to have resulted from reorganization of ice flow as the glacier thinned over the Mahoosuc Range to the north (Thompson and Koteff, 1995; Thompson, 2001).

The minimum age of glacial retreat from the Speckled Mountain quadrangle can be estimated from radiocarbon dating of organic material in lake-bottom sediments deposited soon after deglaciation. Thompson and others (1996) obtained an age of 13,200 radiocarbon years from Cushman Pond in Lovell, so the study area probably was deglaciated by this time. However, isolated masses of stagnant ice may have lingered in valleys. The nearby Saco Valley was certainly ice-free by 12,000 years ago, judging from dated plant remains in Fryeburg (Thompson, 1999). Melting of the late Wisconsinan glacier would have simultaneously produced thinning of the ice sheet and recession of its margin. In the rugged terrain of western Maine, the configuration of the ice margin probably was very irregular, with tongues of still-active ice in some of the valleys when nearby mountain peaks had already emerged from the ice sheet. At some point the mountains interfered with glacial flow, and large masses of ice became detached from the main ice sheet and were left to stagnate in the lowlands.

The lack of end moraines in the Speckled Mountain quadrangle hinders detailed reconstruction of the pattern of deglaciation. However, meltwater channels and sand and gravel deposits provide clues to the history of ice recession in the area. The locations and slopes of channels carved on hillsides by glacial streams generally support a northward recession of the ice margin. Additional evidence of northward retreat is provided by the distribution and topography of glaciofluvial sediments and deposits formed in ice-dammed glacial lakes. South-draining stream basins typically contain glaciofluvial deposits such as the Great Brook outwash (Pgog), in which the stream-graded tops of the deposits are lower from north to south. On the other hand, north-draining valleys such as the Pleasant River basin were temporarily dammed by the receding ice margin and hosted glacial lakes that spilled through the lowest available gaps in the surrounding hills. The history of glacial retreat from the Speckled Mountain quadrangle will be discussed in relation to sand and gravel deposits formed in these two depositional environments.

The oldest glacial meltwater deposits occur in the valleys of Great Brook and Shell Pond Brook. As the ice margin receded from the southwest corner of the quadrangle, sand and gravel washed from the edge of the glacier and built the broad Rattlesnake Brook fan (Pgfr). Sediment input from the ice probably was short-lived, because the high mountains just north of here would have cut off the flow of the thinning ice sheet during an early stage of deglaciation. However, it is likely that some further aggradation of the fan occurred as sediments were eroded from till and colluvium on the freshly exposed mountainsides. This process is called paraglacial sedimentation.

At about the same time that unit Pgfr was being deposited, outwash sand and gravel (Pgog) accumulated in the Great Brook basin in the southeastern part of the quadrangle. The Pgog deposits in the Beaver Brook valley probably were built in part by glacial streams issuing from Miles Notch and meltwater channels in the Isaiah Mountain area. Miles Notch is not nearly as large or spectacular as Evans Notch, but there is an intriguing bit of evidence that it was a drainage route for glacial meltwater. Just south of the highest point on the Miles Notch trail, there is a bedrock outcrop on the east side of the trail, showing milky quartz that is polished to a brilliant mirror luster. Close inspection of this polished surface did not reveal any definite glacial striations. Rather, there are small, shallow, scalloped indentations like those which typically result from abrasion by sediment-laden glacial streams.

As the glacier receded from Speckled Mountain and other peaks in central and northern portions of the quadrangle, meltwater drainage was trapped between the ice margin and topographic divides to the south. It is likely that ice-dammed glacial lakes formed in the Evans Notch and West Branch Pleasant River valleys. The volume of sand and gravel deposited in the lakes is small because there were no major subglacial tunnel systems delivering sediments to the ice margin in this area. The ice-contact deposits just north of Evans Notch (Pgi) may be at least partly deltaic, but in any case they resulted from meltwater pouring off the ice sheet and draining through the notch. Damming of the West Branch valley impounded glacial Lake Mason, which drained eastward through a spillway northeast of Bad Mountain in the East Stoneham quadrangle (see description of unit Plma).

Some of the till exposures in the ice-dammed valleys suggest deposition by debris flows off the glacier and directly into glacial lakes. These waterlain tills contain abundant lenses of silt and sand. One such occurrence in the West Branch basin is shown in Figure 4 on the geologic map. Another example was seen adjacent to the National Forest road on the northeast side of Little Lary Brook (northwestern part of the quadrangle). The latter deposit is unlike the usual till in the area. It is a laminated clay-silt diamicton with scattered stones, which is typical of low-energy ice-marginal (or possibly subglacial) environments where meltwater is ponded.

During and after deglaciation of the Speckled Mountain quadrangle, nonglacial streams began to establish their modern drainage patterns. Water emptied from the glacial lakes upon melting of their ice dams, and the lake deposits (Plma) in the East Branch valley were deeply eroded. As soon as the ice retreated from the sides of hills and mountains, the freshly deposited glacial sediments were very susceptible to erosion until a vegetation cover was established. Much of the alluvial gravel and sand, including the fan deposits, probably formed at this time. The older alluvium commonly occurs as terraces that stand higher than the present-day flood plains along brooks and rivers.

Deposits of recent flood-plain alluvium (unit Ha) continue to accumulate along modern streams in the Speckled Mountain

quadrangle, and organic-rich sediments (unit Hw) are being deposited in small wetlands. Gravel deposits along most streams in the area are very coarse (bouldery), so presumably are transported mostly when water levels are high during spring runoff and floods.

ECONOMIC GEOLOGY

Sand and gravel supplies are limited to valley areas of the quadrangle, where they have been concentrated by glacial and postglacial stream deposition. Several small pits have been worked in the glacial outwash (Pgog), stream terrace deposits (Qst), and alluvial fans in the Speckled Mountain quadrangle. Extensive gravel deposits remain in the fan complex along Evans Brook, but utilization of these sand and gravel resources would be restricted because of their location in the White Mountain National Forest. Much of the sandy till in the quadrangle has a silty-sandy matrix that compacts well in applications where fill is needed.

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APPENDIX A
GLOSSARY OF TERMS USED ON MAINE GEOLOGICAL SURVEY SURFICIAL GEOLOGIC MAPS

compiled by
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Note: Terms shown in italics are defined elsewhere in the glossary.

Ablation till: *till* formed by release of sedimentary debris from melting glacial ice, accompanied by variable amounts of slumping and meltwater action. May be loose and stony, and contains lenses of washed sand and gravel.

Basal melt-out till: *till* resulting from melting of debris-rich ice in the bottom part of a glacier. Generally shows crude stratification due to included sand and gravel lenses.

Clast: pebble-, cobble-, or boulder-size fragment of rock or other material in a finer-grained *matrix*. Often refers to stones in glacial till or gravel.

Clast-supported: refers to sediment that consists mostly or entirely of *clasts*, generally with more than 40% clasts. Usually the clasts are in contact with each other. For example, a well-sorted cobble gravel.

Delta: a body of sand and gravel deposited where a stream enters a lake or ocean and drops its sediment load. Glacially deposited deltas in Maine usually consist of two parts: (1) coarse, horizontal, often gravelly topset beds deposited in stream channels on the flat delta top, and (2) underlying, finer-grained, inclined foreset beds deposited on the advancing delta front.

Deposit: general term for any accumulation of sediment, rocks, or other earth materials.

Diamicton: any poorly-sorted sediment, containing a wide range of particle sizes, e.g. glacial *till*.

Drumlin: an elongate oval-shaped hill, often composed of glacial sediments, that has been shaped by the flow of glacial ice, such that its long axis is parallel to the direction of ice flow.

End moraine: a ridge of sediment deposited at the margin of a glacier. Usually consists of till and/or sand and gravel in various proportions.

Englacial: occurring or formed within glacial ice.

Eolian: formed by wind action, such as a sand dune.

Esker: a ridge of sand and gravel deposited at least partly by meltwater flowing in a tunnel within or beneath glacial ice. Many ridges mapped as eskers include variable amounts of sediment deposited in narrow open channels or at the mouths of ice tunnels.

Fluvial: Formed by running water, for example by meltwater streams discharging from a glacier.

Glaciolacustrine: refers to sediments or processes involving a lake which received meltwater from glacial ice.

Glaciomarine: refers to sediments and processes related to environments where marine water and glacial ice were in contact.

Head of outwash: same as *outwash head*.

Holocene: term for the time period from 10,000 years ago to the present. It is often used synonymously with "postglacial" because most of New England has been free of glacial ice since that time.

Ice age: see *Pleistocene*.

Ice-contact: refers to any sedimentary deposit or other feature that formed adjacent to glacial ice. Many such deposits show irregular topography due to melting of the ice against which they were laid down, and resulting collapse.

Kettle: a depression on the ground surface, ranging in outline from circular to very irregular, left by the melting of a mass of glacial ice that had been surrounded by glacial sediments. Many kettles now contain ponds or wetlands.

Kettle hole: same as *kettle*.

Lacustrine: pertaining to a lake.

Late-glacial: refers to the time when the most recent glacial ice sheet was receding from Maine, approximately 15,000-10,000 years ago.

Late Wisconsinan: the most recent part of *Pleistocene* time, during which the latest continental ice sheet covered all or portions of New England (approx. 25,000-10,000 years ago).

Lodgement till: very dense variety of till, deposited beneath flowing glacial ice. May be known locally as “hardpan.”

Matrix: the fine-grained material, generally silt and sand, which comprises the bulk of many sediments and may contain *clasts*.

Matrix-supported: refers to any sediment that consists mostly or entirely of a fine-grained component such as silt or sand. Generally contains less than 20-30% clasts, which are not in contact with one another. For example, a fine sand with scattered pebbles.

Moraine: General term for glacially deposited sediment, but often used as short form of “*end moraine*.”

Morphosequence: a group of water-laid glacial deposits (often consisting of sand and gravel) that were deposited more-or-less at the same time by meltwater streams issuing from a particular position of a glacier margin. The depositional pattern of each morphosequence was usually controlled by a local base level, such as a lake level, to which the sediments were transported.

Outwash: sediment derived from melting glacial ice, and deposited by meltwater streams in front of a glacier.

Outwash head: the end of an *outwash* deposit that was closest to the glacier margin from which it originated. *Ice-contact* outwash heads typically show steep slopes, *kettles* and hummocks, and/or boulders dumped off the ice. These features help define former positions of a retreating glacier margin, especially where *end moraines* are absent.

Pleistocene: term for the time period between 2-3 million years ago and 10,000 years ago, during which there were several glaciations. Also called the “Ice Age.”

Proglacial: occurring or formed in front of a glacier.

Quaternary: term for the era between 2-3 million years ago and the present. Includes both the *Pleistocene* and *Holocene*.

Striation: a narrow scratch on bedrock or a stone, produced by the abrasive action of debris-laden glacial ice. Plural form sometimes given as “*striae*.”

Subaqueous fan: a somewhat fan-shaped deposit of sand and gravel that was formed by meltwater streams entering a lake or ocean at the margin of a glacier. Similar to a *delta*, but was not built up to the water surface.

Subglacial: occurring or formed beneath a glacier.

Till: a heterogeneous, usually non-stratified sediment deposited directly from glacial ice. Particle size may range from clay through silt, sand, and gravel to large boulders.

Topset/foreset contact: the more-or-less horizontal boundary between topset and foreset beds in a *delta*. This boundary closely approximates the water level of the lake or ocean into which the delta was built.