Instructor's Disclaimer

Do to time constraints, some information has been overly simplified, abbreviated, and in a few instances omitted.

Continued study is encouraged!

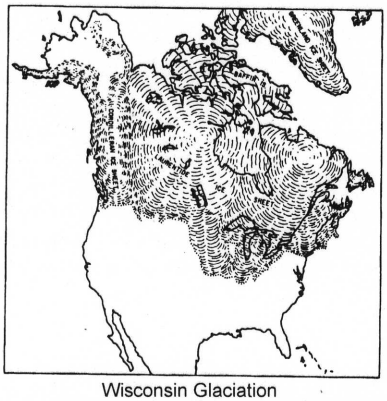
Soil Parent Material

Developed by Peter C. Fletcher

The geologic sediments that the soil formed in.

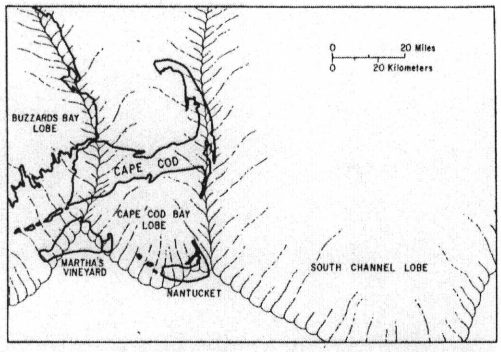
Soil Parent Materials

- Glacial till
- Shallow bedrock
- Glacial outwash
- Lacustrine
- Marine silts and clays
- Windblown
- Organic matter
- Alluvial (floodplain)
- Coastal dunes, beaches, and tidal marsh
- Fill material (HTM)



Wisconsin Glaciation

The Geologic Story, Cape Cod, Martha's Vineyard, and Nantucket, Robert N. Oldale



The Geologic Story, Cape Cod, Martha's Vineyard, and Nantucket, Robert N. Oldale

Glacial Till

Dominantly unsorted and unstratified debris, deposited directly by a glacier, and consisting of a heterogeneous mixture of all the particles sizes - clay, silt, sand, gravel, stones, and boulders

Different Kinds of Glacial Till

Two Broad Groupings of tills:

1. Compact, dense, lodgment, or basal are terms used to designate compact glacial till that was deposited at the base of an actively flowing (moving) glacier.
2. Ablation, loose sandy, or melt-out are terms used to designate loose sandy glacial till that was deposited by a wasting (melting) glacier.

Characteristics of Compact Till Material

- Heterogeneous mixture of all particles sizes, ranging from clay to boulder size
- Unsorted, meaning not stratified
- Angular shaped rock fragments
- Substratum, firm and compact
- Relatively high clay content (5 to 25%)
- Rock fragments are held firmly inplace

Characteristics of Compact Till Material (continued)

- Typically occurs at 2.5 to 3 feet below the ground surface
- Locally referred to as "hardpan"
- Often has a perched water table during the wet seasons of the year and following periods of heavy precipitation

Hardpan

- Any naturally occurring layer of hard, densely, compacted soil
- Generally formed in glacial till soils
- Little void space
- Low permeability and slow perc rate

Kinds of Hardpans

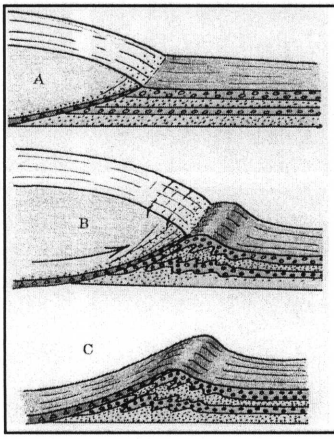
- Moderately restrictive, 20 to 30 min./inch
- Severely restrictive, 30 to 60 min./inch
- Impervious, greater than 60 min./inch

Characteristics of Ablation Till

- Dominantly loose sandy and gravelly material
- Typically extremely variable with pockets and discontinuous strata of different material
- Unstratified to very coarsely stratified
- Small amount of clay (2 to 5%)
- Often has a high percentage of angular stones and boulders

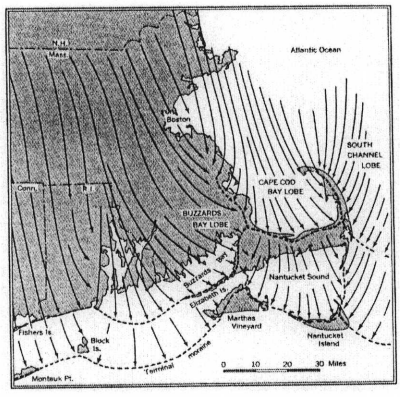
Glacial Till Landforms

- Moraine* – ridge perpendicular to the direction of ice flow, marking a position where the terminus of the ice stood for a period of time
- Drumlin* – oval shaped hill, long axis parallel to the direction of ice flow
- Till Ridge – a ridge of till parallel to the direction of ice flow
- Ground Moraine – an area of glacial till without any characteristic shape

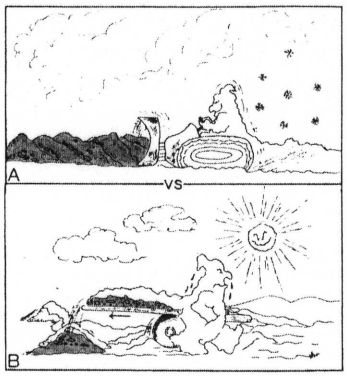


Formation of a Push Moraine

The Ice Age World, Anderson and Borns



The Geologic Story Cape Cod, Martha's Vineyard, and Nantuckey, Robert N. Oldale



Source: Cape Cod and the Islands, The Geologic Story, By Robert N. Oldale

Shallow to Bedrock Soils

These soils almost always occur on the landscape in an intricate pattern that is so small in area (soil complex) that it is not practical to map the individual soils separately. Soil conditions typically range from ledge outcrops, to soils that are underlain at a shallow depth by bedrock, to pockets of deep soil.

Shallow to Bedrock Soils

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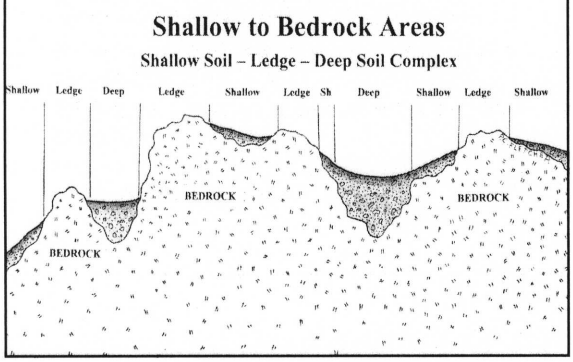
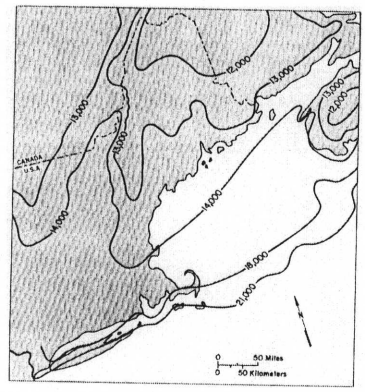


Characteristics of Shallow to Bedrock Soils

- Extremely variable soil conditions that may change within short distances
- Depth to bedrock may change over short distances
- Often, no predictable pattern to the soils
- Some bedrock (ledge) can be excavated (rippable) using heavy equipment
- Solid rock, fractured rock, and weathered rock (saprolite)

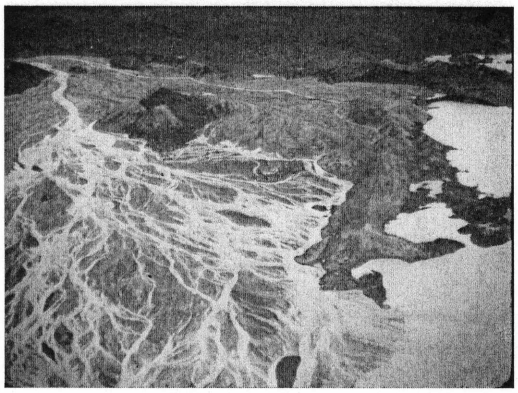


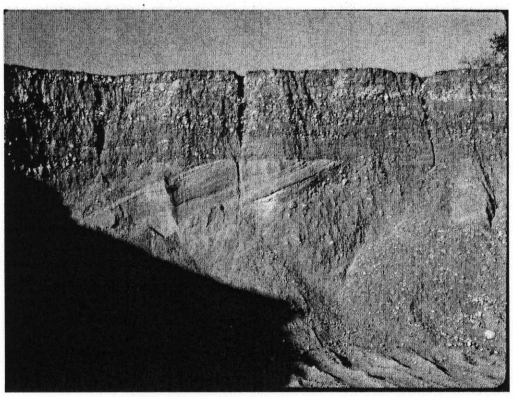
Stages in Retreat of Laurentide Ice Sheet

The Geologic Story, Cape Cod, Martha's Vineyard, and Nantucket, Robert N. Oldale

Glacial Outwash

Stratified deposits of sand and gravel produced by glaciers; and carried, sorted, and deposited by melt-water streams.





Kinds of Glacial Outwash

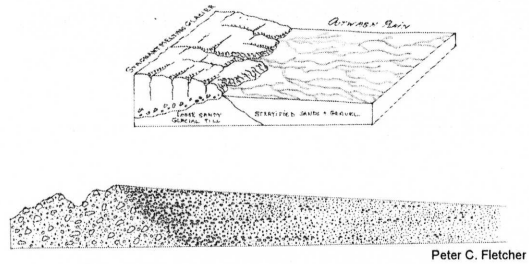
Two broad grouping of outwash:

1. Proglacial outwash: stratified outwash deposited in front of or just beyond the outer limits of the glacier
2. Ice-contact outwash: collapsed outwash originally deposited adjacent to or on top of stagnant glacial ice

Characteristics of Proglacial Outwash Deposits

- Most often occur as broad, nearly level, outwash plains
- Typically stratified sands and gravel
- Particle size is dependent on the original source of material and the velocity of the stream and may range from cobble size to fine sand
- Generally lacks stones and boulders
- Rock fragments are typically rounded or subrounded
- Only a trace amount of fines (silt and clay)
- Loose material, sides of pits often slough in

Landforms Common to Areas of Proglacial Outwash



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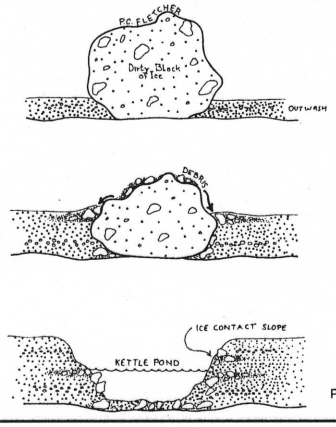
Characteristics of Ice-contact Outwash Deposits

- Irregular topography (uneven terrain)
- Typically, a gravelly sandy material with slumped or collapsed stratification
- Extremely variable material, often with pockets and discontinuous lenses of silts and clays, and pockets of stones and possible boulders.

Landforms Common to Areas of Ice-contact Outwash

- Esker*
- Pitted outwash plain
- Kame*
- Kame and kettle topography
- Kame delta
- Kame terrace*
- Kettle*
- Kettle pond*
- Kettle bog



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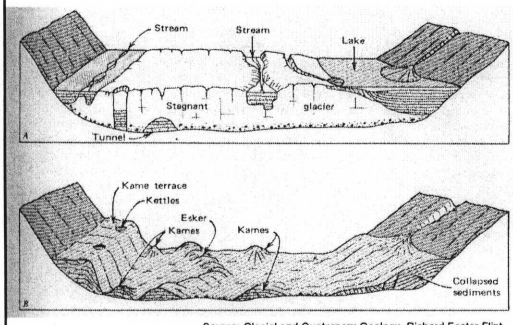
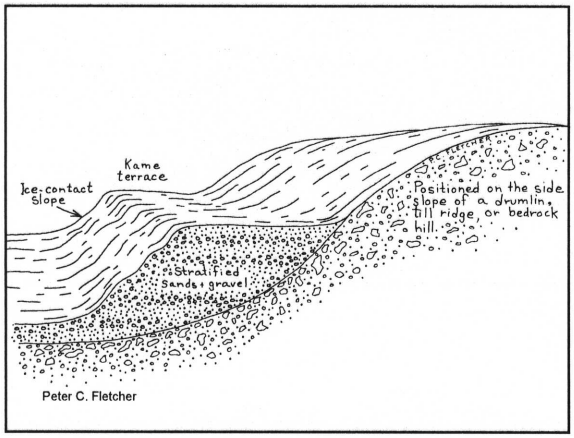


Source: Glacial and Quaternary Geology, Richard Foster Flint


Kame terrace
Ice-contact slope
Positioned on the side slope of a drumlin, till ridge, or bedrock hill.
Stratified sands + gravel
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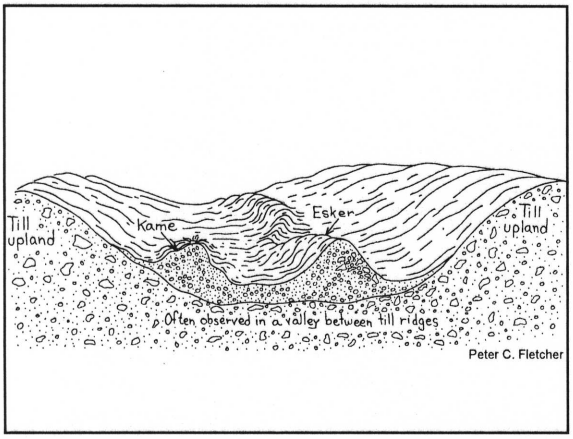
Till upland
Kame
Esker
Till upland
Often observed in a valley between till ridges
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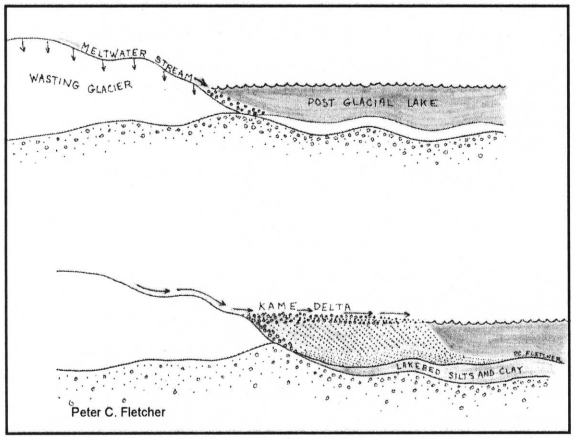
MELTWATER STREAM
WASTING GLACIER
POST GLACIAL LAKE
KAME DELTA
LAKEBED SILTS AND CLAY
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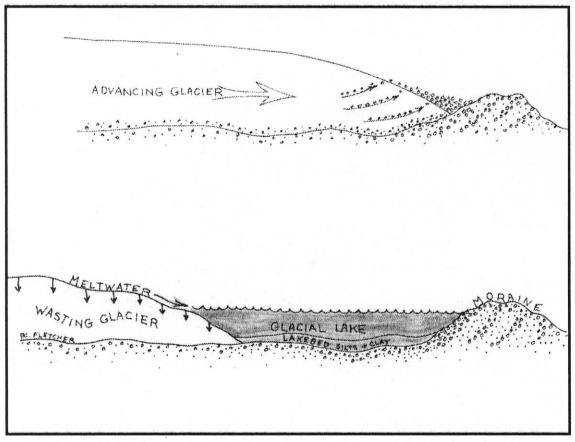
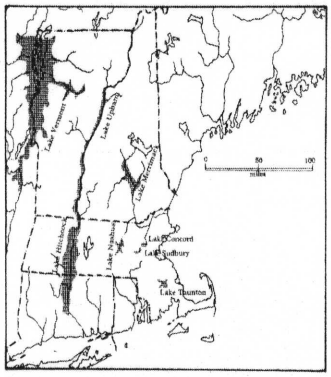
Lacustrine Sediments (lakebed silts and clays)

Silts and clays deposited (varved) at the bottom of a glacial lake which has since drained.

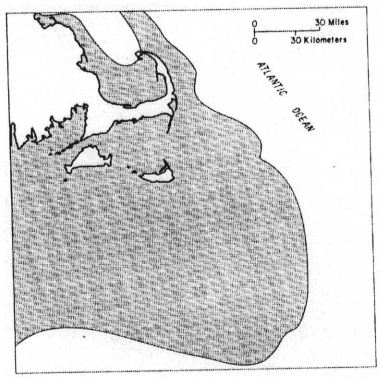




Map showing New England's major glacial lakes.
Source: A Guide to New England's Landscape, Neil Jorgenson

Characteristics of Lacustrine Sediments

- Well sorted, mostly silts and clays
- Typically a high percentage (30% or more) of clay
- Often varved, alternating thin layers of silt and clay
- Few if any rock fragments



Exposed Continental Shelf, Early Stages of Retreat

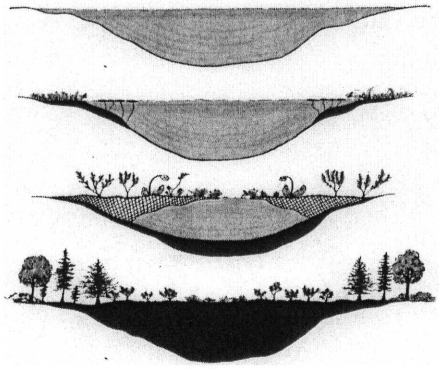
The Geologic Story, Cape Cod, Martha's Vineyard, and Nantucket, Robert N. Oldale

Windblown Mantle (eolian deposits)

Windblown fine sands and silt, deposited as the glacier wasted northward and before the landscape was stabilized by vegetation. Typically occur as a mantle (layer) of fine sand and silt overlying another kind of glacial material.

Organic Deposits

Bog, swamp, and marsh deposits of partially and well decomposed organic matter.



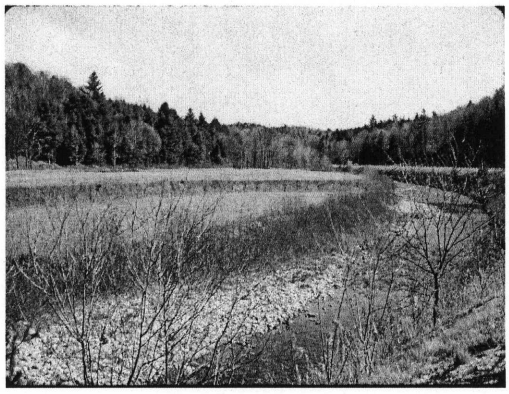
Bogs of the Northeast, Charles W. Johnson

Coastal Marine Deposits

Coastal sand dunes, beaches, and tidal marshes.

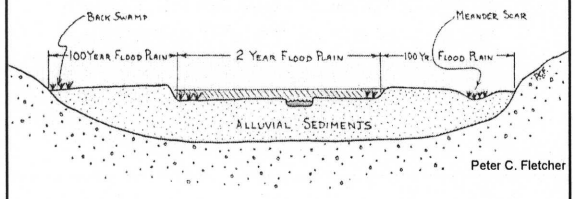
Alluvial Deposits (floodplain)

Sediments deposited by present day streams and rivers. Typically occur as nearly level terraces adjacent to the stream banks.



Landforms Common to Areas of Alluvial Sediments

- Floodplain*
- Stream or river terrace
- Meander scar
- Oxbow lake
- Natural level



Flood Plain (alluvial) Deposits: Material transported and deposited by running water.

Fill Material (HTM)

- Human-transported material (HTM), formerly referred to as fill material or anthropogenic soil, is defined as any material moved and placed onto another area from a different source by directed (intentional) human activity, usually with the aid of heavy equipment.