Tunbridge
Vermont State Soil

Photo Soil Monolith: Chip Clark/Smithsonian Institution

Soil Science Society of America

Introduction

Many states have a designated State bird, flower, fish, tree, or rock. And many states also have a State soil – one that has significance or is important to the state. The Tunbridge soil is the official State soil of Vermont. Let's explore how the Tunbridge soil is important to Vermont.

History

The Tunbridge soil series became the third official State Soil in the United States, through an official Vermont act of legislation in March 1985. A committee of soil scientists, conservationists, and legislators selected the soil as it best represents the unique landscape of Vermont. It is found in all but one county in the state. Its name comes from the town of Tunbridge, Vermont.

What is the Tunbridge Soil?

The Tunbridge soil is a well-drained, loamy, acidic soil formed in Wisconsin-age glacial till. It has schist, gneiss, phyllite or granite bedrock at a depth between 20 and 40 inches. From a geological perspective, these soils are fairly young, with their formation dating back to the melting of the last glacial ice sheet about 10,000 years ago. Tunbridge soils formed under woodland vegetation, with common trees being sugar maple, yellow birch, American beech, eastern hemlock, white birch, white pine, red spruce and red maple.

Every soil can be separated into three separate size fractions called *sand*, *silt*, and *clay*, which makes up the *soil texture*. They are present in all soils in different proportions and say a lot about the character of the soil. The glacial till parent material of the Tunbridge soil is loamy, with typical textures of sandy loam and loam in all the horizons. With those textures, sand ranges from 45 to 70 percent; silt ranges from 20 to 50 percent; and clay ranges from 0 to 12 percent. The thickness of the organic surface layer is 7 inches. A leached layer is from 7 to 12 inches, and the subsoil is from 12 to 28 inches. The depth to bedrock of this soil profile is 28 inches. This soil has never been plowed **(Figure 1)**.

Fig. 1. A Tunbridge soil profile in a hemlock forest. Credit: Thomas Villers

Fig. 2. Typical landscape for Tunbridge soils in the Green Mountains of Vermont. Credit: Thomas Villers

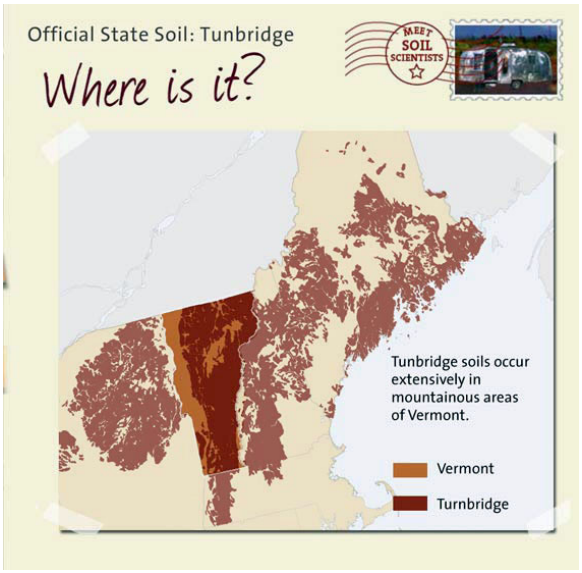

Fig. 3. Location of the Tunbridge soil in Vermont. Credit: Smithsonian Institution's Forces of Change

Where to dig in a Tunbridge soil

Yes, you can dig a soil. It is called a soil pit and it shows you the *soil profile*. The different horizontal layers of the soil are called *soil horizons* (see figure 1). The best place to find a Tunbridge soil is in the woods in the Green Mountains in the central part of Vermont. This does not mean that other types of soil cannot be found there but that the Tunbridge soil is the most common. These soils are on sloping, hilly and mountainous terrain **(Figure 2).** In the early spring, you might see some sap buckets hanging from sugar maple trees, or there might be a ski area or hiking trail nearby. But you can also find Tunbridge soils in some pastures and hayfields, helping to support the many dairy farms in the state. In all, there are a total of about 180 named soils (series) in Vermont. The Tunbridge soil covers well over 400,000 acres of land in 13 counties in Vermont, with many thousands more acres in four other northeastern states (**Figure 3**).

Uses

In general, soils can be used for agriculture (growing food, raising animals, stables); engineering (roads, buildings, tunnels); ecology (wildlife habitat, wetlands), recreation (ball fields, playgrounds, camp areas) and more. Woodland, agriculture, and recreation are what Tunbridge soils are mostly used for, along with some land being used for rural residential development. Because most of the Tunbridge soils are on steeply sloping land, they are not ideal for intensive agriculture that involves annual tillage, like growing corn silage. Instead, most agricultural uses for Tunbridge soils are for pasture land and hayland. But perhaps the most well-known crop harvested from Tunbridge soils is the sap from sugar maple trees, which is boiled down to delicious maple syrup. Vermont is the largest producer of maple syrup in the United States. The steep Tunbridge soils can also be found in the many downhill ski areas in the state **(Figure 4)**.

Importance

What makes the Tunbridge soil so important is its use and prevalence in the State. It supports a huge forest products industry in Vermont, including veneer logs, structural lumber, firewood, woodchips and pellets, and other forest products. As mentioned, maple syrup production in Vermont is the highest in the country, partly due to the forests supported by the Tunbridge soils. The hilly terrain where these soils are found supports many recreational activities, including mountain biking, downhill and cross-country skiing, and hiking. If you hike on the Appalachian Trail or the Long Trail in Vermont, part of your hike will probably be on Tunbridge soils.

Fig. 4. Right: Vermont is the largest producer of maple syrup in the United States. Far right: Killington North Ridge, Credit: Mark Klapper, en.wikipedia.org/wiki/Killington_Ski_Resort, CCY BY 2.5

Fig. 5. Example of windthrown tree.

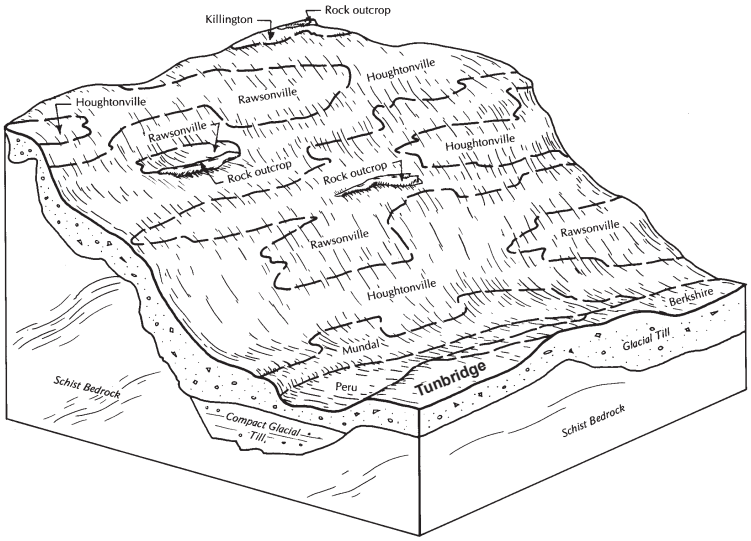

Fig. 6. Relationship of Tunbridge soil to landform position and parent material. Credit: USDA-NRCS

Limitations

When a soil cannot be used for one or more of the described functions, it is referred to as a limitation. Soil experts, called *Soil Scientists*, have studied the Tunbridge soil and identified several severe limitations. These limitations involve two features of the soil. The first feature causing limitations is the moderately deep depth to bedrock. In Tunbridge soils, bedrock is encountered at only 20 to 40 inches below the surface of the soil. That makes it difficult to build a house with a basement, or to install a deep electric, water or sewer line, or put in a septic system, and the depth to bedrock can cause problems for deep-rooted crops and trees, too. Windthrow can be a problem because trees have a shallow rooting depth **(Figure 5)**. The other feature that can be a limitation is the steepness of the slope. In many places, the Tunbridge soil is found on 35 to 60 percent slopes. Erosion can be very severe on those slopes, so any type of agricultural tillage or any construction project that leaves the soil bare can lead to high runoff and soil loss rates. Operating forestry and agricultural equipment on steep slopes is also very difficult and dangerous.

Management

The limitations of Tunbridge soils, moderately deep to bedrock and steep slopes, also affect their management. Deep rooted trees and crops are not well suited because of the limited rooting depth. Erosion control practices are almost always needed, whether for harvesting trees or harvesting hay, and certainly for any construction project. Look again at the photo of the Tunbridge in Figure 1. Because of the types of soil horizons near the surface of the soil, there is evidence that the soil in the photo has never, ever been plowed. How many other state soils have never been plowed? Not many!

Tunbridge soils are also fairly acidic. That greyish layer in the soil is a result of acidic leaching taking place in the soil profile. For most agricultural crops, additions of lime are necessary to raise the soil pH up to a level that's better for plant growth. Most trees can tolerate the acidic soil conditions, especially softwoods and American beech. Sugar maple, however, prefers a higher soil pH and the best growth for that species occurs where the pH level is on the high end of the range for the Tunbridge soil.

Tunbridge Soil Formation

Before there was soil, there was CLORPT. Without CLORPT, there will be no soil. So, what is CLORPT? It is the five major factors that are responsible for forming a soil like the Tunbridge series. It stands for Climate, Organisms, Relief, Parent material and Time. CLORPT is responsible for the development of soil profiles and chemical properties that differentiate soils. So, the characteristics of Tunbridge (and all other soils) are determined by the influence of CLORPT. Soil formation begins to happen when climatic processes such as rainfall and freezing and thawing act on parent materials, causing them to physically and chemically dissolve or fracture and break into pieces. Organisms and the local topography then influence parent materials, and over time these materials change and develop into soils.

Climate – Temperature and precipitation influence the rate at which parent materials weather and dead plants and animals decompose. They affect the chemical, physical and biological relationships in the soil. Tunbridge soils are in cool, moist northern climates, with relatively short growing seasons, long winters, and plentiful moisture and freezing and thawing.

Organisms – These are the plants and animals that live in and on the soil. Plant roots spread into the soil and take up nutrients, animals large and small make the soil their home, and many bacteria and fungi break down plant and animal tissue. Some soil organisms hasten the breakdown of soil particles into smaller ones. Plants and animals influence the formation and differentiation of soil horizons. Plants are the primary contributors of *organic matter* to the soil, and the microscopic bacteria and other organisms help to breakdown complex organic compounds and thus also play a role in adding organic matter to soil. Tunbridge soil formed under a mixed hardwood and softwood forest, and the forest bacteria and fungi played a major role in how these soils developed over time.

Relief – Landform position, or relief or topography, describes the general shape of the land. The 'aspect' describes the direction it faces, which affects how much sunlight and solar heating the soil gets every day and how dry or moist the soil might be. Tunbridge soils are found on hilly to mountainous terrain. Rarely do you find an area of Tunbridge soils that is flat. Perhaps a typical slope range for Tunbridge soils is 15 to 35 percent, but there are also areas of Tunbridge soils on slopes as steep as 60 percent **(Figure 6).**

Parent material – Just like people inherit characteristics from their parents, every soil inherits some traits from the material from which it forms. Some parent materials are transported and deposited by glaciers, wind, water, or gravity. Tunbridge is one of those soils formed from glacial till. Glacial till is one of the most common parent materials in Vermont and in the northeastern United States. It has a loamy texture and has plenty of small stones, and some big ones, too. The depth of the glacial till parent material varies from very shallow (just a few inches thick) to well over 20 to 30 feet thick. But Tunbridge soils have a very specific depth to bedrock – it's found between 20 and 40 inches below the soil surface. Soil scientists refer to this depth to bedrock range as 'moderately deep to bedrock.'

Time – All the other factors act together over time to produce soils. But soils are not all the same age - they vary in age. And just like people, older soils are different from younger soils. Generally, older soils have more strongly expressed horizons than younger soils and have different chemical compounds. Tunbridge soils are young soils, compared to a lot of other soils in the United States. Why? Because they only started forming about 10,000 years ago when the glacier melted in New England and the soil parent material was exposed. Areas of the US south of the coverage of last glacier have much older soils. In Vermont, we like to think of our soils as 'teenagers,' because they're so young. They're still growing up!

Ecoregions, Soils and Land Use in Vermont

The hilly and mountainous land where you find Tunbridge soils in Vermont is part of the Northeastern Highlands ecoregion. It is a heavily forested landscape, with some agriculture in the valleys and flatter ridges. More specifically, within Vermont, Tunbridge soils are common in the Green Mountain/ Berkshire Highlands, the Vermont Piedmont and the Northern Piedmont, and the Quebec/New England Boundary Mountains. These land areas extend into the hills and mountains in Maine, New Hampshire, New York and Massachusetts **(Figure 7).** Ecoregions in Vermont where Tunbridge soils are not found are in the warmer Champlain Lowlands and the Western New England Marble Valleys.

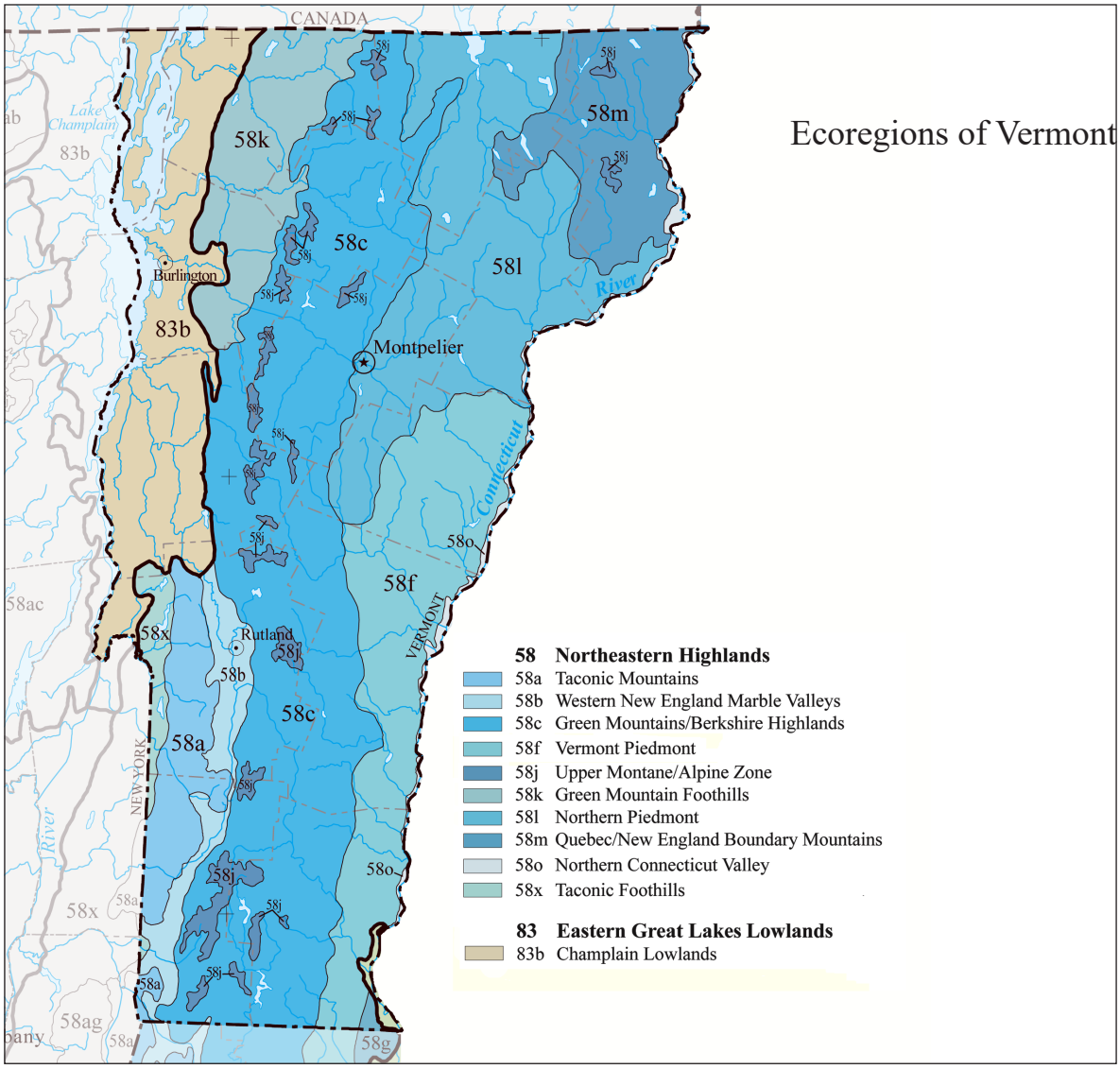

Fig. 6. Ecoregions of Vermont. Adapted from Level III and IV Ecoregions of New England. Credit: US-EPA

Glossary

Clay: A soil particle that is less than 0.002 mm in diameter. Clay particles are so fine they have more surface area for reaction. They hold a lot of nutrients and water in the soil. A clay soil is a soil that has more than 40% clay, less than 45% sand and less than 40% silt.

Ecoregion: Represents areas with similar biotic and abiotic characteristics which determine the resource potential and likely responses to natural and man-made disturbances. Characteristics such as climate, topography, geology, soils, and natural vegetation define an ecoregion. They determine the type of land cover that can exist and influence the range of land use practices that are possible.

Horizon: see Soil horizons

Organic matter: Material derived from the decay of plants and animals. Always contains compounds of carbon and hydrogen.

Sand: A soil particle between 0.05 and 2.0 mm in diameter. Sand is also used to describe soil texture according to the soil textural triangle, for example, loamy sand.

Silt: A soil particle between 0.002 and 0.05 mm diameter. It is also used to describe a soil textural class.

Soil Horizon: A layer of soil with properties that differ from the layers above or below it.

Soil Profile: The sequence of natural layers, or horizons, in a soil. It extends from the surface downward to unconsolidated material. Most soils have three major horizons, called the surface horizon, the subsoil, and the substratum.

Soil Scientist: A soil scientist studies the upper few meters of the Earth's crust in terms of its physical and chemical properties; distribution, genesis and morphology; and biological components. A soil scientist needs a strong background in the physical and biological sciences and mathematics.

Soil Texture: The relative proportion of sand, slit, and clay particles that make up a soil. Sand particles are the largest and clay particles the smallest. Learn more about soil texture at www.soils4teachers.org/physical-properties

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This state soil booklet was developed under the auspices of the Soil Science Society of America's K-12 Committee—their dedication to developing outreach materials for the K-12 audience makes this material possible.

Additional Resources

Soil! Get the Inside Scoop. David Lindbo and others. Soil Science Society of America, Madison, WI.

Know Soil, Know Life. David L. Lindbo, Deb A. Kozlowski, and Clay Robinson, editors. Soil Science Society of America, Madison, WI.

Web Resources

Soils for Teachers—www.soils4teachers.org

Soils for Kids—http://www.soils4kids.org/

Have Questions? Ask a Soil Scientist—https://www.soils.org/ask

Soil Science Society of America—https://www.soils.org/

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