

CECIL

North Carolina State Soil



SOIL SCIENCE SOCIETY OF AMERICA



Introduction

Many states have a designated state bird, flower, fish, tree, rock, and more. And, many states also have a state soil – one that has significance or is important to the state. The “Cecil” is the official state soil of North Carolina. Let’s explore how the Cecil is important to North Carolina.

History

The Cecil was first identified and mapped in Cecil County, Maryland in 1899, and derives its name from that location. Today more than 4 million hectares (10 million acres) or 40,000 km² of Cecil soil are mapped in the Piedmont region of the southeastern United States from Virginia through North Carolina, South Carolina, Georgia and Alabama (**Figure 1**). The typical location of Cecil Soil is in Franklin County, NC.

The Cecil Soil was first selected as the possible State Soil by the Soil Science Society of North Carolina in 1996. A proposal was sent to the NC legislature and the Cecil was officially designated as the State Soil in 1997. Unofficially, the Cecil is one of several related soils that are common to the southeast *Piedmont* often referred to as “Georgia Red Clay”. The Cecil may also have been partially responsible for the name of the popular bluegrass group The Red Clay Ramblers!

What is Cecil Soil?

Cecil soils are one of the most extensive and important soils in North Carolina. They occur on over 1.6 million acres or 5% of the State. They are also extensive on the *Piedmont* in the Southeastern United States occupying nearly one-third of it (**Figure 1**). Cecil soil consists of very deep, well-drained, moderately permeable, residual soils in uplands areas of the *Piedmont*. These soils are observed overlying igneous (solidified from lava or magma) and metamorphic (rock that has undergone transformation by heat and pressure) rocks. The soil is usually 1.8-2.4 meters (6-8 feet) deep followed by a zone of soft weathered bedrock (also known as saprolite) to a depth of up to 3.0-7.6 meters (10-25 feet). It is then underlain by hard, slightly weathered or unweathered bedrock.

Where to dig a Cecil

As an upland soil, Cecil soils occur on broad to narrow ridges and gentle hill slopes of the SE *Piedmont* with slopes ranging from 0 to 25 percent, although most commonly they are found between 2 and 15 percent. They are most often mapped as elongated, irregularly shaped units following the upland *topography* typical of *Piedmont* ridges and hills (**Figure 2**). They occur in areas that are between 8.1-121.4 hectares (20 and 300 acres) in size.

Photo: Chip Clark/Smithsonian Institution

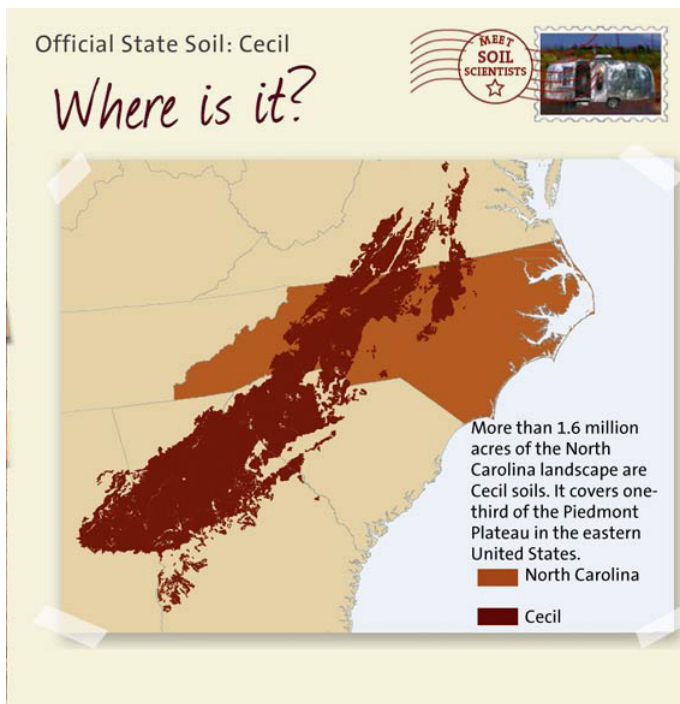


Fig. 1. Location of the Cecil Series in NC, VA, SC and GA). Credit: Smithsonian Institution's Forces of change. <http://forces.si.edu/soils/interactive/statesoils/index.html>

The surface *topography* of the *Piedmont* where the Cecil is observed is characterized by relatively low, rolling hills with elevation between 61 meters (200 feet) and 366 meters (1200 feet) above sea level (**Figure 2**). The gently sloping *uplands* often have a *convex* shape towards the top and become *concave* towards the bottom with Cecil being located on the more *convex* portions of the landscape. Since the Cecil occurs in landscapes that do not accumulate water or have a high *water table*, it is considered to be *well-drained*. In these landscapes, iron oxides are commonly observed through the *profile* which explains the red color of the Cecil.

Importance

The Cecil Series is a geographically extensive soil which in itself makes it important; however it has other important characteristics. It is considered prime farm land by the Natural Resources Conservation Service of the United States Department of Agriculture (USDA-NRCS). Since it is a well-drained soil it is usable for a wide variety of land uses from agriculture to urban uses as the water table is far from the surface. The clay content, depth and structure are benefits to the practice of growing crops (agronomy) and the agricultural practice of growing trees (*silviculture*). It is dominated by kaolinite clay meaning that it does not shrink and swell greatly as is common in soils dominated by other types of clay. The result is that house foundations and roads are not likely to be affected by shrinking and swelling of the soil. Its classification as prime farm land is limited primarily by susceptibility to or previous degrees of erosion. The Cecil Series is on the National List of Benchmark Soils and is a Hall of Fame Soil. A Cecil series profile is on display in Wageningen, The Netherlands at the International Soil Reference and Information Centre and is part of the Smithsonian Institution's "*Dig It! The Secret Life of Soil*" traveling exhibit.

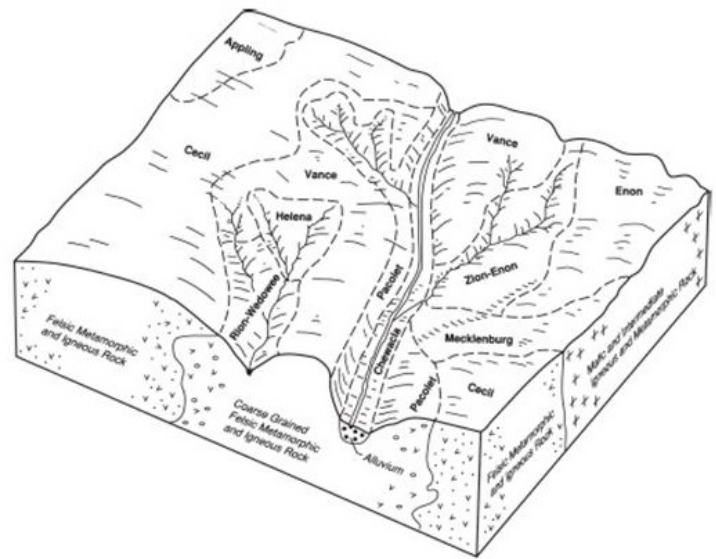


Fig. 2. Relationship of soils, landform position (relief) and parent material. Cecil soil is located on the slopes, and ridges and is deeper to bedrock. (USDA-NRCS)

Uses

Overall, the Cecil Series is suited for a wide variety of land uses. It is well suited for croplands as the first European settlers quickly discovered. Approximately 80-90% of the *Piedmont* was cleared of trees by the late 1800's for agriculture. Major crops today include wheat, soybean, corn and to a lesser extent tobacco. Pasture is common (**Figure 3**) as well and typically occurs on steeper or more historically-eroded areas. Forestry includes pine plantations, usually loblolly pine. Oak and hickory forest dominate where natural regeneration of forests has been allowed to occur. As urban development increases, areas with Cecil soils are often converted from agriculture or forestry to subdivisions.

Prior to European settlement of the SE *Piedmont*, the vegetation was dominated by forests consisting of oak (white oak (*Quercus alba*), red oak (*Q. rubra*), black oak (*Q. velutina*), and post oak (*Q. stellata*) and hickory (*Carya glabra*, *C. tomentosa*, and *C. cordiformis*). Few stands of original forest remain as much of the region was cleared for farming. Today, where forests have regenerated naturally, oak and hickory are still common along with loblolly pine (*Pinus taeda*), yellow poplar (*Liriodendron tulipifera*), and sweet gum (*Liquidambar styraciflua*). Common *understory* trees are dogwood (*Cornus florida*) and redbud (*Cercis Canadensis*).

Limitations

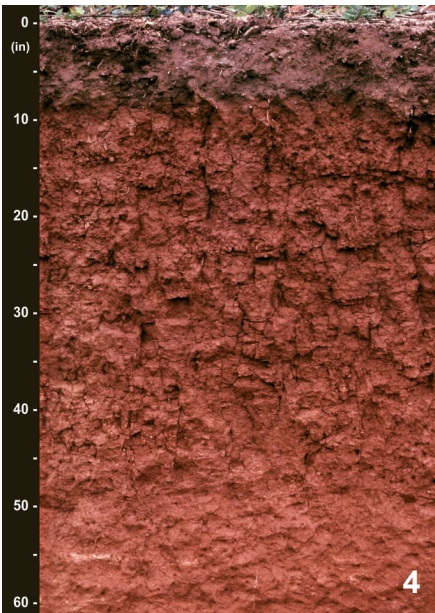
The Cecil Series has few limitations for any land use. The limitations that do exist are related to the high amount of clay which can decrease *permeability*, and to susceptibility to or history of past erosion. Permeability issues are most often seen with urban land uses. These can be overcome by use of proper construction techniques that alleviate *compaction*. Conservation tillage and related agricultural and silvicultural techniques are used to minimize erosion risk.



Fig. 3. Typical Piedmont landscape and land use for Cecil in NC (Credit: John Kelley, retired USDA-NRCS)

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Fig. 4. Typical Cecil profile (John Kelley, retired USDA-NRCS)



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Management

The Cecil soil has few management issues. Since it occurs in landscapes that do not accumulate water or have a high *water table*, it is considered to be *well-drained*.

Cecil Soil Formation

Before there was soil there were rocks and in between, CIORPT. Without CIORPT, there will be no soil. So, what is CIORPT? They are five major factors that are responsible for forming a soil like the Downer series. These are **C**limate, **O**rganisms, **R**elief, **P**arent material and **T**ime – CIORPT, for short. CIORPT is responsible for the development of soil profiles and chemical properties that differentiate soils. So, the characteristics of Cecil soil (and all other soils) are determined by the influence of CIORPT. Weathering happens when environmental processes such as rainfall, freezing and thawing act on rocks causing them to dissolve or fracture and break into pieces. CIORPT now acts on rock pieces, marine sediments and vegetative materials to form 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. The typical climate that the Cecil Series has developed in is that of the humid SE USA. This area has an average of about 127 centimeters (50 inches) of annual rain fall. Humidity is often high throughout the year. The mean annual temperature is approximately 60° F although summer temperatures can exceed 100° F and winter temperatures often dip to below freezing.

Organisms – This refers to plants and animal life. In the soil, plant roots spread through, animals burrow in and bacteria break down plant and animal tissue. These and other soil organisms speed up the breakdown of large soil particles into smaller ones. Plants and animals also influence the formation and differentiation of *soil horizons*. Plants determine the kinds and amounts of organic matter that are added to a soil under normal conditions. Animals breakdown complex compounds into small ones and in so doing add organic matter to soil.

Relief – Landform position or relief describes the shape of the land (hills and valleys), and the direction it faces makes a difference in how much sunlight the soil gets and how much water it keeps. Deeper soils form at the bottom of the hill rather than at the top because gravity and water move soil particles downhill. Cecil in generally located on the more convex portions of the landscape.

Parent Material – Just like people inherit characteristics from their parents, every soil inherited some traits from the material from which it forms. Some parent materials are transported and deposited by glaciers, wind, water, or gravity. The Cecil Series is a residual soil meaning that it has developed directly from the bedrock that underlies it. Therefore many of the properties of the Cecil can be directly related to the local bedrock. The overall geology of the SE *Piedmont* is complex with numerous types of bedrock. The *Piedmont* is the result of the *erosion* of several ancient mountain chains over the past several hundred million years. In the case of the Cecil the underlying bedrock is granite and metamorphic rocks that are described as being felsic. Felsic rocks contain high amounts

of quartz, feldspar, and mica with low amounts of minerals conation calcium and magnesium. The weathering of these minerals results in a soil that will be rich in kaolinite clay.

Time – All of these factors act together over a very long time to produce soils. As a result, soils vary in age. The length of time that soil material has been exposed to the soil-forming processes makes older soils different from younger soils. Generally, older soils have better defined *horizons* than younger soils. Although the rocks of the SE Piedmont are 100's of million years old, the soils upon them are not. These landscapes have been modified by erosion and *deposition* continuously so the soils themselves may only be a few million years old. Nevertheless the Cecil represents a well-developed, highly weathered soil of the SE *Piedmont*.

Ecoregions, Soils and Land Use in North Carolina

North Carolina is divided into four general *ecoregions* and three general soil regions. The major difference in these regions is that the *ecoregions* split the Coastal Plain Soil region into 2 separate regions – Southeastern Plains and Middle Atlantic Coastal Plain. Regardless of the regions – ecoregions versus soil regions – they represent similarities in formation and provide a more homogeneous framework for understanding the environments including hydrologic and related parameters. The river basins in North Carolina cut across different regions. The Cecil Series is located exclusively in the *Piedmont* Region (ecoregion and soil region) and more specifically in the inner and outer *Piedmont ecoregions*.

Glossary

Clay: A soil particle that is less than 0.002 mm in diameter. They can be separated from most soils and used to determine soil textural class.

Compaction: The process by which the porosity of a soil is decreased as a result of its mineral grains being squeezed together by mechanical means

Convex: A surface curved like the exterior of a circle or sphere

Concave: A surface curved like the interior of a circle or sphere

Deposition: The process by which sediments, soil, and rocks are added to a landform or land mass. Wind, ice, and water, as well as sediment flowing via gravity, transport previously eroded sediment, which, at the loss of enough kinetic energy in the fluid, is deposited, building up layers of sediment

Ecoregion: Represents areas with similar biotic (resulting from living things) and abiotic (physical/not derived from living organisms) 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.

Erosion: The process of eroding or being eroded by wind, water, or other natural agents

Geology: The study of earth, the materials (rocks) it is made of, and the physical and chemical processes that change it over time.

Geomorphology: A branch of geology and geography that studies the development of landforms.

Horizon: see Soil horizons

Infiltration: The process by which water on the ground surface enters the soil

Leaching: The removal of soluble material from soil or other material by percolating water.

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

Permeability: The ease with which gases, liquids or plant roots penetrate or pass through a layer of soil

Piedmont: a gentle slope leading from the base of mountains to a region of flat land. The NC Piedmont extends from the Blueridge to Raleigh and tends NE to SW.

Physiographic province: Are broad-scale subdivisions based on terrain texture, rock type, and geologic structure and history.

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.

Silviculture: The growing, management and harvesting of trees while considering soils, landscape and hydrology as part of the overall plan to meet the diverse needs of landowners and society on a sustainable basis.

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

Continued—

Soil Management: The sum total of how we prepare and nurture soil, select types of crops that are suitable for a type of soil, tend the crop and the soil together, determine the best types of fertilizer and other materials to be added to soil so as to maintain productivity and preserve the soil.

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, silt, 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

Soluble bases: Elements (calcium, magnesium, sodium and potassium) that are present in soil as ions and form what is called Cation Exchange Capacity. The amount in the soil can be reduced through leaching.

Subsoil: (B horizon) The soil horizon rich in minerals that eluviated, or leached down, from the horizons above it. Not present in all soils.

Topography: The shape of the land surface. (Relief: refers to differences in elevation of different points in a region.)

Topsoil: (A horizon) – Mostly weathered minerals from parent material with a little organic matter added. The horizon that formed at the land surface.

Understory: The layer of vegetation beneath the main canopy of a forest.

Upland: The higher ground of a region or an area of land lying above the level where water flows or where flooding occurs.

Water table: The top layer of ground water where the soil is filled with standing water. It can move up or down during different seasons.

Well-drained: One of several drainage classes used by soil scientist to indicate the depth to the water table during the growing season. Well drained means the water table is below 122cm or 4 feet during the growing season.

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.

References

Daniels, R.B., S.W. Buol, H.J. Kleiss, and C.A. Ditzler, 1999: *Soil Systems in North Carolina*, North Carolina State University, Soil Science Department, Raleigh, NC

Lindbo, D.L. et al., 2008. *Soil! Get the Inside Scoop.* Soil Science Society of America, Madison, WI.

Lindbo, D.L., D. A. Kozlowski, and C. Robinson, 2012. *Know Soil, Know Life.* Soil Science Society of America, Madison, WI.

Web Resources

Soils Links

Soils for Kids—www.soils4kids.org/

Resources for Teachers—www.soils4teachers.org

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

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

NRCS Links

Natural Resources Conservation Service—<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/>

Natural Resources Conservation Service, Educational Resources—http://soils.usda.gov/education/resources/k_6/

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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.