

NEON Site-Level Plot Summary Oak Ridge National Laboratory (ORNL)

Document Information

Date

June 20, 2017

Author

Jennifer Mason, Soil Survey Office Leader, Clinton, TN

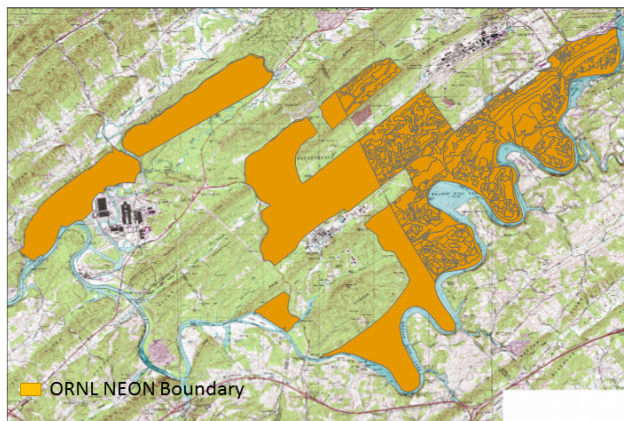
Site Background

The Oak Ridge National Laboratory (ORNL) site is in Major Land Resource Area (MLRA) 128–Southern Appalachian Ridges and Valleys. The NEON Boundary consists of approximately 16,735 acres. The Oak Ridge National Laboratory area is approximately 33,500 acres. All data in this summary are based upon the NEON site boundary that was provided.

The ORNL site is split between Roane (TN145) and Anderson (TN001) Counties, Tennessee. Anderson County has a published soil survey. Most of the Roane County portion within the ORNL site does not have a completed soil survey and is labeled as NOTCOM (Not Complete) (Figure 1). However, small areas of the Roane County portion within the ORNL Boundary have completed soil survey mapping.

Figure 1. Map representing the soils coverage for the NEON Sampling Boundary within Oak Ridge National Laboratory.

Soils Within the ORNL NEON Boundary



The image represents the NEON boundary within the ORNL Boundary. The ORNL Boundary is not shown.

Site Information

Elevation of the ORNL site ranges from approximately 800 to 2,000 feet above sea level.

The parent materials at the ORNL site are residuum, colluvium, and local alluvium derived from Cambrian and Lower to Middle Ordovician geologies. The geologies include the Rome Formation, Conasauga Shale, Knox Group, and Chickamauga Limestone.

Land use is dominated by forest land. A few areas are cleared for idle pasture, hay, or other agricultural or general use.

Plant communities are dominated by oak-hickory forest. Although several plots include loblolly pine, chinkapin oak, and eastern red cedar.

Major soil series on the site include Fullerton, Montevallo, Sunlight, Bodine, Dewey, and Pailo soils, which are on residual ridgetops, shoulder slopes, and back slopes; Minvale and Salacoa soils, which are on colluvial foot slopes, fans, and benches; Etowah, Waynesboro, and Shady soils, which are on stream terraces.

Analysis of Plots for Sampling

Four features were identified for each plot during the pre-analysis: soil map unit, geology, landform, and major vegetative communities. Each unique combination of these four features was labeled as a ‘setting’. One plot per setting was selected for sampling with some back-up plots chosen. Soil mapping within the ORNL NEON site consisted of 50 different map units, however a NEON plot did not fall within 36 of these (Table 1). The plots selected for sampling represent 12 soil map units (Table 2), which represents about 76 percent of the total site area. Evaluation of plots available for sampling resulted in 22 plots being selected for field description, sampling, and lab characterization. Plots ORNL_066 and ORNL_047 were rejected in the field and not sampled because the plots were within areas that were being prepared for a prescribed burn by the Tennessee Wildlife Resources Agency.

The four back-up plots were reviewed, and of these, ORNL_031 was sampled. The remaining three were rejected because they duplicated ‘settings’ that had already been sampled.

The NOTCOM map unit in Roane County consists of 8,651 acres, and 8 NEON plots were sampled in the NOTCOM map unit. The plots sampled within the NOTCOM unit fall within the Range of Characteristics (RIC) of similar map units in the surroundings mapped area.

The remaining 12 plots were sampled in the Anderson County portion of the NEON site.

The selected sample plots are representative of the map units in which they occur. They fall within the Range in Characteristics (RIC) of the individual major component, except for a few outliers (noted below). Most of the soils identified during sampling are common dissimilar or similar inclusions for the map unit. Due to constraints on the ORNL property, landforms such as major flood plains and large acreage low streams are not represented in the selection of plots.

Table 1. Map units sampled at the ORNL NEON site.

Map unit symbol	County	Map Unit Name	% Total Site Area
NOTCOM	TN145	NOTCOM	52%
AkC	TN001	Armuchee silt loam, 5 to 12 percent slopes	2%
AoD2	TN001	Armuchee channery silty clay loam, 12 to 20 percent slopes, eroded	2%
ApE	TN001	Armuchee-Montevallo complex, 25 to 60 percent slopes	5%
CfD	TN001	Colbert-Lyerly-Rock outcrop complex, 5 to 20 percent slopes	4%
DwD	TN001	Dewey silt loam, 12 to 20 percent slopes	.24%
FoD	TN001	Fullerton-Pailo complex, 12 to 20 percent slopes	4%
MnC	TN001	Minvale silt loam, 5 to 12 percent slopes	1.3%
MvD	TN001	Montevallo channery silt loam, 12 to 20 percent slopes	.75%
MvE	TN001	Montevallo channery silt loam, 20 to 35 percent slopes	3.3%
SfD	TN001	Salacoa silt loam, 12 to 20 percent slopes	.8%
WbD	TN001	Waynesboro loam, 15 to 25 percent slopes	.5%
		Total	76%

Table 2. Map units not sampled at the ORNL NEON site.

Map unit symbol	County	Map Unit Name	% Total Site Area
AkD	TN001	Armuchee silt loam, 12 to 20 percent slopes	2.4%
AkE	TN001	Armuchee silt loam, 20 to 35 percent slopes	0.2%
AoE2	TN001	Armuchee channery silty clay loam, 20 to 35 percent slopes, eroded	0.09%
CbB	TN001	Capshaw silt loam, 2 to 5 percent slopes	0.09%
CgC	TN001	Collegedale silt loam, 5 to 12 percent slopes	1%
CgD	TN001	Collegedale silt loam, 12 to 20 percent slopes	0.4%
ChC3	TN001	Collegedale clay, 5 to 12 percent slopes, severely eroded	0.4%
ChD3	TN001	Collegedale clay, 12 to 20 percent slopes, severely eroded	0.1%
CkE	TN001	Collegedale-Rock outcrop complex, 20 to 35 percent slopes	1%
DwC	TN001	Dewey silt loam, 5 to 12 percent slopes	0.4%
DwE	TN001	Dewey silt loam, 20 to 35 percent slopes	1%
En	TN001	Ennis gravelly silt loam, 1 to 5 percent slopes, occasionally flooded	0.3%
EoB	TN001	Etowah loam, 2 to 5 percent slopes	0.4%
EoC	TN001	Etowah loam, 5 to 12 percent slopes	0.5%
FoC	TN001	Fullerton-Pailo complex, 5 to 12 percent slopes	2%
FoE	TN001	Fullerton-Pailo complex, 20 to 35 percent slopes	5%
Hb	TN001	Hamblen silt loam, occasionally flooded	0.4%
MnD	TN001	Minvale silt loam, 12 to 20 percent slopes	2%
MvC	Tn001	Montevallo channery silt loam, 5 to 12 percent slopes	0.2%
Pe	TN001	Pettyjon silt loam	0.01%
SfC	TN001	Salacoa silt loam, 5 to 12 percent slopes	0.1%

Sk	TN001	Shady loam, occasionally flooded	0.1%
SwB	TN001	Swafford loam, 2 to 5 percent slopes	0.4%
TbB	TN001	Tasso loam, 2 to 5 percent slopes	0.4%
TnC	TN001	Townley silt loam, 5 to 12 percent slopes	0.2%
TnD	TN001	Townley silt loam, 12 to 20 percent slopes	0.2%
UaD	TN001	Udorthents, 0 to 25 percent slopes	0.2%
Ur	TN001	Urban land	trace
AmD	TN145	Armuchee silt loam, 12 to 20 percent slopes	0.6%
CaB	TN145	Capshaw silt loam, 2 to 5 percent slopes	0.008%
CbD	TN145	Colbert-Lyerly-Rock outcrop complex, 5 to 20 percent slopes	.005%
DeC	TN145	Dewey silt loam, 6 to 15 percent slopes	0.03%
DeD	TN145	Dewey silt loam, 15 to 25 percent slopes	0.03%
DeE	TN145	Dewey silt loam, 20 to 35 percent slopes	0.2%
FuD	TN145	Fullerton-Pailo complex, 12 to 20 percent slopes	0.02%
W		Water	0.08
		Total	24%

Plot Findings

Soils. The 12 pedons sampled in the Anderson County portion of the site represent 11 soil map units. The major map unit components are Armuchee, Colbert, Lyerly, Dewey, Fullerton, Minvale, Pailo, Montevallo, Salacoa and Waynesboro soils.

Dominant Vegetation. Most of the plots sampled were forested (91%). Secondary land use was pasture or grassland (9%).

Landforms. NEON Plots ORNL_033, 003, 015, 012, 029, 009, 004, 007, 035, 014, 010, and 068 consist of soil formed in residuum on ridgetops and side slopes. Plots ORNL_040 formed in colluvium on foot slopes. Plots ORNL_021 and 008 formed in alluvium over colluvium over residuum on stream terraces. Plots ORNL_027, 018, 001, 032, and 031 formed in alluvium on stream terraces. Sampled plots were 60% residuum, 15% colluvium and colluvium over residuum, and 25% alluvium.

Summary of Soils

The soils sampled under forest generally had very thin or no organic surface horizons. These horizons, when present, ranged from 1 to 5 cm in thickness. The multiple O horizons found in a few of the pedons are accounted for in the aggregated NASIS horizon data. Where thickness allowed, the O horizons were sampled (using normal sampling protocols) for organic matter and bulk density determination.

Sampled soil series were dominantly Montevallo soil (4 samples) on the residual ridgetops and side slopes (ORNL_033, 003, 014, and 009) (Figure 2). In map units AkC and AoD, Armuchee

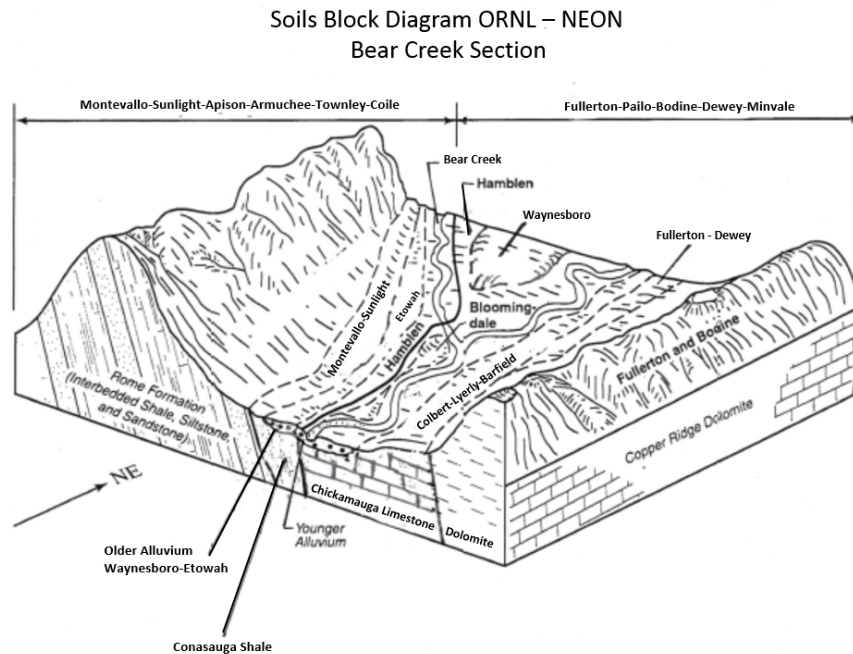
is the named soil, but Montevallo is a common minor component. Montevallo soils developed in residuum and are 20 to 44 cm deep over highly tilted interbedded sandstone, shale, and siltstone bedrock. These soils are loamy skeletal. Field-estimated clay content ranged from about 15 to 30 percent. All pedons of Montevallo were in the normal range in characteristics of the series.

The second most commonly sampled soil series was Bodine, which was sampled 3 times. Bodine soils were sampled on residual side slopes of ridges (ORNL_004, 007, and 035), each in the NOTCOM map unit. These soils developed in residuum and conceptually are greater than 1.5 meters deep over dolomitic limestone bedrock. Bodine soils have an increase in clay content with increasing depth and are loamy-skeletal (rock fragments generally comprise more than 35 % of the subsoil). Field-estimated clay content ranges from 17 to 30% in the subsoil, and the volume of rock fragments increases with depth.

Fullerton, Minvale, Sunlight, and Etowah soils were sampled 2 times each and are the relatively common soils occurring in the sampled plots.

Fullerton soils (Figure 2) were collected on residual ridgetops and side slopes (ORNL_014 and 068). Both plots were in the NOTCOM map unit. Fullerton soils developed in residuum cherty, dolomitic limestone and are conceptually greater than 1.5 meters deep over dolomitic limestone bedrock. These soils have an increase in clay content with increasing depth and are fine-textured. Field-estimated clay content ranges from 35 to 43 percent in the subsoil. The surface and subsurface horizons often display evidence of “soil creep”, or limited movement.

Figure 2. Block Diagram representing the Bear Creek area of the NEON Sampling Boundary at Oak Ridge National Laboratory.



Two plots were sampled as Minvale soil series (ORNL_021 and 008). Plot ORNL_008 was within the NOTCOM map unit. Plot ORNL_021 was within the FoD – Fullerton-Pailo cherty silt loams, 12 to 20% slopes map unit. The Minvale soil series occurs as a common inclusion within the FoD map unit. It consists of very deep, well-drained colluvium and the underlying residuum from cherty limestone on side slopes and foot slopes. Depth to cherty, dolomitic limestone bedrock is conceptually greater than 1.5 meters.

The Sunlight soil series was sampled twice (ORNL_010 and 012). ORNL_010 is in the NOTCOM map unit and ORNL_012 is in the ApE—Armuchee-Montevallo complex, 25 to 60 percent slopes map unit. Sunlight is a minor similar component that commonly occurs in the catena of soils on the Rome Formation and the Conasauga Shale. Sunlight is a shallow, well drained loamy skeletal soil that formed in residuum weathered from interbedded shale, siltstone, and sandstone on ridgetops and side slopes. Sunlight soils have an argillic horizon whereas Montevallo soils do not. They are geographically associated soils. Depth to highly tilted interbedded shale and siltstone is 15 to 18 cm.

Etowah soil series was sampled two times (ORNL_032 and 031). ORNL_032 was sampled in the NOTCOM map unit and ORNL_031 was sampled in the DwD—Dewey silt loam, 12 to 20 percent slopes map unit. Etowah is a common similar minor component in the Dewey map unit and is geographically associated with Dewey, Waynesboro, and Emory soils. Etowah is a very deep, well-drained soil on old high stream terraces. It is formed in alluvium or local colluvium that is commonly underlain by limestone residuum below 1 meter. ORNL_031 had slightly more fragments than normal in the profile. However, it is not enough to affect the interpretations. The site was located along the Clinch River and rounded fragments can be common in the older high terrace positions. Depth to dolomitic limestone bedrock is greater than 1.5 meters.

The following soils were sampled only once.

The soil sampled on plot ORNL_018 could not be designated as a series and was labeled as SND (Series Not Designated). It was classified as loamy-skeletal, siliceous, subactive, thermic, Typic Hapludults. This site was not far from the Clinch River and is an old high terrace and inclusion to the MnC—Minvale silt loam, 5 to 12 percent slopes map unit. Fragment content ranges from 45 percent in the A, to 65 percent in the Bt, to 75 percent in the C horizon. Field estimated clay percentages are approximately 7 percent in the A horizon, 11 percent in the Bt, and 6 percent in the C horizon. It is not uncommon to find terrace remnants along larger river systems such as the Clinch.

The Shady soil series was sampled in ORNL_001 in the MvD—Montevallo channery silt loam, 12 to 20 percent slopes. This is a dissimilar inclusion along a drainageway in the map unit. This plot was also close to the Clinch River. The Shady series is very deep, well-drained and formed on stream terraces in loamy alluvium weathered from sandstone, limestone, and shale. Depth to bedrock is conceptually greater than 1.5 meters.

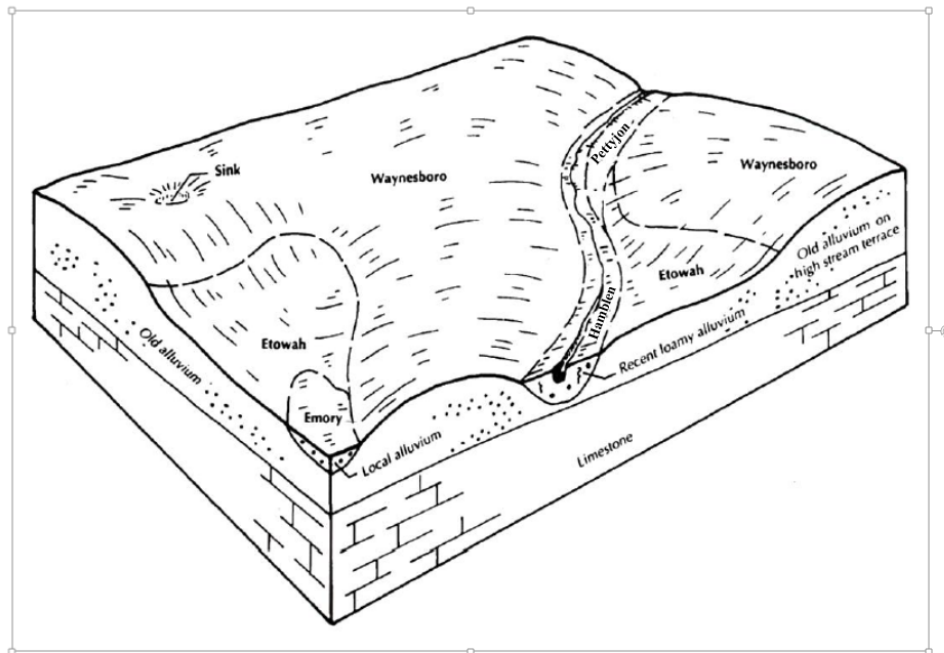
The Barfield soil series was sampled on ORNL_029. Barfield is a common dissimilar inclusion within the CfD—Colbert-Lyerly-Rock outcrop complex, 5 to 20 percent slopes map unit. Barfield is a shallow, well-drained soil formed in residuum from limestone. It is a clayey soil with a field estimated clay percentage in the field of 40 to 55 percent. Fragment content ranges

from 0 to 20 percent channers and flagstones in the A horizon to 3 to 35 percent in the B and C horizons. Depth to hard limestone bedrock at the plot was 15 cm.

The Waynesboro Series (Figure 3) was sampled on ORNL_027 in the WbD—Waynesboro loam, 15 to 25 percent slopes map unit. Waynesboro consists of very deep, well-drained soils that formed in old alluvium or unconsolidated material of sandstone, shale, and limestone origin. Clay content of the Bt horizon ranges from 35 to 50 percent. Depth to bedrock is conceptually greater than 1.5 meters. This pedon was in the normal range of characteristics of the series.

Figure 3. Block diagram illustrating high terraces along the Clinch River within the NEON Sampling Boundary at Oak Ridge National Laboratory.

Soils Block Diagram ORNL-NEON
High Terraces Along the Clinch River



The Salacoa soil series was sampled on ORNL_040. This plot was in the SfD—Salacoa silt loam, 12 to 20 percent slopes map unit. Salacoa consists of very deep, well-drained soils formed in colluvium and the underlying residuum from interbedded sandstone, siltstone, and shale. They are on benches, footslopes, and lower portions of side slopes and back slopes.