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National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Great Smoky Mountains National Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Great Smoky Mountains National Park

grsm_geology.pdf

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Geologic Resources Inventory Map Document for Great Smoky Mountains National Park

Table of Contents

Geologic Resources Inventory Map Document 1
About the NPS Geologic Resources Inventory Program 2
GRI Digital Map and Source Map Citation 4
Map Unit List 5
Map Unit Descriptions 8
Qa - Alluvium (Holocene) 8
Qdf - Debris flows (Holocene) 8
Qc - Colluvium (Holocene and Pleistocene) 8
QTt - Terrace deposits (Tertiary to Holocene) 8
QTs - Sinkholes (Tertiary to Holocene) 8
QTr - Residuum overlying carbonate rock (Tertiary to Holocene) 8
Qd - Debris fans (Pleistocene) 8
Mgg - Greasy Cove and Grainger Formations, undifferentiated (Upper and Lower Mississippian) 9
Mgc - Greasy Cove Formation (Upper and Lower Mississippian) 9
Mg - Grainger Formation (Lower Mississippian) 9
MDc - Chattanooga Shale (Lower Mississippian? and Upper Devonian) 9
PZp - Pegmatite (Paleozoic) 9
Ob - Bays Formation (Middle Ordovician) 9
Os - Sevier Formation (Middle Ordovician) 9
Oc - Chota Formation (Middle Ordovician) 9
Oo - Ottosee Shale (Middle Ordovician) 10
Ot - Tellico Formation (Middle Ordovician) 10
Ocm - Chapman Ridge Marble (Middle Ordovician) 10
Ocr - Chapman Ridge Sandstone (Middle Ordovician) 10
Obl - Blockhouse Shale (Middle Ordovician) 10
Olh - Lenoir Limestone (Middle Ordovician) 10
Oj - Jonesboro Limestone (Lower Ordovician) 10
OCk - Knox Group (Lower Ordovician and Upper Cambrian) 10
Conasauga Group 11
Cno - Nolichucky Shale (Upper and Middle Cambrian) 11
Cml - Maryville Limestone (Upper and Middle Cambrian) 11
Crg - Rogersville Shale (Upper and Middle Cambrian) 11
Crt - Rutledge Limestone (Upper and Middle Cambrian) 11
Cpr - Pumpkin Valley Shale and Rome Formation (Upper and Middle Cambrian) 11
Cr - Rome Formation (Middle Cambrian) 11
Cs - Shady Dolomite (Lower Cambrian) 11
Css - Shady Dolomite, shaly dolomite and dolomitic shale (Lower Cambrian) 11
Chilhowee Group 12
Ccu - Upper part of Chilhowee Group, undifferentiated (Lower Cambrian) 12
Chm - Helenmode Formation (Lower Cambrian) 12
Ch - Hesse Quartzite (Lower Cambrian) 12
Cm - Murray Shale (Lower Cambrian) 12
Cnb - Nebo Quartzite (Lower Cambrian) 12
Cn - Nichols Shale (Lower Cambrian) 12
Cc - Cochran Formation (Lower Cambrian) 12

PZZd - Metadiorite, metadiabase, and altered rocks (dikes and sills) (Paleozoic and Neoproterozoic) 12
PZZud - Metamorphosed dunite and peridotite (early Paleozoic and Neoproterozoic) 13
PZZa - Amphibolite (early Paleozoic and Neoproterozoic) 13
CZct - Cartoogechaye terrane (Cambrian and Neoproterozoic) 13
CZo - Otto Formation of the Dahlonega gold belt (Cambrian and Neoproterozoic) 13
Zss - Sandsuck Formation (Neoproterozoic) 13
Zssc - Sandsuck Formation, conglomerate (Neoproterozoic) 13
Zw - Wilhite Formation (Neoproterozoic) 13
Zwq - Wilhite Formation, quartzite and conglomerate (Neoproterozoic) 13
Zwl - Wilhite Formation, limestone and shale (Neoproterozoic) 13
Zwlc - Wilhite Formation, carbonate rocks and clastic rocks (Neoproterozoic) 14
Zs - Shields Formation (Neoproterozoic) 14
Zsl - Shields Formation, limestone and siltstone (Neoproterozoic) 14
Zsa - Shields Formation, coarse sandstone and siltstone (Neoproterozoic) 14
Zsc - Shields Formation, conglomerate (Neoproterozoic) 14
Zll - Licklog Formation (Neoproterozoic) 14
Zlls - Licklog Formation, conglomeritic sandstone (Neoproterozoic) 14
Znt - Tusquitee Quartzite and Nantahala Formation (Neoproterozoic) 14
Zd - Dean Formation (Neoproterozoic) 14
Zam - Ammons Formation (Neoproterozoic) 15
Zgb - Grassy Branch Formation (Neoproterozoic) 15
Zwe - Wehutty Formation (Neoproterozoic) 15
Zch - Copperhill Formation (Neoproterozoic) 15
Zchs - Copperhill Formation, quartz-muscovite schist and phyllite (Neoproterozoic) 15
Zchsl - Copperhill Formation, slaty metasiltstone (Neoproterozoic) 15
Za - Anakeesta Formation (Neoproterozoic) 15
Zag - Anakeesta Formation, metagraywacke and metasiltstone (Neoproterozoic) 15
Zas - Anakeesta Formation, metasandstone and siliceous metasiltstone (Neoproterozoic) 16
Zal - Anakeesta Formation, metadolomite (Neoproterozoic) 16
Zac - Anakeesta Formation, chloritoid slate (Neoproterozoic) 16
Zc - Cades Sandstone (Neoproterozoic) 16
Zcs - Cades Sandstone, dark metasiltstone (Neoproterozoic) 16
Zcc - Cades Sandstone, boulder conglomerate (Neoproterozoic) 16
Zt - Thunderhead Sandstone (Neoproterozoic) 16
Zts - Thunderhead Sandstone, dark metasiltstone and slate (Neoproterozoic) 16
Ztb - Thunderhead Sandstone, boulder conglomerate (Neoproterozoic) 17
Ze - Elkmont Sandstone (Neoproterozoic) 17
Zes - Elkmont Sandstone, coarse metasandstone and metaconglomerate (Neoproterozoic) 17
Zsb - Snowbird Group, undivided (Neoproterozoic) 17
Zr - Rich Butt Sandstone (Neoproterozoic) 17
Zrs - Rich Butt Sandstone, slate and metasiltstone (Neoproterozoic) 17
Zm - Metcalf Phyllite (Neoproterozoic) 17
Zp - Pigeon Siltstone (Neoproterozoic) 17
Zps - Pigeon Siltstone, metasandstone (Neoproterozoic) 18
Zrf - Roaring Fork Sandstone (Neoproterozoic) 18
Zrfs - Roaring Fork Sandstone, metasandstone (Neoproterozoic) 18
Zl - Longarm Quartzite (Neoproterozoic) 18
Zwb - Wading Branch Formation (Neoproterozoic) 18
Ybg - Biotitic porphyritic metagranitoid (Mesoproterozoic) 18
Ygd - Metagranodiorite (Mesoproterozoic) 18
Ypg - Megacrystic metagranite (Mesoproterozoic) 18
Ymp - Mylonitic monzogranite (Mesoproterozoic) 19
Yg - Metamonzogranite (Mesoproterozoic) 19
Ysg - Spring Creek Metagranitoid (Mesoproterozoic) 19

Ym - Migmatitic biotite gneiss (Mesoproterozoic) 19
Yh - Hornblende-biotite gneiss (Mesoproterozoic) 19
Ya - Amphibolite (Mesoproterozoic) 19
Yu - Ultramafic rocks (Mesoproterozoic) 19
Geologic Cross Section 20
Cross Section A-A' 20
Ancillary Source Map Information 21
Correlation of Map Units 21
Location Map 22
Map Legend 23
Report 23
Index of Map Sources and Scales 24
GRI Digital Data Credits 25

Geologic Resources Inventory Map Document

Great Smoky Mountains National Park, Tennessee and North Carolina

Document to Accompany Digital Geologic-GIS Data

grsm_geology.pdf

Version: 2/16/2016

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Great Smoky Mountains National Park, Tennessee and North Carolina (GRSM).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

For information about the status of GRI digital geologic-GIS data for a park contact:

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: http://irma.nps.gov/App/Reference/Search. To find GRI data for a specific park or parks select the appropriate park

(s), enter “GRI” as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: http://www.nature.nps.gov/geology/inventory, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

GRI Digital Map and Source Map Citation

The GRI digital geologic-GIS map for Great Smoky Mountains National Park, Tennessee and North Carolina (GRSM):

GRI Digital Geologic Map of the Great Smoky Mountains and Vicinity, Tennessee and North Carolina (*GRI MapCode GRSM)*

Southworth, Scott, Schultz, Art, Aleinikoff, J.N., and Merschat, A.J., 2012, Geologic Map of the Great Smoky Mountains National Park Region, Tennessee and North Carolina: U.S. Geological Survey, Scientific Investigations Map SIM-2997, scale 1:100,000 (*GRI Source Map ID 75646*).

Additional information pertaining to the source map is also presented in the GRI Source Map Information (GRSMMAP) table included with the GRI geologic-GIS data.

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Great Smoky Mountains National Park, Tennessee and North Carolina (GRSM) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qal - Alluvium). Units are generally listed from youngest to oldest, however, Paleozoic Era units have been grouped out of order in the unit listing below. Age sorting and information about each geologic unit are also presented in the GRI Geologic Unit Information (GRSMUNIT) table included with the GRI geologic-GIS data.

Cenozoic Era

Quaternary and Tertiary Periods
Qa - Alluvium
Qdf - Debris flows
Qc - Colluvium
QTt - Terrace deposits
QTs - Sinkholes
QTr - Residuum overlying carbonate rock
Qd - Debris fans

Paleozoic Era

PZp - Pegmatite
PZZd - Metadiorite, metadiabase, and altered rocks (dikes and sills)
PZZud - Metamorphosed dunite and peridotite
PZZa - Amphibolite

Mississippian Period
Mgg - Greasy Cove and Grainger Formations, undifferentiated
Mgc - Greasy Cove Formation
Mg - Grainger Formation

Mississippian and Devonian Periods
MDc - Chattanooga Shale

Ordovician Period
Ob - Bays Formation
Os - Sevier Formation
Oc - Chota Formation
Oo - Ottosee Shale
Ot - Tellico Formation
Ocm - Chapman Ridge Marble
Ocr - Chapman Ridge Sandstone
Obl - Blockhouse Shale
Olh - Lenoir Limestone
Oj - Jonesboro Limestone

Ordovician and Cambrian Periods
OCk - Knox Group

Cambrian Period
Cno - Nolichucky Shale

Cml - Maryville Limestone
Crg - Rogersville Shale
Crt - Rutledge Limestone
Cpr - Pumpkin Valley Shale and Rome Formation
Cr - Rome Formation
Cs - Shady Dolomite
Css - Shady Dolomite, shaly dolomite and dolomitic shale
Ccu - Upper part of Chilhowee Group, undifferentiated
Chm - Helenmode Formation
Ch - Hesse Quartzite
Cm - Murray Shale
Cnb - Nebo Quartzite
Cn - Nichols Shale
Cc - Cochran Formation

Paleozoic and Neoproterozoic Eras

Cambrian Period and Neoproterozoic Era
CZct - Cartoogechaye terrane
CZo - Otto Formation of the Dahlonega gold belt

Neoproterozoic Era

Zss - Sandsuck Formation
Zssc - Sandsuck Formation, conglomerate
Zw - Wilhite Formation
Zwq - Wilhite Formation, quartzite and conglomerate
Zwl - Wilhite Formation, limestone and shale
Zwlc - Wilhite Formation, carbonate rocks and clastic rocks
Zs - Shields Formation
Zsl - Shields Formation, limestone and siltstone
Zsa - Shields Formation, coarse sandstone and siltstone
Zsc - Shields Formation, conglomerate
Zll - Licklog Formation
Zlls - Licklog Formation, conglomeritic sandstone
Znt - Tusquitee Quartzite and Nantahala Formation
Zd - Dean Formation
Zam - Ammons Formation
Zgb - Grassy Branch Formation
Zwe - Wehutty Formation
Zch - Copperhill Formation
Zchs - Copperhill Formation, quartz-muscovite schist and phyllite
Zchsl - Copperhill Formation, slaty metasiltstone
Za - Anakeesta Formation
Zag - Anakeesta Formation, metagraywacke and metasiltstone
Zas - Anakeesta Formation, metasandstone and siliceous metasiltstone
Zal - Anakeesta Formation, metadolomite
Zac - Anakeesta Formation, chloritoid slate
Zc - Cades Sandstone
Zcs - Cades Sandstone, dark metasiltstone
Zcc - Cades Sandstone, boulder conglomerate
Zt - Thunderhead Sandstone

Zts - Thunderhead Sandstone, dark metasiltstone and slate
Ztb - Thunderhead Sandstone, boulder conglomerate
Ze - Elkmont Sandstone
Zes - Elkmont Sandstone, coarse metasandstone and metaconglomerate
Zsb - Snowbird Group, undivided
Zr - Rich Butt Sandstone
Zrs - Rich Butt Sandstone, slate and metasiltstone
Zm - Metcalf Phyllite
Zp - Pigeon Siltstone
Zps - Pigeon Siltstone, metasandstone
Zrf - Roaring Fork Sandstone
Zrfs - Roaring Fork Sandstone, metasandstone
Zl - Longarm Quartzite
Zwb - Wading Branch Formation

Mesoproterzoic Era

Ybg - Biotitic porphyritic metagranitoid
Ygd - Metagranodiorite
Ypg - Megacrystic metagranite
Ymp - Mylonitic monzogranite
Yg - Metamonzogranite
Ysg - Spring Creek Metagranitoid
Ym - Migmatitic biotite gneiss
Yh - Hornblende-biotite gneiss
Ya - Amphibolite
Yu - Ultramafic rocks

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

Qa - Alluvium (Holocene)

Unconsolidated silt, sand, cobbles, and boulders along streams, flood plains, and alluvial plains as much as 40 ft (12 m) above stream channel. Coarse alluvium in the western Blue Ridge highlands is transitional with boulder debris on slopes. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Qdf - Debris flows (Holocene)

Debris-flow scars, tracks, and deposits in the western Blue Ridge highlands resulting from modern and historical storms that had high rainfall. Debris-flow scars, tracks, and deposits formed since 1970 typically are not vegetated. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Qc - Colluvium (Holocene and Pleistocene)

Boulder streams, boulder fields, and talus. Deposits are clast-supported diamicton of angular to subrounded boulders and cobbles. Colluvium grades downslope and is transitional into debris fans. Thickness from 10 to 100 ft (3–30 m). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

QTt - Terrace deposits (Tertiary to Holocene)

Unconsolidated sand, gravel, cobbles, and boulders deposited on benches along major rivers. Thickness ranges from 0 to 30 ft (0–9 m) on terraces that lie as much as 30 ft (9 m) above present flood plains. Includes elevated terraces as much as 200 ft (60 m) above present flood plains. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

QTs - Sinkholes (Tertiary to Holocene)

Sinkholes, solution depressions, hummocks, and clusters of sinkholes, bedrock pinnacles, caverns, and cave openings in areas underlain by carbonate bedrock. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

QTr - Residuum overlying carbonate rock (Tertiary to Holocene)

Pebbles, cobbles, and small boulders of subrounded to angular chert, quartz, and jasperoid in red clay and silty soil. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Qd - Debris fans (Pleistocene)

Matrix-supported diamicton that forms fans and sheets on lower slopes and valleys in the Blue Ridge. Subrounded boulders, cobbles, and pebbles of local rocks are in a matrix of unstratified pebbles, sand, silt, and clay. Includes terraces as much as 120 ft (37 m) above adjacent boulder debris fans and alluvium near Cosby, Tenn. Thickness 10 to 100 ft (3–30 m). (*GRI Source Map ID 75646)* (Geologic Map

of the Great Smoky Mountains (SIM 2997)).

Mgg - Greasy Cove and Grainger Formations, undifferentiated (Upper and Lower Mississippian)

See below descriptions for Greasy Cove and Grainger Formations. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Mgc - Greasy Cove Formation (Upper and Lower Mississippian)

Interbedded gray calcareous shale, argillaceous limestone, fine-grained sandstone, and red shale and sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Mg - Grainger Formation (Lower Mississippian)

Noncalcareous siltstone and fine-grained sandstone grading upward into coarser grained feldspathic sandstone and pebble conglomerate interbedded with silty shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

MDc - Chattanooga Shale (Lower Mississippian? and Upper Devonian)

Dark carbonaceous noncalcareous shale; locally at the base is sandy and contains sandstone beds several inches thick. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

PZp - Pegmatite (Paleozoic)

Tabular, lenticular, irregular bodies of pegmatite (plagioclase, perthite, quartz, muscovite, or biotite). Ranges from 1 in. (2.5 cm) thick and 12 in. (30 cm) long to 210 ft (64 m) thick and 490 ft (149 m) long. Represented as a point in the Geologic Point Units feature class (GRSMGPT) where occurrence is too small to show with a polygon. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ob - Bays Formation (Middle Ordovician)

Red calcareous mudrock and siltstone; locally contains coarse-grained feldspathic and light-gray quartzitic sandstone interbedded with red, fine-grained sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Os - Sevier Formation (Middle Ordovician)

Gray, calcareous, silty and sandy shale and, locally, sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Oc - Chota Formation (Middle Ordovician)

Bluish-gray calcareous sandstone and sandy limestone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Oo - Ottosee Shale (Middle Ordovician)

Calcarenite and sandy limestone in the lower part; gray calcareous shale in the upper part. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ot - Tellico Formation (Middle Ordovician)

Gray, sandy and silty calcareous shale containing beds of calcareous sandstone, fine-grained sandstone, and impure limestone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ocm - Chapman Ridge Marble (Middle Ordovician)

Gray to red, thick-bedded to massive, coarsely crystalline marble occurring as lenses at the top of the Chapman Ridge Sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ocr - Chapman Ridge Sandstone (Middle Ordovician)

Gray calcareous sandstone and argillaceous shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Obl - Blockhouse Shale (Middle Ordovician)

Dark-gray, finely laminated, fissile calcareous shale; locally contains beds of calcareous sandstone in the lower part and beds of cobbly argillaceous limestone at the base. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Olh - Lenoir Limestone (Middle Ordovician)

Gray, cobbly argillaceous limestone; locally contains the fine-grained Mosheim Limestone Member, basal clastic rocks of the Douglas Lake Member, and marble of the overlying Holston Formation. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Oj - Jonesboro Limestone (Lower Ordovician)

Light-gray, fine-grained limestone, laminated to thick-bedded; contains some interbeds of dolomite and sandy limestone (locally includes Middle Ordovician Lenoir Limestone). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

OCk - Knox Group (Lower Ordovician and Upper Cambrian)

Comprises the following units in ascending order: Copper Ridge Dolomite- cherty dolomite with the Middle and Upper Cambrian Maynardville Limestone locally included at the base; Chepultepec Dolomite- limestone and subordinate dolomite, with sandstone in the upper part; Longview Dolomite- cherty dolomite; Newala Limestone- limestone interbedded with dolomite and sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Conasauga Group

Cno - Nolichucky Shale (Upper and Middle Cambrian)

Greenish-gray calcareous shale interbedded with oolitic limestone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cml - Maryville Limestone (Upper and Middle Cambrian)

Limestone containing greenish-gray shale near the base and the top. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Crg - Rogersville Shale (Upper and Middle Cambrian)

Variegated purple and green fissile shale; has a 20-ft (6-m)-thick limestone bed in middle part. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Crt - Rutledge Limestone (Upper and Middle Cambrian)

Limestone containing argillaceous partings at the base and fine-grained dolomite at the top. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cpr - Pumpkin Valley Shale and Rome Formation (Upper and Middle Cambrian)

Maroon sandstone, siltstone, and shale, and subordinate quartzite, siltstone, shale, and limestone of the Rome Formation grading upward into greenish-gray and red siltstone, silty shale, and thin layers of limestone of the Pumpkin Valley Shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cr - Rome Formation (Middle Cambrian)

Red and maroon, fissile laminated shale, calcareous siltstone, and fine-grained sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cs - Shady Dolomite (Lower Cambrian)

Thick-bedded dolomite containing thin-bedded laminated shaly dolomite and dolomitic shale (Css). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Css - Shady Dolomite, shaly dolomite and dolomitic shale (Lower Cambrian)

Thin-bedded laminated shaly dolomite and dolomitic shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Chilhowee Group

Ccu - Upper part of Chilhowee Group, undifferentiated (Lower Cambrian)

Quartzite; argillaceous, silty, micaceous shale; and coarse-grained sandstone, undifferentiated. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Chm - Helenmode Formation (Lower Cambrian)

Gray micaceous silty shale and siltstone, containing thin beds of quartzite at the base and coarse-grained sandstone near the top. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ch - Hesse Quartzite (Lower Cambrian)

Thick-bedded white quartzite. *Skolithos linearis* tubes are fewer and shorter than those in the Nebo Quartzite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cm - Murray Shale (Lower Cambrian)

Greenish-gray argillaceous to silty shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cnb - Nebo Quartzite (Lower Cambrian)

Thin-bedded white quartzite containing *Skolithos linearis* tubes. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cn - Nichols Shale (Lower Cambrian)

Greenish-gray, argillaceous to silty, well-laminated fissile shale containing some beds of sandstone and quartzite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Cc - Cochran Formation (Lower Cambrian)

Gray basal conglomerate overlain by maroon pebbly arkose that is interbedded with maroon shale and siltstone. Unit grades upward into light-gray arkose, crossbedded sandstone, and quartzite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

PZZd - Metadiorite, metadiabase, and altered rocks (dikes and sills) (Paleozoic and Neoproterozoic)

Dikes and sills, consisting of metamorphosed coarse-grained hornblende metadiorite, fine-grained metadiabase, greenstone containing epidosite, and ankerite-chlorite schist. Represented as a point in the Geologic Point Units feature class (GRSMGPT) where occurrence is too small to show with a polygon. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

PZZud - Metamorphosed dunite and peridotite (early Paleozoic and Neoproterozoic)

No description given. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

PZZa - Amphibolite (early Paleozoic and Neoproterozoic)

No description given. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

CZct - Cartoogechaye terrane (Cambrian and Neoproterozoic)

Well-foliated, locally migmatitic, sillimanite-grade, biotite-quartz-plagioclase gneiss and biotite-hornblende gneiss. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

CZo - Otto Formation of the Dahlonega gold belt (Cambrian and Neoproterozoic)

Light-gray metasandstone interbedded with muscovite schist. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zss - Sandsuck Formation (Neoproterozoic)

Greenish-gray siltstone, silty shale, and sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zssc - Sandsuck Formation, conglomerate (Neoproterozoic)

Thick lenticular beds of coarse-grained sandstone and quartz pebble conglomerate that occur in the middle part of the section south of Rich Mountain but at the top of the section on Chilhowee Mountain. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zw - Wilhite Formation (Neoproterozoic)

Fine-grained shale, siltstone, and slate. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zwq - Wilhite Formation, quartzite and conglomerate (Neoproterozoic)

White vitreous quartzite, sandstone, and polymict pebble conglomerate. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zwl - Wilhite Formation, limestone and shale (Neoproterozoic)

Limestone and shale. Where occurrence is too small to be shown with a polygon, Zwl is represented as a point in the Geologic Point Units feature class (GRSMGPT) (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zwlc - Wilhite Formation, carbonate rocks and clastic rocks (Neoproterozoic)

Thin beds of limestone and sandy limestone within argillaceous shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zs - Shields Formation (Neoproterozoic)

Dark-gray to greenish-gray laminated siltstone and shale. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zsl - Shields Formation, limestone and siltstone (Neoproterozoic)

Beds of limestone and siltstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zsa - Shields Formation, coarse sandstone and siltstone (Neoproterozoic)

Beds of coarse sandstone and siltstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zsc - Shields Formation, conglomerate (Neoproterozoic)

Beds of coarse conglomerate of polymict pebbles and cobbles interbedded with pebbly sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zll - Licklog Formation (Neoproterozoic)

Argillaceous siltstone and shale interbedded with fine- to coarse-grained sandstone and pebble conglomerate. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zlls - Licklog Formation, conglomeritic sandstone (Neoproterozoic)

Beds of conglomeratic sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Znt - Tusquitee Quartzite and Nantahala Formation (Neoproterozoic)

Nantahala Formation consists of black graphitic metasiltstone and schist interbedded with white metaquartzite. Tusquitee Quartzite is mostly white metaquartzite, interbedded with minor schist, sulfidic in places. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zd - Dean Formation (Neoproterozoic)

Sericite schist containing abundant biotite porphyroblasts and lesser staurolite and garnet porphyroblasts; schist is interbedded with metagraywacke and quartz pebble conglomerate in middle and upper part. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zam - Ammons Formation (Neoproterozoic)

Metasandstone and muscovite schist containing abundant metasiltstone in the lower part. Upper part is dark-gray graphitic and sulfidic mica schist and metasiltstone interbedded with metagraywacke, metasiltstone, and muscovite schist, and locally metaquartzite and garnet-biotite mica schist. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zgb - Grassy Branch Formation (Neoproterozoic)

Metasandstone and subordinate muscovite schist and metagraywacke, grading upward to dark-gray muscovite schist and metasandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zwe - Wehutty Formation (Neoproterozoic)

Dark-gray muscovite-biotite-staurolite-kyanite schist interbedded with metagraywacke and metaconglomerate, and minor tremolite schist, marble, quartz-chlorite schist and metasiltstone, and graphite-apatite schist. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zch - Copperhill Formation (Neoproterozoic)

Massive to coarse-grained metagraywacke and metaconglomerate interbedded with locally sulfidic quartz-garnet-muscovite phyllite and schist; the schist contains porphyroblasts of garnet, kyanite, or staurolite, depending on metamorphic grade; and the phyllite locally is graphitic and sulfidic. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zchs - Copperhill Formation, quartz-muscovite schist and phyllite (Neoproterozoic)

light-brown quartz-muscovite schist and phyllite interbedded with metagraywacke; the schist contains porphyroblasts of garnet, kyanite, or staurolite, depending on metamorphic grade; and the phyllite locally is graphitic and sulfidic. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zchsl - Copperhill Formation, slaty metasiltstone (Neoproterozoic)

Locally graphitic and sulfidic metasiltstone, interbedded with metagraywacke. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Za - Anakeesta Formation (Neoproterozoic)

Dark-gray graphitic and sulfidic slate, metasiltstone, and phyllite, containing local metasandstone and metagraywacke. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zag - Anakeesta Formation, metagraywacke and metasiltstone (Neoproterozoic)

Light-gray, coarse-grained to conglomeratic metagraywacke interbedded with metasiltstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zas - Anakeesta Formation, metasandstone and siliceous metasiltstone (Neoproterozoic)

Light-gray, fine-grained metasandstone, ankerite-rich metasandstone, chloritoid metasiltstone, and ankeritic sandy metadolomite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zal - Anakeesta Formation, metadolomite (Neoproterozoic)

Thin bodies of dark-gray, fine-grained metadolomite, sandy metadolomite, and pisolitic metadolomite; ranging from 1 to 3 ft (0.3–1 m) thick and shown only as a point in the Geologic Point Units feature class (GRSMGPT). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zac - Anakeesta Formation, chloritoid slate (Neoproterozoic)

Light-gray slate containing small dark elliptical porphyroblasts of chloritoid. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zc - Cades Sandstone (Neoproterozoic)

Medium- to coarse-grained feldspathic metasandstone and metagraywacke in thin to medium beds, interbedded with dark-colored metasiltstone and slate. Considered to be a facies of the thicker bedded and coarser grained Thunderhead Sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zcs - Cades Sandstone, dark metasiltstone (Neoproterozoic)

Dark-gray metasiltstone interbedded with fine-grained metasandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zcc - Cades Sandstone, boulder conglomerate (Neoproterozoic)

Interbedded conglomerate, the clasts of which are cobbles and boulders of leucocratic granite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zt - Thunderhead Sandstone (Neoproterozoic)

Thick, graded beds of coarse-grained feldspathic light-gray metasandstone and metaconglomerate interbedded with dark-gray graphitic metasiltstone and slate. Metasandstone and metaconglomerate contain distinctive angular grains and pebbles of potassium feldspar, blue and gray quartz, and leucogranite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zts - Thunderhead Sandstone, dark metasiltstone and slate (Neoproterozoic)

Dark-colored graphitic metasiltstone and slate. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ztb - Thunderhead Sandstone, boulder conglomerate (Neoproterozoic)

Boulder conglomerate consisting of rounded leucocratic granite clasts in a matrix of quartz and feldspar; clasts of large boulders of slate and dolomite occur locally. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ze - Elkmont Sandstone (Neoproterozoic)

Dark-gray feldspathic and argillaceous metasandstone interbedded with dark-gray metasiltstone. Metasandstone is distinctively finer grained, darker in color, and thinner bedded than overlying Thunderhead Sandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zes - Elkmont Sandstone, coarse metasandstone and metaconglomerate (Neoproterozoic)

Coarse-grained metasandstone and metaconglomerate. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zsb - Snowbird Group, undivided (Neoproterozoic)

No description given. See Snowbird Group formation descriptions below. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zr - Rich Butt Sandstone (Neoproterozoic)

Light-gray, medium- to fine-grained feldspathic metasandstone and conglomeratic arkose interbedded with dark-colored, thinly laminated metasiltstone; partly current bedded; minor amounts of arkosic conglomerate and intraformational breccia. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zrs - Rich Butt Sandstone, slate and metasiltstone (Neoproterozoic)

Dark-gray slate and metasiltstone interbedded with fine-grained metasandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zm - Metcalf Phyllite (Neoproterozoic)

Lustrous, greenish-gray chlorite-sericite phyllite and laminated metasiltstone, strongly sheared; contains multiple cleavages. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zp - Pigeon Siltstone (Neoproterozoic)

Massive, greenish-gray, chlorite-rich, laminated metasiltstone containing minor very fine-grained sand of quartz and feldspar. Unit is current bedded, contains soft-sediment folds, and is faulted. Primary foliation is cleavage. Upper part near Dunn Creek fault contains abundant laminae of iron-bearing carbonate. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zps - Pigeon Siltstone, metasandstone (Neoproterozoic)

Thick-bedded, fine-grained feldspathic metasandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zrf - Roaring Fork Sandstone (Neoproterozoic)

Greenish-gray, medium- to fine-grained, thin- to thick-bedded feldspathic metasandstone interbedded with dark-gray chloritic, phyllitic to slaty metasiltstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zrfs - Roaring Fork Sandstone, metasandstone (Neoproterozoic)

Prominent beds of fine-grained feldspathic metasandstone. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zl - Longarm Quartzite (Neoproterozoic)

Light-gray, medium-grained, current-bedded and crossbedded quartzite interbedded with meta-arkose; grades upward to feldspathic metasandstone interbedded with quartz-mica schist. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Zwb - Wading Branch Formation (Neoproterozoic)

Phyllite, sandy slate, quartz-sericite-muscovite schist, and quartz pebble conglomerate; grades upward into coarse pebbly feldspathic metasandstone that contains lenses of quartz pebble conglomerate interbedded with sandy slate and quartz-mica schist. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ybg - Biotitic porphyritic metagranitoid (Mesoproterozoic)

Strongly foliated and lineated dark-gray biotite granitoid gneiss containing distinctive augen of white and pink feldspar in the Cherokee-Raven Fork belt. SHRIMP U-Pb zircon age of 1,022±5 Ma (Aleinikoff and others, 2007). Contains abundant xenoliths of amphibolite. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ygd - Metagranodiorite (Mesoproterozoic)

Medium-grained, mottled, brown and green granodiorite containing hypersthene and tan feldspar on Cove Mountain. SHRIMP U-Pb zircon age of 1,039±7 Ma (Aleinikoff and others, 2007). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ypg - Megacrystic metagranite (Mesoproterozoic)

Coarse-grained granite with large porphyroblasts of feldspar and quartz; intrudes hornblende-biotite gneiss in Ela dome. SHRIMP U-Pb zircon age of 1,066±12 Ma (Aleinikoff and others, 2007). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ymp - Mylonitic monzogranite (Mesoproterozoic)

Monzogranite with protomylonitic and mylonitic foliations (Carter and Wiener, 1999). Includes the foliated and lineated “border gneiss” (Cameron, 1951) on the northern margin of the Bryson City dome. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Yg - Metamonzogranite (Mesoproterozoic)

Medium- to coarse-grained, foliated biotite metamonzogranite that intruded migmatitic biotite gneiss in the Bryson City dome and Dellwood dome. A map-scale xenolith of metamonzogranite within biotitic porphyritic meta-granitoid north of Dellwood yielded a SHRIMP U-Pb zircon age of 1,160±10 Ma (Aleinikoff and others, 2007). Metamonzogranite in the Bryson City dome yielded a SHRIMP U-Pb zircon age of 1,165±8 Ma. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ysg - Spring Creek Metagranitoid (Mesoproterozoic)

Heterogeneous biotite metagranitoid; northeast of the map area it is interlayered with biotite granodioritic gneiss, tonalitic gneiss, quartz monzodioritic gneiss, amphibolite, biotite gneiss, and biotite schist (Carter and Wiener, 1999). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ym - Migmatitic biotite gneiss (Mesoproterozoic)

Migmatitic biotite gneiss containing leucosomes and amphibolite. Light-gray, sugary-textured, leucocratic syenogranite leucosome with centimeter-wide dark clots of biotite, muscovite, and garnet yielded a SHRIMP U-Pb zircon age of 1,194±10 Ma (Aleinikoff and others, 2007). Dark-gray biotite gneiss melanosome yielded a SHRIMP U-Pb zircon age of 1,202±10 Ma (Aleinikoff and others, 2007). (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Yh - Hornblende-biotite gneiss (Mesoproterozoic)

Gray, well-layered, migmatitic hornblende-biotite-quartz-plagioclase gneiss containing amphibolite. Intimately associated with migmatitic biotite gneiss. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ya - Amphibolite (Mesoproterozoic)

Foliated amphibole-plagioclase gneiss in pods, layers, and lenses in Mesoproterozoic gneisses. Represented as a point in the Geologic Point Units feature class (GRSMGPT) where occurrence is too small to show as a polygon. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

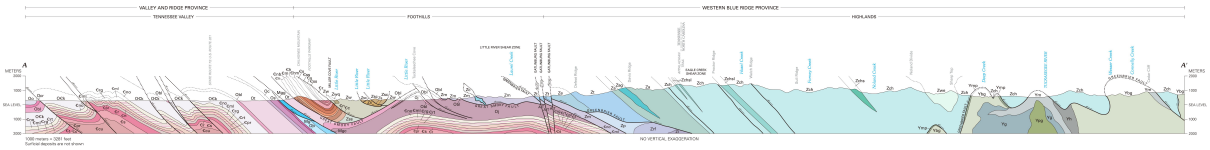
Yu - Ultramafic rocks (Mesoproterozoic)

Pods of metamorphosed mafic and ultramafic rocks within Mesoproterozoic rocks. Includes metaperidotite and metagabbro in the Bryson City dome. Represented as a point in the Geologic Point Units feature class (GRSMGPT) where occurrence is too small to show as a polygon. (*GRI Source Map ID 75646)* (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Geologic Cross Section

The geologic cross section present in the GRI digital geologic-GIS data produced for Great Smoky Mountains National Park, Tennessee and North Carolina (GRSM) is presented below. This cross section graphic was extracted from source PDF document and can be viewed in more detail by zooming in (if viewing the digital format of this document).

Cross Section A-A'

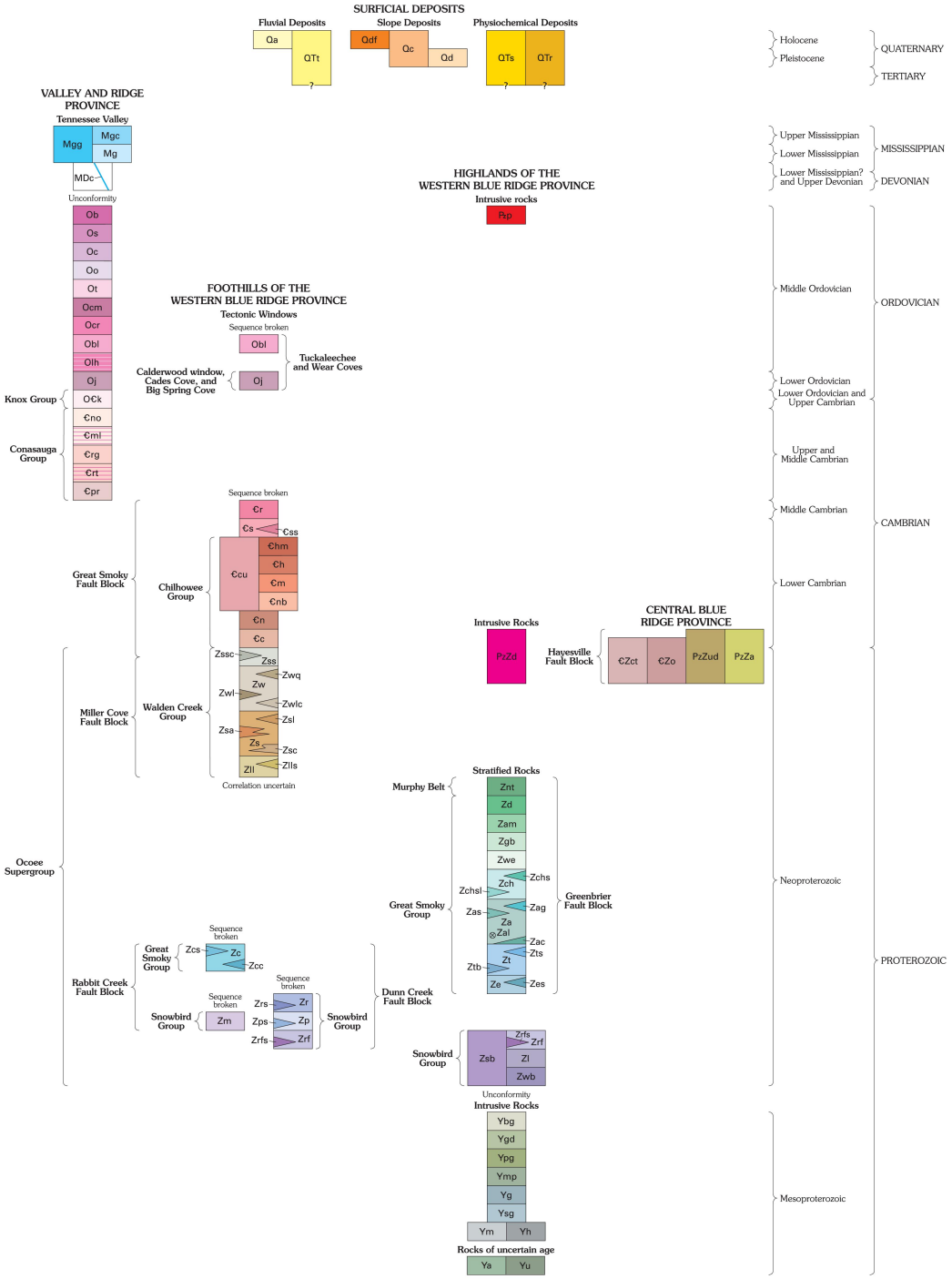


Extracted from: (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Ancillary Source Map Information

Southworth, Scott, Schultz, Art, Aleinikoff, J.N., and Merschat, A.J., 2012, Geologic Map of the Great Smoky Mountains National Park Region, Tennessee and North Carolina: U.S. Geological Survey, Scientific Investigations Map SIM-2997, scale 1:100,000 (*GRI Source Map ID 75646*).

Correlation of Map Units



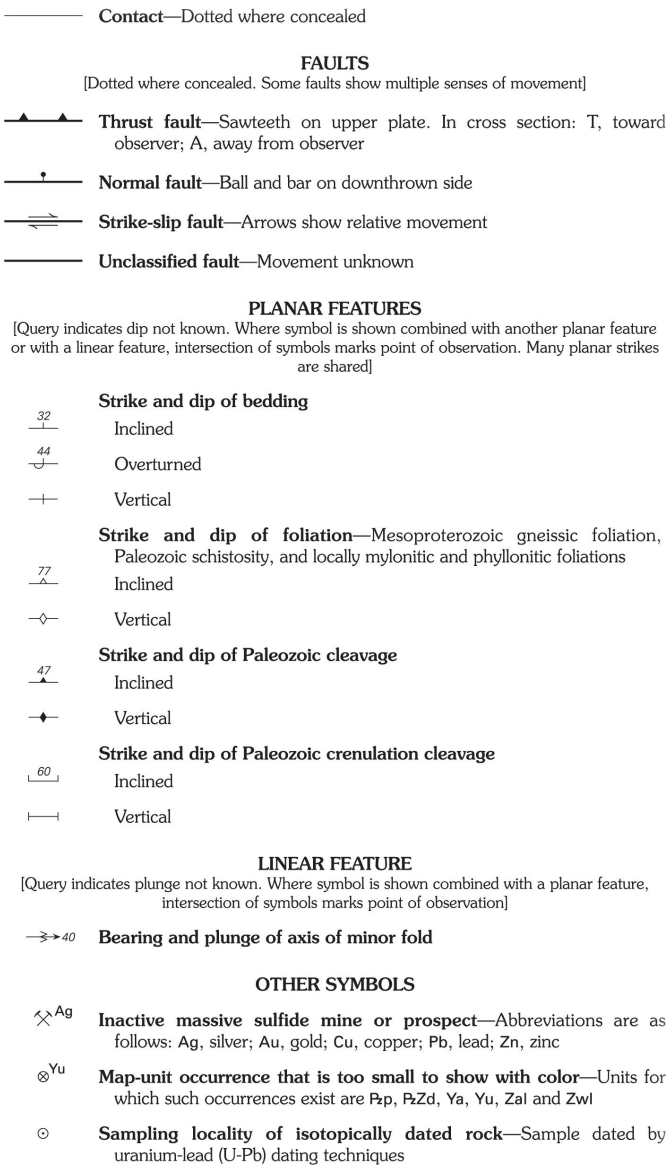
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Location Map



Extracted from: (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Map Legend

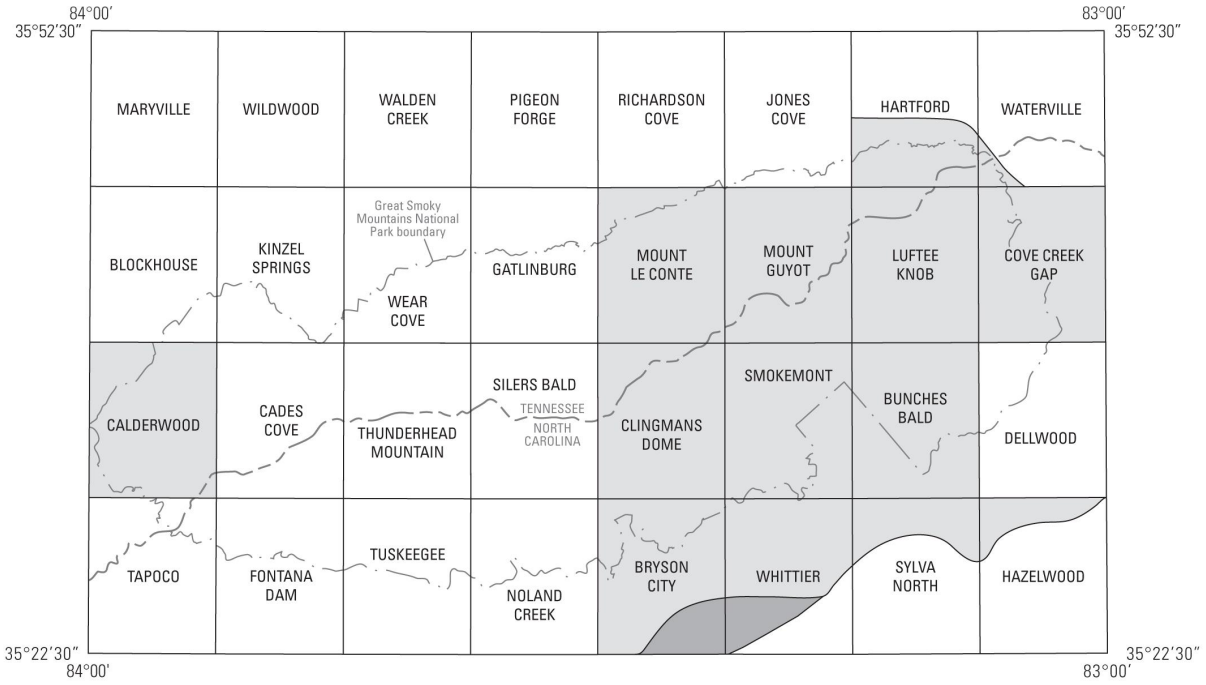


Extracted from: (Geologic Map of the Great Smoky Mountains (SIM 2997)).

Report

The pamphlet accompanying SIM-2997 containing a description of the geologic setting and physiography, descriptions of map units, and a discussion of structure can be viewed here: http://pubs.usgs.gov/sim/2997/pdf/SIM2997.pdf.

Index of Map Sources and Scales



SOURCES OF GEOLOGIC DATA

Blockhouse	Neuman and Wilson (1960) (1:24,000)	Mount Le Conte	Hadley and Goldsmith (1963) (1:62,500); Schultz and others (2000) (1:24,000)
Bryson City	Cameron (1951) (1:24,000); Hadley and Goldsmith (1963) (1:62,500); Southworth (unpub. data, 1:24,000)	Noland Creek	Mohr (1975) (1:24,000); Wiener and Merschat (1992) (1:250,000)
Bunches Bald	Hadley and Goldsmith (1963) (1:62,500)	Pigeon Forge	King (1964) (1:24,000)
Cades Cove	Southworth and others (1999) (1:24,000)	Richardson Cove	Hamilton (1961) (1:24,000)
Calderwood	Neuman and Nelson (1965) (1:62,500)	Silers Bald	King (1964) (north half, 1:24,000)
Clingmans Dome	Hadley and Goldsmith (1963) (1:62,500)	Smokemont	Hadley and Goldsmith (1963) (1:62,500)
Cove Creek Gap	Hadley and Goldsmith (1963) (1:62,500)	Sylva North	Merschat (2009) (1:24,000); Hadley and Goldsmith (1963) (1:62,500)
Dellwood	Hadley and Goldsmith (1963) (1:24,000)		
Fontana Dam	Southworth (1995) (north half, 1:24,000); P.P. Fox (unpub. data) (southeast quadrant); Wiener and Merschat (1992) (1:250,000) (southwest quadrant)	Tapoco	Lesure and others (1977) (west half, 1:48,000); Wiener and Merschat (1992) (east half, 1:250,000)
		Thunderhead Mountain	King (1964) (north half, 1:24,000)
Gatlinburg	King (1964) (1:24,000)	Tuskeegee	Southworth (1995) (north half, 1:24,000); P.P. Fox (unpub. data) (south half)
Hartford	Hadley and Goldsmith (1963) (1:62,500)		
Hazelwood	Merschat (2009) (1:24,000); Hadley and Goldsmith (1963) (1:62,500); Hadley and Nelson (1971) (1:250,000)	Walden Creek	King (1964) (1:24,000)
		Waterville	Hadley and Goldsmith (1963) (1:62,500)
		Wear Cove	King (1964) (1:24,000)
Jones Cove	Hamilton (1961) (1:24,000)	Whittier	Merschat (2009) (1:24,000); Hadley and Goldsmith (1963) (1:62,500); Southworth (unpub. data, 1:24,000)
Kinzel Springs	Neuman and Nelson (1965) (1:24,000)		
Luftee Knob	Hadley and Goldsmith (1963) (1:62,500)		
Maryville	Cattermole (1962) (1:24,000)	Wildwood	Neuman (1960) (1:24,000)
Mount Guyot	Hadley and Goldsmith (1963) (1:62,500)		

Figure 1. Index map of the Great Smoky Mountains National Park region in the Fontana Lake and Knoxville 30' x 60' quadrangles showing 7.5-minute 1:24,000-scale quadrangle names and a list of published geologic maps. Uncolored areas represent geology published at 1:24,000 scale. Areas shown in light gray represent geology published at 1:62,500 scale (Hadley and Goldsmith, 1963; Neuman and Nelson, 1965). Area shown in dark gray represents reconnaissance data at 1:24,000 scale (Southworth, unpub. data). All bedrock data were subject to revision by Southworth in the compilation of this report.

Extracted from: (Geologic Map of the Great Smoky Mountains (SIM 2997)).

GRI Digital Data Credits

This document was developed and completed by James Chappell (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory(GRI) Program. Quality control of this document by Stephanie O'Meara (Colorado State University).

The information in this document was compiled from the GRI source map, and intended to accompany the digital geologic-GIS map and other digital data for Great Smoky Mountains National Park, Tennessee and North Carolina (GRSM) developed by James Winter and James Chappell (Colorado State University) (see the GRI Digital Map and Source Map Citation section of this document for the source map used by the GRI in the completion of this document and the related GRI digital geologic-GIS map).

GRI finalization by James Chappell (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise (NPS GRD, Lakewood, Colorado).