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PRELIMINARY DIGITAL GEOLOGIC MAP OF THE APPALACHIAN PIEDMONT AND BLUE RIDGE, SOUTH CAROLINA SEGMENT

by

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ABSTRACT

This preliminary digital geologic map of the South Carolina segment of the Appalachian Piedmont and Blue Ridge was compiled at 1:500,000 scale as part of a suite of regional and national spatial data sets. All of these coverages are intended for use in the analysis and interpretation of regional geochemical patterns that may have environmental or resource applications. The geology was compiled by integrating data and interpretations from a variety of pre-existing sources, as referenced, without field verification. Map units in the database are categorized by rock type, geologic province, and age to facilitate queries and searches. Customized maps for special applications can be generated by combining the geologic coverage with other types of spatial data.

INTRODUCTION

This preliminary geologic map of the Piedmont and Blue Ridge in South Carolina contributes to a suite of spatial data sets being assembled for the analysis of regional and national geochemical patterns that may have environmental and resource applications. It was motivated and designed to meet internal needs of the USGS Mineral Resources Program. The map was produced by integrating data and interpretations from a variety of pre-existing sources without the benefit of additional field work. Geologic map units are classified in the database according to rock type (lithology), geologic province (Atlantic Coastal Plain, Piedmont Mesozoic basin, Eastern Piedmont, Central Piedmont, Western Piedmont, and Blue Ridge), and age (where known). These criteria can be used to search the database for units having particular characteristics. They can also be used to generate customized maps for special applications by integrating selected geologic features with other digital data sets.

The suite of regional data sets, for which this map is a contribution, will include digitized geologic maps of North Carolina and Georgia originally produced at 1:500,000 scale (Georgia Geologic Survey, 1976; North Carolina Geological Survey, 1985), and this coverage is designed for compatibility. It is more current than Overstreet and Bell's (1965a,b) map, more detailed than Maybin and others' (2000) general state-wide map, and less detailed than Nelson and others' (1998) partial coverage.

The geologic maps of North Carolina and Georgia were produced by multi-year efforts involving many collaborators, far exceeding the very limited scope and magnitude of this preliminary compilation for South Carolina. This coverage was assembled mainly from other regional compilations listed under "Principal Sources of Geologic Map Data." Those sources already incorporate numerous, more detailed geologic maps as well as reconnaissance mapping. Local modifications are based on additional sources listed under "References Cited and Sources of Geologic Data." Although including all of the latest geologic mapping is far beyond the intended scope of this compilation, this coverage for South Carolina is still generally more up-to-date than the comparable coverages for North Carolina and Georgia (Georgia Geologic Survey, 1976; North Carolina Geological Survey, 1985). Dikes of early Jurassic diabase, as compiled separately by Bell (1988), are omitted here. The inner margin of the Atlantic Coastal Plain is adapted from Offield and Sutphin (2000) with local modifications, and it differs slightly from that of Prowell and others (2000). Surficial geologic units are not shown in the Piedmont and Blue Ridge on this coverage or others nearby (Georgia Geologic Survey, 1976; North Carolina Geological Survey, 1985, Virginia Division of Mineral Resources, 1993), although deposits such as floodplain alluvium can be important for understanding regional geochemical patterns. Map-unit symbols use letters, such as "C" for Cambrian and TR for Triassic, rather than special characters, due to software limitations.

Multiple rock types may be lumped into a single unit, because of the compilation scale (1:500,000) and because the geology of many areas has not been mapped and studied in detail. No field verification was conducted, so errors in the source maps will be perpetuated. This compilation and others of similar scale in this region (e.g., Georgia Geologic Survey, 1976; North Carolina Geological Survey, 1985) should be considered progress reports to be superseded as knowledge of the geology improves. This map product is intended to meet short-term needs until more accurate coverage of the regional geology is available. It may also draw attention to regional geologic issues and areas where new studies could be especially beneficial.

This general compilation is not intended for use at scales larger (more detailed) than 1:500,000, and it should not be applied in the investigation of local and site-specific issues, which require more detailed geologic information. However, it can provide a regional context for understanding geologic aspects of the local environment.

SOURCES OF GEOLOGIC MAP DATA

Numerous sources of geologic data were combined and integrated into this digital compilation, and they are listed individually under "References Cited and Sources of Geologic Data." An index map shows where the "Principal Sources of Geologic Map Data" were used. These major sources include Barker and others (1998), Boland (1996), Butler (1977, 1988), Curl (1998), Daniels (1974), Dennis (1995), Goldsmith and others (1988), Hadley and Nelson (1971), Lawrence (1999), Maher and others (1991), Maybin and Niewendorp (1993), Nelson and others (1998), Offield and Sutphin (2000), Pray (1997), Robinson and others (1992), Schaeffer (1981), Secor and others (1986), West (1997). Local modifications are based on references cited in the Description of Map Units as well as the following additional sources: western Piedmont (Curl and Hatcher, 1997; Griffin, 1974; Hatcher, 1997; and Ranson and others, 1999), central Piedmont (Anonymous, 1972; Boland, 1998; Butler, 1966; Butler and Secor, 1991; Dennis and Wright, 1995; and Offield, 1995); plutonic rocks (Dennis and Wright, 1995; Nystrom and Niewendorp, 1998; Privett, 1995; Speer, 1987; and Speer and others, 1986), shear zones and faults (Boland, 1998; Dennis, 1991; Doar, 1996; Garihan and others, 1991, 1993; Lawrence and others, 1995; Maybin and Clendenin, 1998; and Sieling and others, 1997). Choices between inconsistent source maps were influenced by levels of detail, recency, and comparison with aeromagnetic data (Zietz and Daniels, 1982).

ACKNOWLEDGMENTS

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DESCRIPTION OF MAP UNITS

ATLANTIC COASTAL PLAIN

TK — Coastal Plain sediments (Tertiary and Cretaceous)—Undivided

EARLY MESOZOIC RIFT BASINS

TRc — Chatham Group (Triassic)—Undivided conglomerate, sandstone, and mudstone of Wadesboro basin and smaller Crowburg basin

LATE PALEOZOIC SHEAR ZONES

bz — Mylonitic rocks of Brevard fault zone (Late Paleozoic)—Mylonitic and phyllonitic equivalents of Chauga River Formation and other adjacent rock units

myg — mylonitic gneiss (Late Paleozoic)—Includes mylonitic gneiss in shear zone east of Winnsboro granite (Barker and others, 1998); mylonitic gneiss, button schist and phyllonite of Cross Hill and Chappells shear zones (West, 1997, Lawrence, 1999); and Beaver Creek gneiss (West, 1997)

ph — Phyllonite and phyllonitic schist (Late Paleozoic)—In shear zones such as Gold Hill, Waxhaw, Lowndesville, and Buzzard's Roost shear zones

mym — Mylonitic rocks of Modoc fault zone (Late Paleozoic)—Mylonitic paragneiss and schist (Pray, 1997)

PLUTONIC AND ASSOCIATED IGNEOUS ROCKS

LATE PALEOZOIC PLUTONIC ROCKS

Cg — Granite (Carboniferous and Permian)—Including named plutons: br, Bald Rock; b, Batesburg (gneissic); cr, Catawba-Roddey; ch, Cherryville; cc, Clouds Creek; cv, Clover; cp, Cold Point; cl, Columbia; co, Coronaca; ct, Cuffytown Creek; e, Edgefield; ep, unnamed granites of eastern Piedmont; gv, Graniteville-Vaucluse; h, Harbison; j, Johnston (gneissic sheets) ; lx, Lexington; lh, Liberty Hill; p, Pageland; w, Winnsboro; y, York. Geochronology summarized in McSween and others, 1991, Table 7-1).

Cd Gabbro and diorite (Carboniferous)—Including named plutons: dc, Dutchmans Creek (olivine gabbronorite; McSween and Nystrom, 1977); cc, Clouds Creek (diorite, McSween and others, 1991, p. 124)

MIDDLE PALEOZOIC PLUTONIC ROCKS

Concord Plutonic Suite (Devonian to Silurian)

DScg Gabbro—Including named plutons: a, Abbeville; b, Buffalo; cf, Calhoun Falls, ch, Chester; g, Greenwood, mc, McCormick; me, Mecklenburg; m, Mt Carmel; ny, North York; o, Ogden; rn, Rock Hill North, rs, Rock Hill South

DScs Syenite—Including named plutons: b, Buffalo; m, Mount Carmel

Dgg Gray Court metagranite (Devonian)—Foliated, medium-grained, equigranular to porphyritic, biotite granite (includes Gray Court, Ott, and Rabun Creek facies of Wagener, 1977); has concordant $^{207}Pb/^{206}Pb$ zircon age of 359 Ma (Nelson and others, 1998) and Rb-Sr whole rock age of 375±23 Ma (McSween and others, 1991)

Dp Pacolet granite (Devonian)—Biotite monzogranite to granodiorite, equigranular to porphyritic; Rb-Sr isochron age is 383±5 Ma (Mittwede and Fullagar, 1987)

Granite of Lowrys pluton (Devonian)

Dle Equigranular granite (Devonian)

Dlp Porphyritic granite (Devonian)—Previously described by Wagener (1977) as “McConnells porphyry” (informal name); 399±4 Ma Rb-Sr whole rock age (Fullagar, 1971)

Sgn Newberry granite and similar, possibly related granites (Silurian)—Nonfoliated and contains foliated xenoliths; Rb-Sr age is 415±9 Ma (McSween and others, 1991)

Table Rock Plutonic Suite (Ordovician to Silurian) and possible equivalents

DSg Granodiorite gneiss and granite gneiss (Devonian to Silurian)

Pzgf Reedy River complex (informal name of Wagener, 1977) and smaller unnamed plutons (Paleozoic)—Gneissic biotite granite to granodiorite

Pzgp Gneissic granite of Greenville (Paleozoic)—Interpreted by Nelson and others (1998) as within Paris Mountain thrust sheet

SOsga Gneissic granite of Antreville (Silurian to Ordovician)—Gneissic biotite granite to granodiorite of Antreville pluton

SOsg Gneissic granite of Starr (Silurian to Ordovician)—Gneissic biotite granite to granodiorite of Starr pluton and nearby satellite plutons; interpreted by Nelson and others (1998) as within Six Mile thrust sheet

SOg Caesars Head Granite (Silurian to Ordovician)—Well foliated, locally segregation-banded biotite granitoid gneiss or gneissic granitoid; cuts Seneca thrust fault; discordant $^{207}Pb/^{206}Pb$ age is 435 Ma (Nelson and others, 1998)

SOgg Granite gneiss, undivided (Silurian to Ordovician)—Equigranular to inequigranular granite gneiss and augen gneiss previously mapped as "Henderson Gneiss" but having younger Rb-Sr whole rock age of 445±20 Ma (McSween and others, 1991; Fullagar and others, 1997). Map unit may include outliers of Henderson Gneiss (Chg) intruded by Ordovician granite

Ogt Toluca Granite and associated metagranites (Ordovician?)—Weakly to strongly foliated, garnet-bearing, metamorphosed monzogranite to granodiorite; ranges from equigranular and medium-grained to inequigranular having coarse microcline megacrysts. Toluca has 480±50 Ma $^{207}Pb/^{206}Pb$ zircon age (Davis and others, 1962; discussion in Odom and Fullagar, 1973)

Omg Migmatitic granitoid gneiss (Ordovician?)—Variably foliated, variably migmatitic, and granitic to quartz dioritic in composition. Equivalent to "Omg" of Robinson and others (1992, Plate 1) and "OCmg" of North Carolina Geological Survey (1985)

EARLY PALEOZOIC PLUTONIC ROCKS

Chg Henderson Gneiss (Cambrian)—Biotite granitoid augen gneiss having distinctive microcline augen; monzonite to granodiorite composition; equivalent to exposures in type area of Henderson County, NC and having U-Pb concordia upper-intercept zircon ages of about 600 Ma (Sinha and Glover, 1978) and 538 Ma (Odom and Fullagar, 1973) and Rb-Sr whole-rock age of 513±34 Ma (Fullagar and others, 1997, Table 1)

PLUTONS OF UNDETERMINED AFFINITY AND AGE

Pza Anderson metagabbro (Paleozoic?)—Metagabbro grading into amphibolite; composed of plagioclase, hornblende, and commonly garnet, ferrohypersthene, clinopyroxene, and quartz

Pzgj Granite sheets near Joanna (Paleozoic?)—Equivalent to "Joanna sills" of Wagener (1977); age undetermined

Pzgsa Santuck granite (Paleozoic?)—Age undetermined

PzZgr Metamorphosed granitoids (Paleozoic to Neoproterozoic)—Undivided plutonic rocks of different age including probable equivalents of CZgr, the Sand Creek granite of Dennis and Shervais (1996, Fig. 2), the Cokesbury metagranite of West (1997), and granite having 338 Ma concordant $^{207}Pb/^{206}Pb$ zircon age. (Nelson and others, 1998)

CZgr Metamorphosed granite to granodiorite (Cambrian to Neoproterozoic)—Includes rock from York County having U-Pb concordia intercept age of 532±15 Ma (Gilbert and others, 1982). Foliated "biotite porphyry qranodiorite" intrusive into metabasalt at Stop 5 of Dennis and others, (1995) has U-Pb zircon age of about 571±16 Ma (Dennis and Wright, 1997). Rock variously described as "foliated granodiorite" (Dennis and others, 1995, Stop 12) or "foliated diorite" intrusive into mafic metavolcanic rocks has U-Pb zircon upper concordia intercept age of 579±4 Ma; includes unit "mg" of Boland (1996, 1997)

CZdi Diorite (Cambrian to Neoproterozoic)—Includes "unmetamorphosed, undeformed biotite-hornblende diorite" which intrudes metadiorite of Mean Crossroads complex as well as mafic metavolcanic rocks and has U-Pb zircon date of 535±4 Ma (Dennis and Wright, 1997)

EARLY PALEOZOIC-NEOPROTEROZOIC PLUTONS AND SUBVOLCANIC COMPLEXES

OCgw Waxhaw metagranite (Cambrian)—Metamorphosed fine- to medium-grained biotite granite and hypabyssal quartz porphyry, non-foliated except adjacent to Gold Hill and Waxhaw shear zones where it is weakly gneissic to phyllonitic (Boland, 1996); Rb-Sr whole rock age is 495±21 Ma (Fullagar, 1981; McSween and others, 1991)

CZge Edgemoor metagranite (Cambrian or Neoproterozoic)—Medium-grained, foliated to non-foliated, metamorphosed metagranite containing biotite±muscovite±garnet Boland, 1996); Rb-Sr whole rock age is 508±61 Ma (Fullagar, 1971; McSween and others, 1991)

CZggf Great Falls metagranite (Cambrian or Neoproterozoic)—Foliated, metamorphosed muscovite-biotite granite having accessory garnet and discordantly intruding surrounding rocks (Privett, 1985); Rb-Sr whole rock age is 565±57 Ma (Fullagar, 1971; McSween and others, 1991)

CZgph Pleasant Hill metagranite (Cambrian or Neoproterozoic?)—Possibly similar to nearby Great Falls metagranite (McSween and others, 1991, Table 7-1)

Zglt Longtown Metagranite (Neoproterozoic)—Biotite metagranite having 551.2±2.6 Ma weighted mean $^{207}Pb/^{206}Pb$ zircon age, Barker and others, 1998)

mtg Biotite metatonalite and granodiorite (Paleozoic or Neoproterozoic?)

Ztr Metatrondhjemite (Neoproterozoic?)

Zto Metatonalite (Neoproterozoic)—Metamorphosed biotite tonalite and lesser amounts of hornblende tonalite , trondhjemite, and granodiorite. Locally contains angular xenoliths of Battleground Formation metavolcanic and metasedimentary rocks. Discordant $^{207}Pb/^{206}Pb$ age is about 590 Ma (Goldsmith and others, 1988)

Ztl Little Mountain metatonalite (Neoproterozoic)—U-Pb concordia upper-intercept age is 550±4 Ma (Dallmeyer and others (1986)

PzZq Metamorphosed quartz diorite to diorite (Paleozoic or Neoproterozoic?)

CZmd Metadiorite (Cambrian or Neoproterozoic?)

PzZg Metagabbro and minor metadiorite (Middle Paleozoic to Neoproterozoic?)—Includes named bodies: **PzZgbw**, Big Wateree Creek; **PzZgbc**, Chester

CZdg Metadiorite and minor metagabbro, containing sparse hornblendite and pyroxenite (Cambrian or Neoproterozoic?)—Includes **CZdgm**, Mean Crossroads intrusive complex (informal name of Dennis and Shervais, 1991, 1996) having U-Pb concordia intercept age of 538±5 Ma (Dennis and Wright, 1997); **CZdgw**, Wildcat Branch complex; **CZdgl**, Lockhart metadiorite

MAFIC-ULTRAMAFIC COMPLEXES AND ULTRAMAFIC ROCKS

um Ultramafic rock (Paleozoic or Neoproterozoic)—Metamorphosed

m Latimer complex of Griffin (1979) (Paleozoic or Neoproterozoic)—Metamorphosed mafic-ultramafic complex consisting mainly of mafic rocks including amphibolite, metagabbro, and greenstone metabasalt, and lesser amounts of ultramafic rock composed of talc, chlorite, serpentine, and minor cummingtonite(?) (Griffin, 1979); interpreted by Higgins and others (1988, 1989) as part of the "Juliette slice" of the "Macon mélange" and by Butler (1989) as mafic igneous rocks of calc-alkaline magmatic arc

Hammett Grove Meta-igneous Suite of Mittwede (1989) (Paleozoic or Neoproterozoic)

hgg Metagabbro

hgu Metamorphosed ultramafic rocks—Hornblendite, pyroxenite, serpentinite, and talc schist

Burks Mountain complex of Sacks and others (1989) (Cambrian or Neoproterozoic)

CZbu Ultramafic rocks of Burks Mountain complex (Cambrian or Neoproterozoic)

CZba Amphibolite of Burks Mountain complex (Cambrian or Neoproterozoic)

LAYERED AND STRATIFIED METAMORPHIC ROCKS

BELAIR BELT

CZvs Metavolcanic and metasedimentary rocks of Belair belt (Ordovician to Neoproterozoic?)—Lower greenschist facies rocks in Belair belt of Crickmay (1952), may include rocks equivalent to Persimmon Fork Formation (Daniels, 1974; Offield and Sutphin, 2000)

KIOKEE BELT

CZk Migmatitic paragneiss and schist of Kiokee belt (Cambrian or Neoproterozoic?)—Migmatitic hornblende-biotite paragneiss having interlayered sillimanite schist and amphibolite; principal unit of Kiokee belt as defined by Crickmay's (1952) and extended by Daniels (1974); interpreted by Maher and others (1991) as part of Savannah River terrane

CAROLINA SLATE BELT AND CHARLOTTE BELT

OCc Cid Formation (Ordovician to Late Cambrian?)—Cid Formation as proposed by Offield and Sutphin (2000), equivalent to Cid Formation Mudstone Member of previous usage. Mainly laminated metamudstone; contains euconodonts no older than Late Cambrian in North Carolina (Koeppen and others, 1995; Offield and Sutphin, 2000)

OCr Richtex Formation (Ordovician to Middle Cambrian)—Laminated metamudstone; contains Middle Cambrian or younger sponge spicules (Bourland and Rigby, 1982); Ordovician age proposed by Offield and Sutphin (2000) based on similarity and possible correlation with Tillery Formation in North Carolina, which contains bryozoans and other fossils no older than Middle Ordovician (Koeppen and others, 1995)

Cap Asbill Pond Formation (Middle Cambrian)—Siltstones and sandstones having interbedded felsic to mafic metavolcanic rocks; age based on Middle Cambrian trilobite fauna (Secor and others, 1983; Samson and others, 1990)

OZfs Flat Swamp Formation (Ordovician to Neoproterozoic?)—Flat Swamp Formation as proposed by Offield and Sutphin (2000), equivalent to Flat Swamp Member of Cid Formation of previous usage. Crystal and lithic metatuff of rhyolite to rhyodacite composition (Goldsmith and others, 1988); not reliably dated; age and stratigraphic relations uncertain since Koeppen and others' (1995) discovery of fossils in Tillery Formation nearby in North Carolina (Offield and Sutphin, 2000)

OZvi Layered metavolcanic rocks (Ordovician to Neoproterozoic?)—Interlayered mafic to felsic metavolcanic rocks, undivided

OZvf Felsic metavolcanic rocks and layered felsic gneiss interpreted to be metavolcanic (Ordovician to Neoproterozoic?)--Stratigraphic relations undetermined

OZvm Mafic to intermediate metavolcanic rocks including layered hornblende gneiss and amphibolite (Ordovician to Neoproterozoic?)—Stratigraphic relations undetermined

CZpf Persimmon Fork Formation (Cambrian to Neoproterozoic)—Predominantly metatuff; age based on 550.5±5.9 Ma weighted mean of $^{207}Pb/^{206}Pb$ ages (Barker and others, 1998)

CZph Quartz-sericite phyllite and schist (Cambrian to Neoproterozoic?)—Includes exposures in Nanny Mountain area

Zlm Lincolnton Metadacite (Neoproterozoic)—566±15 Ma U-Pb zircon upper intercept concordia age (Carpenter and others, 1982) is similar to age of Persimmon Fork Formation as well as Uwharrie Formation in North Carolina

gn Biotite-quartz-plagioclase gneiss (Paleozoic to Neoproterozoic)—Undivided biotite gneisses containing interlayered amphibole gneiss, amphibolite, and mica schist; includes unit “g” of Nelson and others (1998). Gneiss in Newberry County contains isolated blocks of amphibolitized eclogite (Libby and Carpenter, 1969; Shervais and others, 1997)

am Amphibolite and amphibole gneiss (Paleozoic to Neoproterozoic)

ms Tuffaceous metasiltstone (Paleozoic to Neoproterozoic)

LITTLE RIVER SEQUENCE

CZlr Metasedimentary rocks of Little River Sequence (Cambrian or Neoproterozoic?)—White-mica schist and phyllite, metatuff, quartz-muscovite schist, and minor quartzite; equivalent to metasedimentary part of “Little River Series” as described by Crickmay (1952, p. 31-33), also known as “Little River Group” (Austin, 1969) and renamed Little River Sequence by Chowns (1976)

BATTLEGROUND AND BLACKSBURG FORMATIONS

CZbl Blacksburg Formation, undivided (Neoproterozoic?)—Metamorphosed sedimentary sequence of interlayered sericite schist and phyllite, sericitic quartzite, marble, amphibolite, and calc-silicate rock; stratigraphic relation to Battleground Formation undetermined because of intervening faults and plutons (Horton, 1983; Goldsmith and others, 1988)

Battleground Formation (Neoproterozoic)—Metavolcanic facies (Zbm, Zbf, Zbp) are most abundant in the lower part of the Formation and metasedimentary facies (Zba) are most abundant in the upper part; intruded by metatonalite (Horton, 1983)

Zba Metasedimentary rocks (undivided)—Quartz-sericite schist and phyllite and interlayered quartzite, quartz-pebble conglomerate, high-alumina quartzite, and manganiferous schist

Zbp Schistose to phyllitic volcaniclastic rocks

Zbf Felsic metavolcanic rocks

Zbm Mafic to intermediate metavolcanic rocks

CENTRAL PIEDMONT ALLOCHTHON OF MAYBIN AND NIEWENDORP (1993)

eca Enoree mélange (informal name of Mittwede and Maybin, 1989), Cedar Shoals gneiss (informal name of Horkowitz, 1984) and Cross Anchor mafic complex (informal name as used by Maybin and Niewendorp, 1993) collectively interpreted by Maybin and Niewendorp (1993) as part of Central Piedmont allochthon. Cedar Shoals gneiss is biotite-quartz-feldspar gneiss interpreted as metagraywacke and interlayered felsic gneiss interpreted as metavolcanic rock (Dennis and others, 1995, Stop 10)

pcc Philson Crossroads complex (informal name of Maybin and Niewendorp, 1993)—Biotite-quartz-feldspar gneiss having interlayers of amphibolite and metagranite; interpreted by Dennis and Shervais (1996, Fig. 2) as mafic metavolcanic rock. Possibly equivalent to metavolcanic rocks in lower Battleground Formation (Zbf and Zbm)

CZgi Biotite gneiss having interlayered marble, calc-silicate gneiss, sillimanite-muscovite schist, and garnet-quartz rock (Cambrian to Neoproterozoic?)—Stratigraphic significance undetermined; variously interpreted as west of "Central Piedmont suture" by Horkowitz (1984) and Dennis and Shervais (1996), and east of "Central Piedmont suture" by Dennis (1995)

WESTERN PIEDMONT
(stratigraphic order undetermined)

CZcp Chauga River Formation and Poor Mountain Formation (Cambrian or Neoproterozoic?)—Undivided

CZwa Wallhalla metamorphic suite (informal name of Horton and McConnell, 1991) (Cambrian or Neoproterozoic?)—Predominantly hornblende-plagioclase gneiss and amphibolite, locally having interlayers of biotite-quartz-feldspar gneiss, undivided

CZgl Biotite-quartz-plagioclase gneiss and interlayers locally containing hornblende, sillimanite, microcline, and muscovite (Cambrian or Neoproterozoic?)—Locally contains feldspar porphyroblasts, schist interlayers rich in biotite and/or sillimanite, and granitic gneiss interlayers. Includes gneiss assigned to Laurens thrust sheet by Nelson and others (1998)

CZwr Biotite-quartz-feldspar gneiss of Whitmire reentrant (Cambrian or Neoproterozoic?)—Mapped and interpreted by West (1997, Fig. 3-3) as Inner Piedmont gneiss separated by thrust fault from structurally-higher allochthonous rocks of the Carolina terrane.

CZga Amphibolite having interlayered biotite gneiss, hornblende gneiss, and minor mica schist (Cambrian or Neoproterozoic?)

CZsp Sillimanite schist and sillimanite-mica schist (Cambrian or Neoproterozoic?)—Sillimanite-rich aluminous schist composed mainly of sillimanite, biotite, muscovite, and minor quartz; sillimanite abundant as needles matted in foliation and locally as larger prismatic crystals

CZsg Biotite-plagioclase-quartz gneiss and biotite-muscovite schist (Cambrian or Neoproterozoic?)—Variably interlayered, containing subordinate layers of amphibolite and sillimanite-mica schist. Includes rocks assigned by Nelson and others (1998) to Six Mile thrust sheet

CZpg Megacrystic biotite gneiss (Cambrian or Neoproterozoic?)—Variably layered biotite-quartz-feldspar gneiss having porphyroclasts and/or porphyroblasts of plagioclase and locally of quartz and potassium feldspar

CZms Sillimanite-mica schist and muscovite-biotite schist (Cambrian or Neoproterozoic?)—Thin to thick layered sillimanite-mica schist and sillimanite-bearing muscovite-biotite schist, locally garnetiferous, having subordinate interlayers of muscovite-biotite-quartz-feldspar gneiss; sillimanite commonly altered to sericite

CZbg Biotite gneiss and muscovite-biotite gneiss (Cambrian or Neoproterozoic?)—Layered biotite-quartz-feldspar gneiss, locally garnetiferous, locally inequigranular and having microcline porphyroblasts, having interlayers of sillimanite-mica schist, calc-silicate rock, and amphibolite. Locally contains small masses of granite

CZgs Garnetiferous mica schist (Cambrian or Neoproterozoic?)—Aluminous muscovite-biotite schist, locally having subordinate amphibolite layers

BLUE RIDGE

Tallulah Falls Formation (Neoproterozoic?)

Zatb Gneissic metagraywacke and schist—Biotite-quartz-plagioclase gneiss interpreted to be metagraywacke, and interlayered biotite-muscovite schist, garnet-mica schist, and amphibolite

Zata Amphibolite

Yt Toxaway Gneiss (Mesoproterozoic)—Banded granite gneiss consisting of very light gray layers rich in quartz, plagioclase, and microcline alternating with dark gray biotite-rich layers; Rb-Sr whole-rock age is 1197±56 Ma (Fullagar and others, 1979)

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