GEOLOGIC TIME SCALE

Era	Period	Epoch	Age	Approximate age of boundaries (millions of years)
Cenozoic Era 0-65	Quaternary 0-2	Holocene 0-0.01		
		Pleistocene 0.01-2		
	Tertiary 2-65	Pliocene 2-5		
		Miocene 5-24		
		Oligocene 24-38		
		Eocene 38-55		
		Paleocene 55-65		
Mesozoic Era 65-245	Cretaceous 65-144	Late Cretaceous Epoch		
		Early Cretaceous Epoch		
	Jurassic Period 144-206			
	Triassic Period 206-245			
Paleozoic Era 245-570	Permian Period 245-290			
	Carboniferous 290-360	Pennsylvanian Period 290-320		
		Mississippian Period 320-360		
	Devonian Period 360-408			
	Silurian Period 408-438			
	Ordovician Period 438-505			
	Cambrian Period 505-570			
Proterozoic	Late Proterozoic Era 570-1,000			
	Middle Proterozoic Era 1,000-1,600			
	Early Proterozoic Era 1,600-2,500			
Archezoic	Archezoic Era 2,500-4,600			
	Chiefly crystalline rocks in U.S.			1600*
	Oldest known rocks in world			3960*

Adapted from U.S. Geological Survey, 1965; Compiled from Cohee, in Geologic Time, 1962, U.S. Geological Survey Bulletin 1230-A, p. 9-15.

*Kano, R.M., Poorman, F.P., Shaw, W.C., and Renault, R.C., 1984, Geology, geochronology, and rock geochemistry of the Middle Proterozoic Pamlico County Tuff, eastern North Carolina: Southeastern Geology, v. 25, p. 61-81.

**Bowring, S.A., Grotzinger, J.P., Isachsen, C.E., Knoll, A.H., Pelechaty, S.M., and Kolosov, P., 1993, Calibrating rates of early Cambrian evolution: Science, v. 261, p. 501-507.

MURPHY BELT

METAMORPHIC ROCKS

- Pzm — MINERAL BLUFF FORMATION — Quartz-sericite-sericite schist and phyllite; with the chemical facies field within interbedded graphite-quartz-sericite schist, chlorite-sericite schist, chlorite-biotite schist, and phyllite
- Pzq — MURPHY MARBLE, ANDREWS FORMATION, AND NOTTELY QUARTZITE — Marble; quartzite
- Pzs — SNOWBIRD GROUP — Sericite schist, quartz-sericite schist, Andrews Formation: calcareous cross-bedded schist
- Zm — BRASSTOWN FORMATION — Cross-bedded schist; includes miscavoose member

NANTAHALA FORMATION AND TUGGUTALE QUARTZITE, UNDIVIDED — Nantahala Formation: slate and metasiltstone; dark gray, laminated to thin bedded; sulfidic
- Zna — Nantahala Formation
- Zqt — Tuggutale Quartzite: white to light yellowish gray, numerous, thin-state layers

INTRUSIVE ROCKS

- AMPHIBOLITE — Amphibolite; massive to foliated and folded, dioritic to basaltic dikes and sills; originally metadiabase

BLUE RIDGE BELT

SEDIMENTARY AND METAMORPHIC ROCKS

- Zbr — ROME FORMATION — Shale and siltstone, variegated red to brown; interbedded fine-grained sandstone and minor dolomite
- Zbs — SHADY DOLOMITE — Light-gray, fine grained, massive, locally thin bedded dolomite

CHILHOWEE GROUP

- Zc — UPPER CHILHOWEE — Vitreous quartz arenite, white to light gray; interbedded sandy siltstone and shale; Erwin and Hampton Formations of Rankin (1967)
- Zcl — LOWER CHILHOWEE — Feldspathic arenite, white to yellowish gray; feldspathic quartz arenite; feldspathic and conglomeratic in lower part; includes Unicoi Formation of Rich Springs sandstone

OCOEE SUPERGROUP

- Zbl — BALDFACE GROUP, UNDIVIDED — Slate to metasiltstone; locally thin beds and pods, interbedded with quartzite; includes Ashe and Mount Rogers Formations
- Zbq — BALDFACE QUARTZITE — Thick and massive/massive; quartzite of massive to graded beds of metagraywacke and metarkosites with conglomerate lenses; includes Mount Rogers Formation
- Zbs — CEDAR FORMATION — Sericite schist with quartz-sericite-chlorite and garnet-staurolite-kyanite-chlorite-sericite schists; in Cranberry quadrangle, includes Ashe Formation
- Zbm — MITCHELL METAMORPHIC METAMORPHIC METASTONE ANDAMICA SCHIST — Basic and lenses of calc-silicate rock locally abundant; includes Ashe Formation: sericite-chlorite-quartz schist, locally garnetiferous; Snaggy Ridge and Wilhoux formations in southern area; Horse Branch Member of Ammons Formation and Snaggy Ridge Formation in Cranberry area
- Zbl — LEATHERMAN FORMATION — Slate to schist, dark gray; graphitic and sulfidic; includes Horse Branch, Wilhoux, and Snaggy Ridge Formations; includes Ashe Formation: sericite-chlorite-quartz schist, locally garnetiferous
- Zbs — SLATE, UP COPPERING, FORMATION — Slate to phyllite, dark gray; graphitic, sulfidic; includes metagraywacke with local graded bedding
- Zp — PHYLLITE — Dark shale gray, graphitic and sulfidic
- Zs — ANAKEESTA FORMATION — Slate to schist, dark gray, graphitic and sulfidic; includes interbedded argillaceous, feldspathic metagraywacke and quartzite
- Zbd — BUCK GAP FORMATION — Dark gray, highly-sulfidic slate and metasiltstone interbedded and gradational with metagraywacke. Stratigraphic position uncertain. Chestnut Creek Formation upper part of Buck Gap Formation
- Zbb — RICE BLUFF, SINGING FORE — Feldspathic, interbedded with dark argillaceous beds and laminae. Stratigraphic position uncertain
- Zb — BROWNBERG GROUP, UNDIVIDED — Feldspathic metasiltstone, metaarenite, and phyllite. Basal schist contains lenses of quartz-pebble conglomerate
- Zbg — PIGEON SILTSTONE — Thin bedded to laminated, commonly cross-laminated, feldspathic metasiltstone, with local metaarenite and arkosic metaarenite grading to slate interbedded
- Zbr — ROARING FORK SANDSTONE — Greenish-gray, fine to medium grained, massive, feldspathic, metaarenite, interbedded metasiltstone and phyllite
- Zbl — LONGARM QUARTZITE — Cross-bedded, feldspathic, locally conglomeratic, quartzite; in Roan Mountain quadrangle
- Zbw — WADNA BRANCH FORMATION — Sericite-quartz to cianite-garnet-biotite metagraywacke with local graded bedding. Basal quartz sericite schist on phyllite

MOUNT ROGERS FORMATION

- Zrc — Metarhyolite tuff (Late Proterozoic, 620 my, 38) — Light-colored porphyritic extrusive rock
- Zrs — Metagraywacke — Interbedded with metacongloomerate, laminated metasiltstone, and slate; minor calcareous metasandstone, greenstone, and metarhyolite

- Zaa — ALLIGATOR BACK FORMATION — Micaschist and phyllite — Laminated to thin-layered, interlayered with minor biotite-muscovite gneiss and amphibolite
- Zmm — Gneiss — Finely laminated to thin layered, locally contains muscovite and biotite-muscovite porphyroblastic gneiss, minor amphibolite, and amphibolite
- Zam — Amphibolite — Equigranular, massive to well foliated, interlayered, minor biotite-hornblende gneiss, biotite-muscovite and sericite-muscovite, may include metasedimentary rock
- ASHE METAMORPHIC SUITE AND TALLULAH FALLS FORMATION
- Zmg — Metagraywacke — Foliated to massive, locally conglomeratic, interlayered with minor biotite-muscovite gneiss, muscovite-biotite gneiss, and sericite-muscovite schist
- Zgm — Magnetite-quartzite — Locally sulfidic, interlayered with graphitic quartzite, quartz-sericite schist, and muscovite-biotite gneiss
- Zms — Mica schist — Locally sulfidic and graphitic; minor interlayered mica gneiss and amphibolite
- Zbg — Biotite gneiss — Interlayered with biotite-garnet gneiss, biotite-muscovite gneiss, and muscovite-biotite gneiss; minor amphibolite
- Zam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist
- Zmu — Metagabbro — Coarse-textured and gneissic; contains lenses of amphibolite
- Zcm — COWEETA GROUP — Quartz-dioritic gneiss; feldspar-quartz-biotite gneiss, biotite-muscovite gneiss, muscovite-biotite gneiss, biotite-muscovite schist, and minor amphibolite. Quartz dioritic gneiss predominant
- Zbb — BOTE GNEISS — Migmatitic; interlayered and gradational with biotite-muscovite gneiss, muscovite-biotite gneiss, muscovite-biotite schist, and minor amphibolite
- Zam — Amphibolite — Equigranular, massive to well foliated; interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist; may include metasedimentary rock

INTRUSIVE ROCKS

- Zbg — GRANODIORITIC GNEISS (Middle Proterozoic, 1176 my, 2) — Granitic gneiss to granitic gneiss, predominantly to muscovite-biotite, epidotic, sericitic, and chlorite-bearing
- Zbg — TOXAWAY GNEISS (Middle Proterozoic, 1250 my, 1) — Poorly foliated to well foliated, equigranular to porphyritic granitic
- Zbg — BOTE GNEISS, GNEISS (Late to Middle Proterozoic, 880-1250 my) — Granitic gneiss, biotite-muscovite gneiss, muscovite-biotite gneiss, muscovite-quartz monzonitic. Includes variably mylonitized orthogneiss and paragneiss of the Ocoee Supergroup, Ashe Formation, and Snowbird Group. Dates granites of the Ocoee City area, Straight Fork window, and Elk River area
- Zam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist
- Zbg — MIGMATITIC BIOTITE-HORNBLENDE GNEISSES (Middle Proterozoic, 1214 my, 12) — Layered, quartz-quartz gneiss, biotite-hornblende gneiss, biotite-muscovite gneiss, and minor amphibolite. Dates Ocoee rocks
- Zam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist; may include metasedimentary rock

INTRUSIVE ROCKS

- Zd — PEDMATITES (Devonian to Ocoee, 365-450 my, 21) — Lenticular to irregular, pegmatitic to aplitic, muscovite-bearing, locally tourmaline-bearing, areas of alkali-feldspar and accessory muscovite-bearing (Hiden Ed, pers.)
- Zd — TRONDHJEMITE (Devonian?) — Postmetamorphic dikes and sills. Foreignained leucocratic, weakly foliated, trondhjemite-granodiorite to tonalite. Dates Ocoee rocks in Cranberry quadrangle and Ashe County
- Zd — QUARTZ DIORITE OR GRANODIORITE (Devonian) — Minor dikes in Cranberry quadrangle, and vicinity, includes Whiteside Mountain, Cullowhee, Sylva, and Sylvan Pass, and other smaller plutons
- Zd — NABLUS GNEISS (Devonian or Ordovician, 1B — Weakly foliated biotite granite to quartz monzonite
- Zd — METALUTAMATIC ROCK — Metamorphosed diorite, local peridotite, pyroxenite, and other altered ultramafic rock. Only larger bodies shown
- Zd — AMPHIBOLITE — Equigranular, massive to well foliated; dioritic to basaltic dikes and sills; originally metadiabase
- Zd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic) 680-710 my, 25, 27) — Massive to foliated; locally mylonitic. Beech Crossroads, Brown Mountain, Linville, and Grandfather Stocks
- Zd — MAN PATCH GRANITE — Metaleucogranite and light green, coarse-grained to pegmatitic, muscovite-bearing
- Zd — BANNER ELK METAGRANITE (Late Proterozoic, 724 my, 16) — Thin dikes and sills; first shown separately; areas of abundance shown by pattern

GRANDFATHER MOUNTAIN WINDOW

METAMORPHIC ROCKS

- Zbm — MINITOR GNEISS — Light gray, fine-grained, massive, locally thin-bedded biotite-quartz-feldspar gneiss

CHILHOWEE GROUP, UNDIVIDED

- Zc — UPPER CHILHOWEE — Vitreous quartzite, white to light gray; interbedded sandy metasiltstone and slate
- Zcl — LOWER CHILHOWEE — Feldspathic quartzite, white to yellowish gray; feldspathic quartzite; conglomeratic in lower part; includes Unicoi Formation

GRANDFATHER MOUNTAIN FORMATION

- Zgm — Metarhyolite — Schistose, porphyritic, locally cross-bedded, interlayered metasiltstone and slate
- Zgm — Metagraywacke — Massive to well foliated, conglomeratic, interlayered metasiltstone rocks. Includes Macrocarpon Member (metaflow-breccia member)
- Zgm — Porphyritic volcanic rock (Late Proterozoic, 630 my, 26) — Rhyolite to andesite; contains euhedral to subhedral phenocrysts of plagioclase and pink potassic feldspar. Remembers quartzite and mica schist
- Zgm — Metasiltstone — Locally contains thin bedded iron-bearing dolomite member, interbedded with phyllite, lithologically similar to Minitor Gneiss
- Zgm — Metagraywacke — Crossbedding and graded bedding common; feldspathic, lithic, and quartzose; minor conglomerate
- Zgm — Felsic metabasalt, mica and metasedimentary rocks (Late Proterozoic, 630 my, 26) — Tentatively correlated with Grandfather Mountain Formation

UNCONFORMITY

- Zbg — BLOWING ROCK GNEISS (Middle Proterozoic, 1176 my, 2) — Granitic gneiss to granitic gneiss, predominantly to muscovite, epidotic, sericitic, and chlorite-bearing
- Zbg — TOXAWAY GNEISS (Middle Proterozoic, 1250 my, 1) — Poorly foliated to well foliated, equigranular to porphyritic granitic
- Zbg — BOTE GNEISS, GNEISS (Late to Middle Proterozoic, 880-1250 my) — Granitic gneiss, biotite-muscovite gneiss, muscovite-biotite gneiss, muscovite-quartz monzonitic. Includes variably mylonitized orthogneiss and paragneiss of the Ocoee Supergroup, Ashe Formation, and Snowbird Group. Dates granites of the Ocoee City area, Straight Fork window, and Elk River area
- Zam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist
- Zbg — MIGMATITIC BIOTITE-HORNBLENDE GNEISSES (Middle Proterozoic, 1214 my, 12) — Layered, quartz-quartz gneiss, biotite-hornblende gneiss, biotite-muscovite gneiss, and minor amphibolite. Dates Ocoee rocks
- Zam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist; may include metasedimentary rock

INTRUSIVE ROCKS

- Zd — PEGMATITES (Devonian to Ocoee, 365-450 my, 21) — Lenticular to irregular, pegmatitic to aplitic, muscovite-bearing, locally tourmaline-bearing, areas of alkali-feldspar and accessory muscovite-bearing (Hiden Ed, pers.)
- Zd — TRONDHJEMITE (Devonian?) — Postmetamorphic dikes and sills. Foreignained leucocratic, weakly foliated, trondhjemite-granodiorite to tonalite. Dates Ocoee rocks in Cranberry quadrangle and Ashe County
- Zd — QUARTZ DIORITE OR GRANODIORITE (Devonian) — Minor dikes in Cranberry quadrangle, and vicinity, includes Whiteside Mountain, Cullowhee, Sylva, and Sylvan Pass, and other smaller plutons
- Zd — NABLUS GNEISS (Devonian or Ordovician, 1B — Weakly foliated biotite granite to quartz monzonite
- Zd — METALUTAMATIC ROCK — Metamorphosed diorite, local peridotite, pyroxenite, and other altered ultramafic rock. Only larger bodies shown
- Zd — AMPHIBOLITE — Equigranular, massive to well foliated; dioritic to basaltic dikes and sills; originally metadiabase
- Zd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic) 680-710 my, 25, 27) — Massive to foliated; locally mylonitic. Beech Crossroads, Brown Mountain, Linville, and Grandfather Stocks
- Zd — MAN PATCH GRANITE — Metaleucogranite and light green, coarse-grained to pegmatitic, muscovite-bearing
- Zd — BANNER ELK METAGRANITE (Late Proterozoic, 724 my, 16) — Thin dikes and sills; first shown separately; areas of abundance shown by pattern

INNER PIEDMONT, CHAUGA BELT, SMITH RIVER ALLOCHTHON, AND SAURATOWN MOUNTAINS ANTICLINORIUM

METAMORPHIC ROCKS

- CZbr — ROCKS OF BREVARD FAULT ZONE — "Fine-grained" schist and phyllonite, gneiss, and minor amphibolite
- CZbr — UPPER CHILHOWEE — Vitreous quartzite, white to light gray; interbedded sandy metasiltstone and slate
- CZbr — LOWER CHILHOWEE — Feldspathic quartzite, white to yellowish gray; feldspathic quartzite; conglomeratic in lower part; includes Unicoi Formation
- CZbr — GRANDFATHER MOUNTAIN FORMATION
- CZbr — Metarhyolite — Schistose, porphyritic, locally cross-bedded, interlayered metasiltstone and slate
- CZbr — Metagraywacke — Massive to well foliated, conglomeratic, interlayered metasiltstone rocks. Includes Macrocarpon Member (metaflow-breccia member)
- CZbr — Porphyritic volcanic rock (Late Proterozoic, 630 my, 26) — Rhyolite to andesite; contains euhedral to subhedral phenocrysts of plagioclase and pink potassic feldspar. Remembers quartzite and mica schist
- CZbr — Metasiltstone — Locally contains thin bedded iron-bearing dolomite member, interbedded with phyllite, lithologically similar to Minitor Gneiss
- CZbr — Metagraywacke — Crossbedding and graded bedding common; feldspathic, lithic, and quartzose; minor conglomerate
- CZbr — Felsic metabasalt, mica and metasedimentary rocks (Late Proterozoic, 630 my, 26) — Tentatively correlated with Grandfather Mountain Formation

UNCONFORMITY

- CZbg — BLOWING ROCK GNEISS (Middle Proterozoic, 1176 my, 2) — Granitic gneiss to granitic gneiss, predominantly to muscovite, epidotic, sericitic, and chlorite-bearing
- CZbg — TOXAWAY GNEISS (Middle Proterozoic, 1250 my, 1) — Poorly foliated to well foliated, equigranular to porphyritic granitic
- CZbg — BOTE GNEISS, GNEISS (Late to Middle Proterozoic, 880-1250 my) — Granitic gneiss, biotite-muscovite gneiss, muscovite-biotite gneiss, muscovite-quartz monzonitic. Includes variably mylonitized orthogneiss and paragneiss of the Ocoee Supergroup, Ashe Formation, and Snowbird Group. Dates granites of the Ocoee City area, Straight Fork window, and Elk River area
- CZam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist
- CZbg — MIGMATITIC BIOTITE-HORNBLENDE GNEISSES (Middle Proterozoic, 1214 my, 12) — Layered, quartz-quartz gneiss, biotite-hornblende gneiss, biotite-muscovite gneiss, and minor amphibolite. Dates Ocoee rocks
- CZam — Amphibolite — Equigranular, massive to well foliated, interlayered with minor biotite-hornblende gneiss, biotite-muscovite gneiss, and micaschist; may include metasedimentary rock

INTRUSIVE ROCKS

- CZd — DIABASE — Dikes, gray to black
- CZd — HOLMES TO MAGGIE GRANITIC ROCK (Pennsylvanian to Permian, 270-290 my, 14) — Massive to foliated; locally mylonitic. Hickory Nut Gorge, Chestnut Mountain, and Rutherfordton Stocks
- CZd — CHERRYVILLE GRANITE — Mississippian, 351 my, 23,21) — Massive to weakly foliated, northeast-trending, Shun-Inversing on east side
- CZd — CHEROKEE HEAD GRANITE GNEISS (Devonian to Silurian, 408 my, 19) — Massive to weakly foliated, northeast-trending, massive to well foliated, locally mylonitic
- CZd — GRANITE GNEISS (Ordovician to Silurian, 438 my, 17) — Poorly foliated; northeast-trending, Shun-Inversing on east side
- CZd — MYSANTITE GRANITIC GNEISS (Ordovician) — Relatively massive, granitic to quartz monzonite, locally mylonitic. Mysantite and Ellenboro Stocks
- CZd — METAMORPHOSED GRANITIC ROCK (Cambrian to Ordovician, 450-540 my) — Massive to foliated; locally mylonitic. Mountain Rest, Tallulah Falls, Tallulah Gneiss, Sassafras Mountain, and Tallulah Falls Stocks
- CZd — HENDERSON GNEISS (Cambrian, 524 my, 10) — Monzonite to granite gneiss, locally mylonitic
- CZd — METAMORPHOSED GABBRO AND UCAPITA — Foliated to massive
- CZd — METALUTAMATIC ROCK — Metamorphosed diorite, local peridotite, pyroxenite, and other altered ultramafic rock. Only larger bodies shown
- CZd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic, 680-710 my, 18) — Massive to foliated; locally mylonitic

CHARLOTTE AND MILTON BELTS

METAMORPHIC ROCKS

- CZbm — FINE GRAINED BIOTITE GNEISS — Massive to strongly foliated; minor quartz-biotite-muscovite gneiss
- CZbm — FELSIC MICA GNEISS — Interlayered with biotite and hornblende gneiss and amphibolite
- CZbm — MIGMATITE AND METAGRAWACKE — Migmatitic; interlayered with biotite gneiss, felsic mica gneiss, and amphibolite
- CZbm — Metagraywacke — Massive, thin-bedded and gneissic; contains felsic mica gneiss, minor biotite gneiss, and amphibolite. Contains lenses of quartzite
- CZbm — METAMORPHOSED ROCK — Metasedimentary rocks (Late Proterozoic) — Schist and gneiss; contains lenses of quartzite
- CZbm — MAFIC METAVOLCANIC ROCK — Metamorphosed basalts to andesite; tuffs and flows; contains lenses of quartzite. Locally includes hypabyssal intrusive rocks (Late Proterozoic)
- CZbm — FELSIC METAVOLCANIC ROCK — Metamorphosed dacite to rhyolite; flows and tuffs. Light gray to pinkish gray; minor mafic and intermediate flows and tuffs
- CZbm — QUARTZITE — Massive to well foliated; contains andalusite, kyanite, or sillimanite, otherwise, pure quartzite
- CZbm — PHYLLITE AND SCHIST — Minor biotite, pyrite, and sillimanite; includes minor quartzite

INTRUSIVE ROCKS

- CZd — DIABASE — Dikes, gray to black
- CZd — GRANITIC ROCK (Pennsylvanian to Permian, 285-325 my, 11,12) — Massive to foliated; locally mylonitic. Concord and Wilkes Counties
- CZd — PHYLLITE AND SCHIST — Locally semivitreous and quartzitic; includes phyllonite, sheared fine-grained metasediment, and metavolcanic rock. In Charlotte belt, includes Kannapolis Formation; in Milton belt, includes Northfork Gneiss and Carson Schist
- CZd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive
- CZd — METALUTAMATIC ROCK — Metamorphosed diorite and peridotite, serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown
- CZd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic to late Cambrian, 500-680 my, 5,7,18,21,24,25) — Megacrystic, weak foliated to massive; locally mylonitic. Chapel Hill, Cheatham, Fortington, Meadow Flats, Mount Hall, Parks Crossroads plutons, and Flatbrook and Grace County bodies

CAROLINA SLATE BELT

METAMORPHIC ROCKS

- CZcs — TAZEWELL FORMATION — Metamorphosed graywacke, volcanic sandstone, flows and tuffs; contains lenses of quartzite and small lenses of metadacite and metagabbro
- CZcs — METAVOLCANIC AND METAGRAWACKE — Metamorphosed argillite, mudstone, and tuff; contains lenses of quartzite and small lenses of metadacite and metagabbro
- CZcs — MICA SCHIST — Contains garnet, staurolite, kyanite, or sillimanite; in some areas, contains felsic gneiss lenses; metaarenite quartzite; biotite gneiss, amphibolite, and phyllite

TERTIARY

- Tpc — INJECTED DIKES — Biotite gneiss and schist intruded by numerous aplitic and pegmatitic dikes; contains lenses of amphibolite and quartzite
- CZcs — FELSIC MICA GNEISS — Interlayered with graphitic mica schist and metagarnet schist; commonly with kyanite; minor hornblende gneiss
- CZcs — MIGMATITE AND MALDOUSITE SCHIST — Garnet, andalusite, kyanite, or sillimanite schist; quartzite
- CZcs — QUARTZITE — Massive to well foliated; contains andalusite, kyanite, or sillimanite, otherwise, pure quartzite
- CZcs — PHYLLITE AND SCHIST — Minor biotite, pyrite, and sillimanite; includes minor quartzite

INTRUSIVE ROCKS

- CZd — RHYOLITE (Jurassic, 190 my, 6) — Dike; medium to dark gray, glassy; contains porphyritic microfelsite and quartz commonly with calcite or clay amygdules
- CZd — DIABASE — Dikes, gray to black
- CZd — GRANITIC ROCK (Pennsylvanian to Permian, 285-325 my, 11) — Megacrystic to equigranular. Concord and Wilkes Counties
- CZd — FOLIATED TO MASSIVE GRANITIC ROCK (Pennsylvanian to Permian, 270-290 my, 14) — Massive to weakly foliated. Gold Hill, Kannapolis, Rowan County, and Salisbury Stocks
- CZd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive
- CZd — METALUTAMATIC ROCK — Metamorphosed diorite and peridotite, serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown
- CZd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic to late Cambrian, 500-680 my, 5,7,18,21,24,25) — Megacrystic, weak foliated to massive; locally mylonitic. Chapel Hill, Cheatham, Fortington, Meadow Flats, Mount Hall, Parks Crossroads plutons, and Flatbrook and Grace County bodies

RALEIGH BELT

METAMORPHIC ROCKS

- CZbr — AMPHIBOLITE — Metamorphosed mafic extrusive and intrusive rock; massive to well foliated; locally contains felsic gneiss lenses. Amphibolite dikes and sills
- CZbr — METAVOLCANIC-EPICLASTIC ROCK — Metamorphosed argillite, mudstone, and tuff; contains lenses of quartzite and felsic gneiss
- CZbr — FELSIC METAVOLCANIC ROCK — Metamorphosed dacite to rhyolite; flows and tuffs; light gray to pinkish gray; minor felsic and mafic flows and tuffs
- CZbr — INJECTED DIKES — Biotite gneiss and schist intruded by numerous aplitic and pegmatitic dikes; contains lenses of amphibolite and quartzite
- CZbr — FELSIC MICA GNEISS — Interlayered with graphitic mica schist and metagarnet schist; commonly with kyanite; minor hornblende gneiss
- CZbr — MIGMATITE AND MALDOUSITE SCHIST — Garnet, andalusite, kyanite, or sillimanite schist; quartzite
- CZbr — QUARTZITE — Massive to well foliated; contains andalusite, kyanite, or sillimanite, otherwise, pure quartzite
- CZbr — PHYLLITE AND SCHIST — Minor biotite, pyrite, and sillimanite; includes minor quartzite

INTRUSIVE ROCKS

- CZd — RHYOLITE (Jurassic, 190 my, 6) — Dike; medium to dark gray, glassy; contains porphyritic microfelsite and quartz commonly with calcite or clay amygdules
- CZd — DIABASE — Dikes, gray to black
- CZd — GRANITIC ROCK (Pennsylvanian to Permian, 285-325 my, 11) — Megacrystic to equigranular. Concord and Wilkes Counties
- CZd — FOLIATED TO MASSIVE GRANITIC ROCK (Pennsylvanian to Permian, 270-290 my, 14) — Massive to weakly foliated. Gold Hill, Kannapolis, Rowan County, and Salisbury Stocks
- CZd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive
- CZd — METALUTAMATIC ROCK — Metamorphosed diorite and peridotite, serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown
- CZd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic to late Cambrian, 500-680 my, 5,7,18,21,24,25) — Megacrystic, weak foliated to massive; locally mylonitic. Chapel Hill, Cheatham, Fortington, Meadow Flats, Mount Hall, Parks Crossroads plutons, and Flatbrook and Grace County bodies

TRIASSIC BASINS

NEWARK SUPERGROUP

DAN RIVER GROUP

- Ꞓdr — DAN RIVER GROUP, UNDIVIDED — Basinwarpen conglomerate and sandstone, red siltstone, dark-gray siltstone and black shale; contains fossil fish, plants, and invertebrates; Triassic and Jurassic
- Ꞓdr — STONEFIELD FORMATION — Conglomerate, sandstone, and mudstone; lenticular and laterally discontinuous
- Ꞓdr — COB BRANCH FORMATION — Mudstone with minor sandstone; contains fossil fish, plants, and invertebrates; Triassic and Jurassic
- Ꞓdr — FIRE HILL FORMATION — Sandstone, mudstone, and conglomerate; lenticular and laterally discontinuous

DURHAM GROUP

- Ꞓdu — DURHAM GROUP, UNDIVIDED — Conglomerate, feldspathic sandstone, and mudstone; contains fossil fish, plants, and invertebrates (shown by patterns)
- Ꞓdu — Arkosic sandstone, tan, medium to very coarse-grained, micaceous
- Ꞓdu — Sandstone and mudstone with thin interbeds of chert and impure limestone
- Ꞓdu — Arkosic sandstone and dolomitic sandstone, brown, interbedded with mudstone; dark-gray sandstone and mudstone
- Ꞓdu — SANFORD FORMATION — Conglomerate, feldspathic sandstone, and mudstone
- Ꞓdu — CUMNOCK FORMATION — Sandstone and mudstone; gray to black; contains fossil plants and invertebrates; Triassic and Jurassic
- Ꞓdu — PEKIN FORMATION — Conglomerate, sandstone, and mudstone
- Ꞓdu — DIABASE — Dikes and sills, gray to black

EASTERN SLATE BELT

METAMORPHIC ROCKS

Rocks of Eastern slate belt are partly covered by Quaternary surficial deposits not shown; in addition, greater than approximately 25 feet concealed by surficial deposits are not shown on this map

- CZcs — METAVOLCANIC-EPICLASTIC ROCK — Metamorphosed argillite, mudstone, and tuff; contains lenses of quartzite and felsic gneiss
- CZcs — FELSIC METAVOLCANIC ROCK — Metamorphosed dacite to rhyolite; flows and tuffs; light gray to pinkish gray; minor felsic and mafic flows and tuffs
- CZcs — MIGMATITE AND MALDOUSITE SCHIST — Garnet, andalusite, kyanite, or sillimanite schist; quartzite
- CZcs — QUARTZITE — Massive to well foliated; contains andalusite, kyanite, or sillimanite, otherwise, pure quartzite
- CZcs — PHYLLITE AND SCHIST — Minor biotite, pyrite, and sillimanite; includes minor quartzite
- CZcs — METAVOLCANIC-EPICLASTIC ROCK — Metamorphosed argillite, mudstone, volcanic sandstone, tuff, conglomerate, and volcanic tuff
- CZcs — VOLCANIC METACONGLOMERATE — Includes metapyroclastic and metaarenite
- CZcs — PHYLLITE AND SCHIST — Locally semivitreous and quartzitic; includes phyllonite, sheared fine-grained metasediment, and metavolcanic rock. In Charlotte belt, includes Kannapolis Formation; in Milton belt, includes Northfork Gneiss and Carson Schist

INTRUSIVE ROCKS

- CZd — DIABASE — Dikes, gray to black
- CZd — GRANITIC ROCK (Pennsylvanian to Permian, 285-325 my, 11) — Megacrystic to equigranular. Concord and Wilkes Counties
- CZd — FOLIATED TO MASSIVE GRANITIC ROCK (Pennsylvanian to Permian, 270-290 my, 14) — Massive to weakly foliated. Gold Hill, Kannapolis, Rowan County, and Salisbury Stocks
- CZd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive
- CZd — METALUTAMATIC ROCK — Metamorphosed diorite and peridotite, serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown
- CZd — METAMORPHOSED GRANITIC ROCK (Late Proterozoic to late Cambrian, 500-680 my, 5,7,18,21,24,25) — Megacrystic, weak foliated to massive; locally mylonitic. Chapel Hill, Cheatham, Fortington, Meadow Flats, Mount Hall, Parks Crossroads plutons, and Flatbrook and Grace County bodies

COASTAL PLAIN

QUATERNARY

- Qs — SURFICIAL DEPOSITS, UNDIVIDED — Sand, clay, gravel, and peat deposits; in Dismal Swamp, Holocene and Pleistocene deposits; elsewhere, deposits not shown or indicates greater than approximately 25 feet concealed by surficial deposits
- Qs — Holocene deposits
- Qs — Pleistocene deposits

TERTIARY

- Tp — PINEHURST FORMATION — Sand, medium to coarse-grained, cross-bedded, pebbly, kaolinitic, feldspathic quartzose sandstone; commonly cemented by secondary silica; Eocene
- Tpw — TERRACE DEPOSITS AND UPLAND SEDIMENT — Sand, clayey sand, and sand and gravel; commonly cemented secondary
- Tpw — Terrace deposits — Sand, medium to very coarse, quartz with and clay. Quartzose, lacks feldspar; Pleistocene
- Tpw — Upland sediment — Sand, medium to very coarse, quartz with and clay; Pleistocene
- Tpw — VONTAMAR FORMATION AND DUPLIN FORMATION, UNDIVIDED — Vontamar Formation: Fossiliferous clay with varying amounts of fine-grained sand; Miocene. Duplin Formation: Sand, medium to coarse-grained sand; sandy fossiliferous clay; Miocene. Vontamar Formation: Sand, medium to coarse-grained sand; sandy fossiliferous clay; Miocene
- Tpb — BELGRADE FORMATION, UNDIVIDED — Fossiliferous Member: Coquina of shelled marine fossils; Miocene. Yorktown Member: Sand, medium to very coarse, quartz with and clay; Miocene. Haworth Landing Member: Fossiliferous clayey sand, gray to brown; Miocene. Belgrade Member: Sand, medium to very coarse, quartz with and clay; Miocene

CAPE FEAR FORMATION, UNDIVIDED

- Tpc — CAPE FEAR FORMATION — Lithologically variable; in Cape Fear area, includes Black Creek Formation; Paleocene and Eocene
- Tpc — Upper member — Sand, medium to very coarse, quartz with and clay; Paleocene
- Tpc — Middle member — Clay, gray, fossiliferous; Paleocene
- Tpc — Lower member — Sand, medium to very coarse, quartz with and clay; Paleocene

CRETACEOUS

- Kp — PEEDEE FORMATION — Sand, clayey sand, and clay, greenish gray to dark gray; massive glauconitic, locally fossiliferous and calcareous; Upper Cretaceous
- Kn — BLACK CREEK FORMATION — Clay to black lignite, commonly thin beds and laminae of fine-grained, micaceous sand and thin lenses of calcareous sandstone; Upper Cretaceous
- Kn — UPPER CREEK FORMATION — Sand, medium to very coarse, quartz with and clay; Upper Cretaceous
- Kn — NEWBERN FORMATION — Sand, sandstone, and conglomerate; quartz with and clay; massive; clay beds and lenses; Upper Cretaceous; commonly cemented; beds laterally discontinuous; cross-bedding common
- Kn — CAPE FEAR FORMATION — Sandstone and sandy mudstone; yellowish gray to brown-gray; mottled red to yellowish orange; indurated, graded bedding common; cross-bedding, blocky clay, hard cross-bedding; lower upper and minor common

REFERENCES FOR AGE DATES IN LEGEND

1. Aleinikoff, J.N., 1982, Chandler Bend dike from Bath, N.C.: 1982 Geochronological Laboratory Annual Report, U.S. Geological Survey, Open-File Report 83-771, p. 4-6.
2. Aleinikoff, J.N., Ratcliffe, N.M., and Fanning, C.M., 1985, Proterozoic U-Pb ages, Blue Ridge and Inner Piedmont, Georgia and North Carolina: U.S. Geological Survey Open-File Report 85-557, p. 3-5.
3. Bechtenstein, M.L., and Lewis, S.E., 1984, Evolution of Concord Granite in the Charlotte belt, Cabarrus County, North Carolina: Southeastern Geology, v. 24, p. 1-15.
4. Bowring, S.A., Grotzinger, J.P., Isachsen, C.E., Knoll, A.H., Pelechaty, S.M., and Kolosov, P., 1993, Calibrating rates of early Cambrian evolution: Science, v. 261, p. 501-507.
5. Bream, B.R., 1991, Petrogenesis of the Late