GEOLOGIC TIME SCALE

				Estimated age of boundaries in millions of years
Phanerozoic	Cenozoic Era (Cz)	Quaternary Period (Q)	Holocene Epoch	0.010
			Pleistocene Epoch	1.8
		Tertiary Period (T)	Pliocene Epoch (Tp)	3
			Miocene Epoch (Tm)	14
			Oligocene Epoch (Tg)	28
			Eocene Epoch (Te)	43
			Paleocene Epoch (Tpa)	63
	Mesozoic Era (MZ)	Cretaceous Period (K)	Late Cretaceous Epoch	97
			Early Cretaceous Epoch	135
		Jurassic Period (J)		158
		Triassic Period (Tr)		205
		Permian Period (P)		~240
	Paleozoic Era (PZ)	Carboniferous Period (C)	Pennsylvanian Period (IP)	290
			Mississippian Period (IM)	~330
		Devonian Period (D)		360
		Silurian Period (S)		408
		Ordovician Period (O)		439
		Cambrian Period (Cr)		505
				~570
Proterozoic	Late Proterozoic Era (Y)			900
	Middle Proterozoic Era (X)			1600
	Early Proterozoic Era (W)			2500
Archeozoic				3600?
		Oldest known rocks in U.S.		~3800?
		Oldest known rocks in world		

Adapted from U.S. Geological Survey, 1990, Geologic Time: Publication No. 2002, U.S. Geological Survey Bulletin 1789, 4 p., and Tom A. Steeples, Ph.D., Paleontologist, Kansas Geological Survey, Lawrence, Kansas.

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MURPHY BELT

METAMORPHIC ROCKS

Zmq — MINERAL BLUFF FORMATION — Quartz-chlorite-sericite schist and phyllite; rare thin quartzite layers; and more interbedded graphitic schist, garnet-mica schist, staurolite schist, cross-bedded schist, and quartzite

Zmgs — MARBLE CREEK AND ANDREWS FORMATIONS, AND NOTTELY QUARTZITE, UNDIVIDED — Nottely Marble: calcareous to dolomitic Andrews Formation: calcareous cross-bedded schist Nottely Quartzite: cross-bedded quartzite

Zmgc — BRASSTOWN FORMATION — Cross-bedded schist; includes micaceous quartzite in lower part

Zhl — HAYESVILLE AND CHATUGE QUARTZITE, UNDIVIDED — Hayesville Formation: slate and metasiltstone; dark gray, laminated to thin bedded. Chatuge Quartzite: white to light yellowish gray; numerous, thin slate beds

INTRUSIVE ROCKS

Zmp — AMPHIBOLITE — Commonly massive to well foliated, dioritic to basaltic dikes and sills; variably metamorphosed

BLUE RIDGE BELT

SEDIMENTARY AND METAMORPHIC ROCKS

Zbr — ROME FORMATION — Shale and siltstone, variegated red to brown; interbedded fine-grained sandstone and shaly dolomite

Zbg — SHADY DOLOMITE — Light gray, fine-grained, massive, locally thin bedded limestone

CHILHOWEE GROUP

Zch — UPPER CHILHOWEE — Vitreous quartz arenite, white to light gray; interbedded locally with siltstone and shale. Erwin and Hampton formations of Mack Swanson and others

Zcl — LOWER CHILHOWEE — Feldspathic arenite, white to yellowish gray; locally pebbly. Includes interbedded metasiltstone and quartzite in lower part. Includes Unicoi Formation of Hot Springs window.

OCOEE SUPERGROUP

Zwc — WALDEN CREEK GROUP, UNDIVIDED — Slate to metasiltstone, local limy beds and pods; interbedded with quartz-pebble conglomerate and quartz metasandstone

Zwcs — WALDEN CREEK FORMATION — Slate and metasiltstone, dark green to black; interbedded locally with quartz-pebble conglomerate and metasandstone; sandy metasiltstone; and quartzite in lower part

Zgf — GREAT SMOKY GROUP, UNDIVIDED — Thick metasedimentary sequence of massive to graded beds of metagraywacke and metasiltstone with interbedded graphitic and sulfidic slate and schist

Zdf — DEAN FORMATION — Sericite schist with cross-bedite, staurolite, and kyanite porphyroblasts; interbedded metagraywacke and quartz-pebble metaconglomerate

Zmt — METASANDSTONE, METAGRAYWACKE, METASILTSTONE, AND MICA SCHIST — Beds and lenses of calcareous quartz-mica rock locally abundant garnet, staurolite, and cross-bedite porphyroblasts common in fine-grained rocks; beds and lenses of quartz-pebble metaconglomerate in southern area. Horse Branch Member of Ammons Formation and Grassy Branch Formation in northern area

Zam — ANTHONY FORMATION — Slate to schist, dark gray, graphitic and sulfidic; includes mica schist, metagraywacke, and metaconglomerate

Zcm — COPPERHILL FORMATION — Metagraywacke, massive, graded-bedding common; includes dark-gray slate, mica schist, and nodular calc-silicate rock

Zs — SLATE OF COPPERHILL FORMATION — Slate to phyllite, dark green, graphitic, sulfidic; includes metagraywacke with local graded bedding

Zf — PHYLLITE — Dark olive gray, graphitic and sulfidic

Zat — ANAKEESTA FORMATION — Slate to schist, dark gray, graphitic and sulfidic; includes interbedded argillaceous, feldspathic metagraywacke

Zcp — ROY GAP FORMATION — Dark gray, highly sulfidic slate and metasiltstone interbedded and gradational with metagraywacke. Stratigraphic position uncertain in Ownsbey County includes upper part of Buck Bald Formation

Zrb — RICH BUTT SANDSTONE — Feldspathic; interbedded with dark argillaceous layers and laminae. Stratigraphic position uncertain

Zs — **SNOWBIRD GROUP, UNDIVIDED** — Feldspathic metasiltstone, metasandstone, and phyllite. Basal schist contains lenses of quartz-pebble metaconglomerate

Zp — PIGEON SILTSTONE — Thin bedded to laminated, commonly cross-bedded, metamorphosed; locally includes argillite and calcareous and arkarotic metasiltstone grading to silty metalimestone

Zrd — ROUND STONE FORMATION — Dawsonite-gray, fine to medium grained; locally cross-bedded, metamorphosed; interbedded metasandstone and phyllite

Zl — LONGARM QUARTZITE — Cross-bedded, feldspathic, locally conglomeratic; includes dark slate and metasiltstone

Zbw — BUNKING BRANCH FORMATION — Slate, sandy to coarse-grained pebbly metagraywacke with local graded bedding. Basal quartz-sericite schist or gneiss

MOUNT ROGERS FORMATION

Zmr — Metarhyolite (Late Proterozoic, 620 my; **20**) — Light-colored porphyritic extrusive rock

Zmg — Metagraywacke — Interlayered with metaconglomerate, laminated metasiltstone and slate, minor calcareous metasandstone, greenstone, and metarhyolite

GRANDFATHER MOUNTAIN WINDOW

METAMORPHIC ROCKS

Cgm — SHADY DOLOMITE — Light-gray, fine-grained, massive, locally thin-bedded limestone; thin beds of phyllite

CHILHOWEE GROUP

Zch — UPPER CHILHOWEE — Vitreous quartzite, white to light gray; interbedded with siltstone and shale

Zcl — LOWER CHILHOWEE — Feldspathic quartzite, white to yellowish gray; locally pebbly; interbedded metasiltstone and phyllite

GRANDFATHER MOUNTAIN FORMATION

Zgmm — Meta-arkose — Sericitic, conglomeritic; locally cross-bedded; interlayered metasiltstone and phyllite

Zgmc — Conglomerate — Schistose to massive, amygdaloidal; interlayered with metagraywacke, arkose, and phyllite; includes Montezuma Member (metabasalt) in upper part

Zgmp — Porphyritic felsic volcanic rock (Late Proterozoic; 620 my; **20**) — Phyllitic to schistose; contains subhedral to subhedral phenocrysts of gray quartz and pink potassic feldspar. Resembles quartzite and metasiltstone

Zgmq — Metasiltstone — Locally contains thin bedded iron-bearing dolomitic limestone; interlayered with metagraywacke, metaarkose, and metavolcanic rock

Zgmg — Metagraywacke — Cross-bedding and graded bedding common; locally conglomeratic; interlayered with metasiltstone and phyllite

Zgmb — Felsic metaclastic rocks and metasedimentary rocks (Late Proterozoic, 820 my; **20**) — Tentatively correlated with Grandfather Mountain formation

UNCONFORMITY

YBmg — BLOWING ROCK GNEISS (Middle Proterozoic, 1000 my; **19**) — Abundant white porphyroclastic feldspar megacrysts in finely banded biotite schist; locally calcareous. Interlayered with quartz-feldspar schist, calcareous biotite gneiss, biotite schist, calc-silicate rock, calcareous quartzite, sulfidic graphitic schist, and biotite schist

YBgg — BRITTIN GRANITIC GNEISS (Middle Proterozoic; 950–1250 my; **18**) — Commonly massive, but locally foliated; contains megacrysts of pink potassic feldspar and inclusions of biotite schist and amphibolite; locally calcareous; mineralized, or recrystallized equivalents of the Grandfather Mountain Granite. Equivalent to the Crowders Creek Granite

INTRUSIVE ROCKS

Zdm — LINVILLE METADIABASE — Metadiabase, greenstone, and amphibolite dikes and sills; massive to schistose

Zg — GRANITE GNEISS — Biotite granite gneiss (Late Proterozoic; 690–710 my; **25,27**) — Massive to foliated, locally rhyolitic. Equivalent to Brown Mountain Granite

KINGS MOUNTAIN BELT

CZbf — FINE-GRAINED BIOTITE GNEISS — Strongly foliated; minor layers of amphibolite and muscovite schist

CZbl — BULLSTICK GNEISS — Syenite schist, locally with graphite, phyllonitic quartz-mica quartzite, banded marble, amphibolite, and minor calc-silicate rock

ZM — BATTLEGROUND FORMATION — Quartz-sericite schist with metavolcanic rock, quartz-pebble metaconglomerate, kyanite-sillimanite quartzite, and garnet-quartz rock

INTRUSIVE ROCKS

JD-Jc — DIABASE — Dikes, gray to black

PPmg — FOLIATED TO MASSIVE GRANITIC ROCK (Pennsylvanian to Permian, 270-230 my; **18,19**) — Megacrystic to equigranular. High Shoals Granite and Toluca Granite

Mc — CHERRYVILLE GRANITE—(Mississippian; 351 my; **20,21**)—Massive to weakly foliated; contains pegmatites

PPZb — METAMORPHOSED QUARTZ DIORITE — Foliated to massive

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

METAMORPHIC ROCKS

CZhr — ROCKS OF BREVARD FAULT ZONE — "Fish-scale" schist and phyllonite, derived from granitic rocks, pegmatite, and metasedimentary rocks

CZhg — BIOTITE GNEISS AND SCHIST — Inequigranular, locally abundant potassic feldspar megacrysts; interlayered and gradational with calc-silicate rock, hornblende-biotite schist, mica schist, and amphibolite. Includes Toluca Granite

CZhl — FINE-GRAINED GNEISS — Strongly foliated; minor layers of amphibolite and muscovite schist

CZmq — MICA SCHIST — Garnet, staurolite, and kyanite; minor locally, lenses and lenses of quartz schist, muscovite quartzite, calc-silicate rock, biotite gneiss, amphibolite, and marble

CZgf — AMPHIBOLITE AND BIOTITE GNEISS — Interlayered; minor layers and lenses of hornblende gneiss, metagabbro, mica schist, and granitic gneiss

CZa — MEGASCHISTOSE, BIOTITE GNEISS — Poorly layered to massive; megacrystic; includes hornblende gneiss, thin layers of mica schist, calc-silicate rock, and marble. Also includes small masses of metadiorite and amphibolite

CZgn — Metasyenite — Locally contains thin bedded iron-bearing dolomitic limestone; interlayered with metagraywacke, metaarkose, and metavolcanic rock

Zgmw — Metagraywacke — Cross-bedding and graded bedding common; locally conglomeratic; interlayered with metasiltstone and phyllite

Zgmb — Felsic metaclastic rocks and metasedimentary rocks (Late Proterozoic, 820 my; **20**) — Tentatively correlated with Grandfather Mountain formation

UNCONFORMITY

YBmg — BLOWING ROCK GNEISS (Middle Proterozoic, 1000 my; **19**) — Abundant white porphyroclastic feldspar megacrysts in finely banded biotite schist; locally calcareous. Interlayered with quartz-feldspar schist, calcareous biotite gneiss, biotite schist, calc-silicate rock, calcareous quartzite, sulfidic graphitic schist, and biotite schist

YBgg — BRITTIN GRANITIC GNEISS (Middle Proterozoic; 950–1250 my; **18**) — Commonly massive, but locally foliated; contains megacrysts of pink potassic feldspar and inclusions of biotite schist and amphibolite; locally calcareous; mineralized, or recrystallized equivalents of the Grandfather Mountain Granite. Equivalent to the Crowders Creek Granite

INTRUSIVE ROCKS

Zdm — LINVILLE METADIABASE — Metadiabase, greenstone, and amphibolite dikes and sills; massive to schistose

Zg — GRANITE GNEISS — Biotite granite gneiss (Late Proterozoic; 690–710 my; **25,27**) — Massive to foliated, locally rhyolitic. Equivalent to Brown Mountain Granite

CHARLOTTE AND MILTON BELTS

METAMORPHIC ROCKS

CZhg — FINE-GRAINED BIOTITE GNEISS — Massive to strongly foliated; minor layers of amphibolite and muscovite schist

CZhc — FELSIC MICA GNEISS — Interlayered with biotite and hornblende gneiss and schist

CZhm — BIOTITE GNEISS AND SCHIST — Inequigranular and megacrystic; gradational with calc-silicate rock, hornblende-biotite schist, and amphibolite; locally interlayered and gradational with calc-silicate rock, sillimanite-mica schist, mica schist, and amphibolite. Includes Toluca Granite and Tillery Granite

CZhs — METAVOLCANIC ROCK — Interlayered felsic to mafic tuffs and flowrock

CZmq — MAFIC METAVOLCANIC ROCK — Metamorphosed basaltic to andesitic tuffs and flows, grayish green to black. Locally includes hypabyssal intrusive rock, biotite gneiss, amphibolite, and marble

CZmg — FELSIC METAVOLCANIC ROCK — Metamorphosed dacitic to rhyolitic tuffs and flows, grayish green to black. Locally includes hypabyssal intrusive rock, biotite gneiss, metadiorite, mica schist, and granitic gneiss

CZgn — AMPHIBOLITE — Metamorphosed mafic extrusive and intrusive rock; includes hornblende gneiss, thin layers of mica schist, calc-silicate rock, and marble. Also includes small masses of metadiorite and metagabbro

CZgs — MEGASCHISTOSE, BIOTITE GNEISS — Poorly layered to massive; megacrystic; includes hornblende gneiss, thin layers of mica schist, amphibolite, and marble

CZgr — QUARTZITE — Interlayered with quartz-mica schist and gneiss; commonly micaceous, andalusite, kyanite, or sillimanite

CZgm — METAGRAYWACKE, AMPHIBOLITE, AND KYANITE SCHIST — Metagraywacke, amphibolite, and kyanite-staurolite-garnet schist and gneiss; interlayered and gradational with amphibolite and kyanite schist; minor sillimanite and granitic rock

CZmt — METASANDSTONE — Contains quartz and microline porphyroblasts

CZgd — BANDED GNEISS — Interlayered with calc-silicate rock, metacongomerate, amphibolite, sillimanite-mica schist, and granitic rock

CZph — PHYLLITE AND SCHIST — Includes phyllite and interlayered biotite schist

CZng — INEQUIGRANULAR BIOTITE GNEISS — Weakly foliated to massive; contains inequigranular, porphyroclastic, garnet, locally large megacrysts of quartz and feldspar

CZpm — PORPHYRITIC GRANITIC GNEISS — Massive to foliated, granodioritic, megacrystic

CZmh — GARNET-MICA SCHIST — Interlayered with amphibolite

Yg — GRANITIC GNEISS (Middle Proterozoic, 1192 my; **27**) — Megacrystic, in places contains amphibolite

INTRUSIVE ROCKS

JD-Jc — DIABASE — Dikes, gray to black

Ta — CHARNOCKITE GRANITIC MICROGRANITE (Triassic; 351 my; **20,21**) — Massive to weakly foliated; contains pegmatites. Lithium-bearing on Kings Mountain

Tc — CATAWBA GRANITE (Triassic; 351 my; **20,21**) — Massive; 408 my; **18**—Equigranular to porphyritic, massive to well foliated; contains biotite and hornblende

Tgr — GRANITE GNEISS (Cordovian to Silurian, 438 my; **17**) — Poorly foliated; locally megacrystic

Tgc — MICMATITIC GRANITIC GNEISS — Foliated to massive, granitic to quartz monzonitic; contains pegmatites and amphibolite common

Tgm — METAMORPHOSED GRANITIC ROCK (Cambrian to Ordovician; 456–540 my; **18**) — Equigranular to megacrystic; foliated to massive. Includes Toluca Granite

Tgn — HENDERSON GNEISS (Cambrian; 524 my; **10**) — Monzonitic to granodioritic, inequigranular

Tg — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

Tq — METAQUITRAMAFIC ROCK — Metamorphosed dunite, local peridotite, pyroxenite, soapstone, and other ultramafic rock. Only larger bodies shown

CZg — METAMORPHOSED GRANITIC ROCK (Late Proterozoic; 680-710 my; **18**) — Massive to foliated; locally myrmekitic

CAROLINA SLATE BELT

METAMORPHIC ROCKS

CZy — YADKIN FORMATION — Metamorphosed graywacke, volcanic sandstone, and siltstone; includes conglomerate and intermediate and intermediate to felsic crystal tuff

CZvt — METAVOLCANIC AND META-ARGILLITE — Thin to thick bedded; bedding plane and axial-planar cleavage common; interbedded with graywacke, siltstone, and conglomerate. Includes:
- CZmq – Floyd Church Formation
- CZmq – Cid Formation
- CZmq – Tillery Formation

(southwest of Asheboro)

CZmc — METAVOLCANIC ROCK — Metamorphosed basaltic to andesitic tuff and flow breccia, lapilli tuff, and flowrock; interbedded with felsic and intermediate metaclastic rock and metamudstone of Asheboro

CZmf — FELSIC METAVOLCANIC ROCK — Metamorphosed dacitic to rhyolitic tuff and flowrock; interbedded with mafic and intermediate metaclastic rock, metagraywacke, and metamudstone. Includes:
- CZfv – Cid Formation (southwest of Asheboro)
- CZfv – Uwharrie Formation (south to south)

CZmt — INTERMEDIATE METAVOLCANIC ROCK — Metamorphosed andesitic tuffs and flows, medium to dark-gray green; minor felsic and mafic interbeds

CZmv — METAVOLCANIC ROCK — Interbedded felsic to mafic tuffs and flowrock

CZmx — METAVOLCANIC-EPICLASTIC ROCK — Metamorphosed argillite, mudstone, tuff, volcanic sandstone, conglomerate, and volcanic rock

CZvc — VOLCANIC METACONGLOMERATE — Includes metagraywacke and metamudstone

CZph — PHYLLITE AND SCHIST — Dark-gray, graphitic and pyritic; includes phyllonite, sheared fine-grained metasediment, and metavolcanic rock

INTRUSIVE ROCKS

JD-Jc — DIABASE — Dikes, gray to black

PPfg — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; **11**) — Megacrystic to equigranular. Castalia, Whitakers, Mabel, Mount Airy, Sparta, and Siloam granites

PPfc — PEE DEE GABBRO (Pennsylvanian; 314 my; **21**) — Dark gray to black; massive to foliated; locally layered

PPmg — METAMORPHOSED GRANITIC ROCK — Foliated to massive

PPmd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

PPmu — METAMORPHOSED MAFIC ROCK — Metagabbro, metadiorite, and mafic plutonic-volcanic complexes

PPmm — METAMORPHOSED ULTRAMAFIC ROCK — Metamorphosed dunite and peridotite; serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown

CZg — METAMORPHOSED GRANITIC ROCK — Megacrystic; well foliated; locally contains hornblende

SYMBOLS

- Contact
- Fault
- Fault—Showing relative horizontal movement
- Normal fault — Bar and ball on downthrown side
- Overturned normal fault
- Thrust fault — Sawteeth on upper plate
- Overturned thrust fault
- Anticline — Showing direction of plunge
- Overturned anticline — Showing direction of dip of limbs
- Syncline — Showing direction of plunge
- Dike — Dashed where inferred from aeromagnetic data
- Scarp — Hachured on downslope side
- Zone of mylonitization

RALEIGH BELT

METAMORPHIC ROCKS

CZmq — AMPHIBOLITE — Metamorphosed basaltic to andesitic extrusive and intrusive rock; includes hornblende gneiss, thin layers of mica schist, and small nonlayered masses of metadiorite and metagabbro

CZmg — BIOTITE GNEISS AND SCHIST — Inequigranular, locally megacrystic; includes coarse-grained, inequigranular and gradational with mica schist and amphibolite. Includes Rolesville Granite

CZms — MICA SCHIST — Contains garnet, staurolite, kyanite, or sillimanite; interlayered with quartzite, calc-silicate rock, metagraywacke, and metaconglomerate

CZfg — INJECTED GNEISS — Biotite gneiss and schist intruded by numerous sills and dikes of granitic rock; commonly has minor hornblende gneiss

CZfc — FELSIC MICA GNEISS — Interlayered with graphitic mica schist and mica-garnet schist; commonly with kyanite; minor sillimanite

CZgn — LINEATED FELSIC GNEISS AND SCHIST — White to pink, with strong lineation of potassic feldspar augen; interlayered with biotite gneiss and schist. Includes Battleboro Granite

CZgh — PHYLLITE AND SCHIST — Dark gray, graphitic and pyritic; includes phyllonite, sheared fine-grained metasediment, and metavolcanic rock

INTRUSIVE ROCKS

JD-Jc — DIABASE — Dikes, gray to black

PPfg — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; 11) — Megacrystic to equigranular. Castalia, Whitakers, Mabel, Mount Airy, Sparta, and Siloam granites

PPfs — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; 11) — Megacrystic to equigranular. Louisburg, Wake, and Rolesville granites

PPmg — FOLIATED TO MASSIVE GRANITIC ROCK (Pennsylvanian to Permian, 270-322 my; 18) — Megacrystic to equigranular. Buttermead Creek intrusive and Rocky Mount intrusive suite

PPmm — METAMORPHOSED ULTRAMAFIC ROCK — Metamorphosed dunite and peridotite; serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown

PPmd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

PPmu — METAMORPHOSED MAFIC ROCK — Metagabbro, metadiorite, and mafic plutonic-volcanic complexes

CZg — METAMORPHOSED GRANITIC ROCK — Megacrystic; well foliated; locally contains hornblende

EASTERN SLATE BELT

METAMORPHIC ROCKS

Rocks of Eastern slate belt are partly covered by Quaternary surficial sediment not shown on map. Bedrock contacts are inferred where concealed by surficial sediment

CZmc — METAVOLCANICLASTIC ROCK — Metamorphosed argillite, mudstone, volcanic sandstone, conglomerate, and volcanic rock

CZmq — FELSIC METAVOLCANIC ROCK — Metamorphosed dacitic to rhyolitic flows and tuffs, light gray to greenish gray; interbedded with mafic and intermediate metaclastic rock, metargillite, and metamudstone

CZmt — INTERMEDIATE METAVOLCANIC ROCK — Metamorphosed andesitic tuffs and flows, medium to dark gray green; minor felsic and mafic interbeds

CZmc — MAFIC METAVOLCANIC ROCK — Metamorphosed basaltic flows and tuffs, dark green to black; interbedded with felsic and intermediate metaclastic rock and metamudstone

CZgn — AMPHIBOLITE — Metamorphosed mafic extrusive and intrusive rock; includes hornblende gneiss, thin layers of mica schist, calc-silicate rock, and marble. Also includes small masses of metadiorite and metagabbro

CZgs — MEGASCHISTOSE, BIOTITE GNEISS — Poorly layered to massive; megacrystic; includes hornblende gneiss, thin layers of mica schist, amphibolite, and marble

CZgr — QUARTZITE — Interlayered with quartz-mica schist and gneiss; commonly micaceous, andalusite, kyanite, or sillimanite

CZgm — METAGRAYWACKE, AMPHIBOLITE, AND KYANITE SCHIST — Metagraywacke, amphibolite, and kyanite-staurolite-garnet schist and gneiss; interlayered and gradational with amphibolite and kyanite schist; minor sillimanite and granitic rock

CZgd — BANDED GNEISS — Interlayered with calc-silicate rock, metacongomerate, amphibolite, sillimanite-mica schist, and granitic rock

CZph — PHYLLITE AND SCHIST — Includes phyllite and interlayered biotite schist

CZpm — PORPHYRITIC GRANITIC GNEISS — Massive to foliated, granodioritic, megacrystic

CZmh — GARNET-MICA SCHIST — Interlayered with amphibolite

Yg — GRANITIC GNEISS (Middle Proterozoic, 1192 my; **27**) — Megacrystic, in places contains amphibolite

INTRUSIVE ROCKS

JD-Jc — DIABASE — Dikes, gray to black

Ta — CHARNOCKITE GRANITIC MICROGRANITE (Triassic; 351 my; **20,21**) — Massive to weakly foliated; contains pegmatites. Lithium-bearing on Kings Mountain

Tc — CATAWBA GRANITE (Triassic; 351 my; **20,21**) — Massive; 408 my; **18**—Equigranular to porphyritic, massive to well foliated; contains biotite and hornblende

Tgr — GRANITE GNEISS (Cordovian to Silurian, 438 my; **17**) — Poorly foliated; locally megacrystic

Tgc — MICMATITIC GRANITIC GNEISS — Foliated to massive, granitic to quartz monzonitic; contains pegmatites and amphibolite common

Tgm — METAMORPHOSED GRANITIC ROCK (Cambrian to Ordovician; 456–540 my; **18**) — Equigranular to megacrystic; foliated to massive. Includes Toluca Granite

Tgn — HENDERSON GNEISS (Cambrian; 524 my; **10**) — Monzonitic to granodioritic, inequigranular

Tg — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

Tq — METAQUITRAMAFIC ROCK — Metamorphosed dunite, local peridotite, pyroxenite, soapstone, and other ultramafic rock. Only larger bodies shown

CZg — METAMORPHOSED GRANITIC ROCK (Late Proterozoic; 680-710 my; **18**) — Massive to foliated; locally myrmekitic

CAROLINA SLATE BELT

METAMORPHIC ROCKS

CZy — YADKIN FORMATION — Metamorphosed graywacke, volcanic sandstone, and siltstone; includes conglomerate and intermediate and intermediate to felsic crystal tuff

CZvt — METAVOLCANIC AND META-ARGILLITE — Thin to thick bedded; bedding plane and axial-planar cleavage common; interbedded with graywacke, siltstone, and conglomerate. Includes:
- CZmq – Floyd Church Formation
- CZmq – Cid Formation
- CZmq – Tillery Formation

(southwest of Asheboro)

CZmc — METAVOLCANIC ROCK — Metamorphosed basaltic to andesitic tuff and flow breccia, lapilli tuff, and flowrock; interbedded with felsic and intermediate metaclastic rock and metamudstone of Asheboro

CZmf — FELSIC METAVOLCANIC ROCK — Metamorphosed dacitic to rhyolitic tuffs and flows, grayish green to black. Locally includes hypabyssal intrusive rock, biotite gneiss, metadiorite, mica schist, and granitic gneiss

CZfv — Cid Formation (southwest of Asheboro)

CZfv — Uwharrie Formation (south to south)

CZmt — INTERMEDIATE METAVOLCANIC ROCK — Metamorphosed andesitic tuffs and flows, medium to dark-gray green; minor felsic and mafic interbeds

CZmv — METAVOLCANIC ROCK — Interbedded felsic to mafic tuffs and flowrock

CZmx — METAVOLCANIC-EPICLASTIC ROCK — Metamorphosed argillite, mudstone, tuff, volcanic sandstone, conglomerate, and volcanic rock

CZvc — VOLCANIC METACONGLOMERATE — Includes metagraywacke and metamudstone

CZph — PHYLLITE AND SCHIST — Dark-gray, graphitic and pyritic; includes phyllonite, sheared fine-grained metasediment, and metavolcanic rock

INTRUSIVE ROCKS

JD-Jc — DIABASE — Dikes, gray to black

PPfg — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; 11) — Megacrystic to equigranular. Castalia, Whitakers, Mabel, Mount Airy, Sparta, and Siloam granites

PPfs — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; 11) — Megacrystic to equigranular. Louisburg, Wake, and Rolesville granites

PPmg — FOLIATED TO MASSIVE GRANITIC ROCK (Pennsylvanian to Permian, 270-322 my; 18) — Megacrystic to equigranular. Buttermead Creek intrusive and Rocky Mount intrusive suite

PPmm — METAMORPHOSED ULTRAMAFIC ROCK — Metamorphosed dunite and peridotite; serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown

PPmd — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

PPmu — METAMORPHOSED MAFIC ROCK — Metagabbro, metadiorite, and mafic plutonic-volcanic complexes

CZg — METAMORPHOSED GRANITIC ROCK — Megacrystic; well foliated; locally contains hornblende

TRIASSIC BASINS

NEWARK SUPERGROUP

DAN RIVER GROUP

TRdr — DAN RIVER GROUP, UNDIVIDED — Basin-margin conglomerate and sandstone; red to brown, interbedded with gray siltstone, gray coal beds and mudstone, grown to brown. Conglomerate shown by pattern

TRdrs — STONEVILLE FORMATION — Conglomerate, sandstone, and mudstone, lenticular and laterally-replaced bedding. Intercongues with Stanleyville and Pine Hall formations

TRdrp — PINE HALL FORMATION — Conglomerate, sandstone, and mudstone, yellowish orange to brown

CHATHAM GROUP

TRcg — CHATHAM GROUP, UNDIVIDED — Conglomerate, fanglomerate, sandstone, and mudstone; red to brown, interbedded with gray coal beds and pattern

TRcgs — Arkosic sandstone, tan, medium- to very coarse-grained, micaceous

TRcgm — Sandstone and mudstone with thin interbeds of chert and impure limestone

TRcgc — Arkosic sandstone and gray siltstone; interbedded with brown to dark-gray sandstone and mudstone

TRcgf — Conglomerate — Conglomerate, fanglomerate, sandstone, and mudstone

CUMVDCK — CUMNOCK FORMATION — Sandstone and mudstone, gray to black; coal beds and carbonaceous shale. Grades into Pekin and Sanford formations

PEKIN — PEKIN FORMATION — Conglomerate, sandstone, and mudstone

DIABASE

TRd — DIABASE — Dikes and sills, gray to black

COASTAL PLAIN

QUATERNARY

Qsc — SURFICIAL DEPOSITS, UNDIVIDED — Sand, silt, clay, gravel, and peat deposited in marine, fluvial, estian, and subcuatine environments. Quaternary deposits are not shown on map. Bedrock contacts are inferred where more than 6 feet (2 m) thick

TERTIARY

Tp — PINEHURST FORMATION — Sand, medium- to coarse-grained, cross-bedding and laminations of clayey sand common; unconsolidated

Tcs — TERRACE DEPOSITS AND LAND SEGMENT — Gravel, clayey sand, and sandy clay; unconsolidated

Tcsw — WACCAMAW FORMATION — Fossiliferous sand with silt and clay; bluish-gray to tan, loosely consolidated. Straddles Pleistocene-Pliocene boundary

Tcy — YORKTOWN FORMATION AND DUPLIN FORMATION, UNDIVIDED

Yorktown Formation: Sandy, fossiliferous limestone and calcareous sand in the Blue Ridge and Piedmont of the Carolinas (Pl-Et; Eocene) Chapel Hill, North Carolina, Geologic and Mineral Resources Section

Duplin Formation: Shelly, medium- to coarse-grained sand; sandy mudstone, and limestone, bluish gray; marerly in area south of Neuse River

Tcb — BELGRADE FORMATION, UNDIVIDED

Pollocksville Member: Oyster-shell mounds in tan to orange sand and sandy mudstone

Haywood Landing Member: Fossiliferous sand and clay, commonly dark brown. Members grade into each other laterally

Tcr — RIVER BEND FORMATION — Limestone, calcarenite overlain by and interrelated with indurated, sandy, mollusan-mold limestone

Tcc — CASTLE HAYNE FORMATION

Spring Garden Member: Mollusan-mold limestone, indurated, very sandy. Forms downward-coarsening sequence with Castle Hayne Limestone Member

Comfort Member and Newer Hanover Member, undivided

Comfort Member: Bryozoan-echinoid skeletal limestone, locally dolomitized, solution cavities common

Newer Hanover Member: Phosphatic limestone, glauconitic, thin; restricted to basal part of Castle Hayne Formation in southwestern counties

Tcbf — BEAUFORT FORMATION, UNDIVIDED

Beaufort Limestone: Fossiliferous sand and clay; glauconitic fossiliferous, and locally calcareous

Jericho Run Member: Siliceous mudstone with sandstone lenses, thin bedded, basal phosphatic pebble conglomerate

CRETACEOUS

Kp — PEEDEE FORMATION — Sand, clayey sand, and clay, greenish gray to black; glauconitic, micaceous, and locally fossiliferous. Includes Fishburne Formation of sandy mollusan-mold limestone in upper part

Kb — BLACK CREEK FORMATION — Clay, clay to black, lignitic; contains thin beds and lenses of fine-grained micaceous sand and thick lenses of cross-bedded sand. Glauconitic, fossiliferous clayey sand lenses in upper part

Kcm — MIDDENDORF FORMATION — Sand, clayey sand, and clay; glauconitic, micaceous, and locally fossiliferous. Contains thin, discontinuous concretions common, beds laterally discontinuous, cross-bedding common

Kcf — CAPE FEAR FORMATION — Sandstone and sandy mudstone, yellowish-gray to bluish gray, mottled red to yellowish orange, indurated, graded bedding and cross-bedding common. Basting, biotite clay, herb tuss-bedding, kaolinite and mica common

REFERENCES FOR AGE DATES IN LEGEND

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2. Bartholomew, M.J., and Lewis, S.E., 1984, Evolution of Grenville orogenesis in the Blue Ridge and Inner Piedmont of northeastern North Carolina and northwestern South Carolina: Geological Society