

TIME-Ma (millions of years ago)	GEOLOGIC EVENTS OF THE CAROLINAS AND BEYOND
5-Recent	Erosion of the Schooley Peneplain formed a new erosional surface in the Piedmont and Blue Ridge, the Harrisburg Peneplain . Uplift and entrenchment of the French Broad and New River have continued til the present.
20-Recent	Uplift and erosion in the Piedmont and Blue Ridge formed the Schooley Peneplain , the Eastern Continental Divide , the Appalachian (Blue Ridge) Escarpment , the Fall Zone and monadnocks such as Mt. Mitchel and Grandfather Mountain .
47-Recent	The ocean has followed a back and forth retreat and advance on the Coastal Plain.
65-Recent	During late Cretaceous the tensional stresses which opened the Atlantic were reversed and replaced with compressional stresses that have produced the uplift and topography that we see in the southern Appalachians today.
144	Erosion of the Appalachians to gently rolling hills by the end of Triassic and their complete erosion to a nearly flat surface by late Jurassic.
175	Seafloor spreading, opening of the Atlantic Ocean between North America and Africa, and formation of the Mid Atlantic Ridge .
200	Diabase dike swarms and sills were created in the Piedmont in response to continued crustal extension.
230	Early rifting stresses between Laurasia and Africa formed the Dan River and Deep River Triassic rift basins in the Piedmont.
320 (325-280)	Alleghanian Orogeny : The Appalachian Orogen was completed and the supercontinent of Pangea was created with the collision of Laurasia and Gondwana's northwestern African coast. As closure of the Rheic Ocean moved from north to south through oblique subduction under Laurasia, the Goochland Terrane was reacceted and transported south by dextral transpression to Virginia. Massive sheets of rock moved long distances toward the northwest forming thrust faults and décollement , often covering younger rocks with older rocks. Erosion has exposed the underlying rocks in windows at such places as Grandfather Mountain , Hot Springs and the Sauratown Mountains . The Smith River Allochthon exposes rocks transported from the Inner Piedmont to their present location within the Blue Ridge.
Carolinas: 350 (400-330) Northeast: 430-370	Acadian Orogeny : Laurentia followed a clockwise path relative to Gondwana, colliding with Baltica along its northern margin and Avalonia in the northeast begining in early Silurian to create Laurasia (Old Red Sandstone continent) . Baltica remained united with North America until late Cretaceous. Partial subduction of the Cat Square Terrane beneath the Carolina Terrane and subduction of the Tugaloo Terrane beneath the overriding Cat Square Terrane led to high grade metamorphism and created plutons such as Looking Glass Rock , Stone Mountain , Pink Beds and Mount Airy Granite . Pegmatite dikes formed in the Piedmont and Blue Ridge (Spruce Pine Pegmatites). The Iapetus Ocean was completely consumed as the Cat Square and Carolina Terranes obliquely docked with Laurasia, dextrally decoupling the Western Inner Piedmont from the Eastern Blue Ridge along the Brevard Fault Zone .
430-400	The Cat Square Terrane (Eastern Inner Piedmont) was deposited in the remnant Iapetus Ocean between the Tugaloo and Carolina Terranes, possibly as an accretionary prism in front of the oncoming Carolina Terrane.
440-420	Erosion of the Taconic thrust sheets deposited sediments in the Martinsburg Foredeep Basin of east Tennessee and Virginia.
460 (480-440)	Taconic Orogeny : Continued subduction of oceanic crust along eastern Laurentia closed a forearc basin and resulted in the accretion of the Central Blue Ridge and the Tugaloo Terrane. Collision formed a stack of thrust sheets, causing the obduction of ophiolites onto Laurentia. Subduction beneath the Tugaloo Terrane caused plutonism (Whiteside Granite , Ceasars Head Granite , Henderson Gneiss and Dysertsville Tonalite), volcanism (Poor Mountain Formation) and widespread metamorphism. The Precordillera Terrane docked with the western Gondwana margin of Argentina.
505-490	East dipping subduction of oceanic crust near eastern Laurentia marked the formation of arc complexes of the Dahlonge gold belt , Cowrock and Cartoogachaye Terranes (Central Blue Ridge).
540-480	As the Iapetus Ocean invaded much of Laurentia, limestone was deposited along a slowly subsiding passive eastern continental margin to form a carbonate platform . These deposits are now exposed in the Valley & Ridge foreland fold-and-thrust province of East Tennessee.
540-520	The Tugaloo Terrane (Eastern Blue Ridge & Western Inner Piedmont) was deposited in a back-arc setting of deep water oceanic crust and rifted fragments of Grenville crust such as the Toxaway and Tallulah Falls domes . The Goochland Terrane to the north and the Precordillera Terrane to the south were also rifted microcontinents of Grenville crust. The Carolina and Avalonia Terranes separated from Gondwana to begin crossing the Iapetus, opening the Rheic Ocean along their trailing edges.
570-540	Iapetus Ocean seafloor spreading reached the Carolinas from the north and completed the separation of Laurentia from South America. Laurentia drifted from its position near the South pole northward toward equatorial waters at a rapid rate, leaving behind the supercontinent of Gondwana which formed as East Gondwana (Australia, East Antarctica and India) joined West Gondwana. Oblique closure of the Carolina and Avalonia Terranes with West Gondwana formed a sinstral transform boundry and resulted in deformation.
570	Rifting stresses between Laurentia and South America continued to deposit the Ocoee Supergroup in rift basins. Rifting related volcanic activity was displayed in the Catoctin Formation of Virginia.
630-535	An arc of volcanic islands was created far from eastern Laurentia in waters between Baltica and West Gondwana (Africa and South America), as oblique sinstral subduction of oceanic crust near West Gondwana formed the Carolina and Avalonia Terranes .
630-610	A mantle plume at a triple junction in northeast Laurentia rifted Baltica and began to open up the Iapetus Ocean between Laurentia & the South American cratons.
750 (760-720)	Early rifting stresses between eastern Laurentia and western South America created block-faulted extensional rift basins which began to accumulate sedimentary deposits of the Ocoee Supergroup . Magmatic activity was displayed in plutonic deposits of the Crossnore Complex and the Bakersville mafic dike swarm and volcanic deposits of the Mount Rogers Formation . This rifting phase failed to separate Laurentia and South America at this time.
1100 (1200-1000)	Grenville Orogeny : Basement rocks of the Western Blue Ridge such as the Cranberry Gneiss of the Elk Park Plutonic Suite were deformed and metamorphosed when the southeastern margin of Laurentia collided with the Amazonia and Rio de la Plata cratons of South America. The Mars Hill Terrane was sutured to Laurentia to become the oldest rocks in the southeastern USA. East Antarctica, Australia, India, Baltica , Siberia and the cratons of Africa also fused with Laurentia and South America to form the supercontinent of Rodinia .
1800-1600	The Mars Hill Terrane was formed far from its present location in the Blue Ridge of North Carolina, possibly as part of Amazonia.
1950-1850	Archean island arc terranes combined to form the core of Laurentia (ancestral North America), the Precambrian Canadian Shield .

References

A more detailed list of references will be forthcoming, but for now, the best overview of Carolina geology can be found in:

Horton, J.W., Jr., and Zullo, V.A., eds., 1991, *The Geology of the Carolinas: Carolina Geological Society Fiftieth Anniversary Volume*: Knoxville, The University of Tennessee Press, Carolina Geological Society, 406 p.

Recent thinking about the tectonics of the Southern Appalachians can be found in the research of Robert D. Hatcher at the University of Tennessee-Knoxville, his students and associates. The two Carolina Geological Society Annual Field Trip Guidebooks are downloadable as pdf files at the [Carolina Geological Society website](#). The included maps will help to visualize the location and relationship of the various terranes in the Carolinas.

Hatcher, R.D., Jr., and Bream, B.R., eds, 2002, Inner Piedmont geology in the South Mountains-Blue Ridge Foothills and the southwestern Brushy Mountains, central-western North Carolina, *in* Carolina Geological Society Annual Field Trip Guidebook: Raleigh, North Carolina Geological Survey, 145 p.

Hatcher, R.D., Jr., Bream, B.R., Merschat, A.J., Mapes, R.W., and Miller, C.F., 2005, Evidence for the (Neo-) Acadian Orogeny in the Southern Appalachians: Geological Society of America Abstracts with Programs, v. 37, no. 2, p. 5-6. [pdf file list](#)

Bream, Brendan R., Mapes, R.W., Hatcher, R.D., Miller, C.F., and Fullagar, P.D., 2005, Laurentian and Exotic Components of the Southern Appalachian Inner Piedmont: Geological Society of America Abstracts with Programs, v. 37, no. 2, p. 6.

Hatcher, R.D., Jr., Merschat, A. J., eds, 2005, Blue Ridge Geology Geotraverse East of the Great Smokey Mountains National Park, Western North Carolina: North Carolina Geological Survey, Carolina Geological Society Annual Field Trip Guidebook, 132 p. [pdf file list](#)

George Schissler sams@main.nc.us