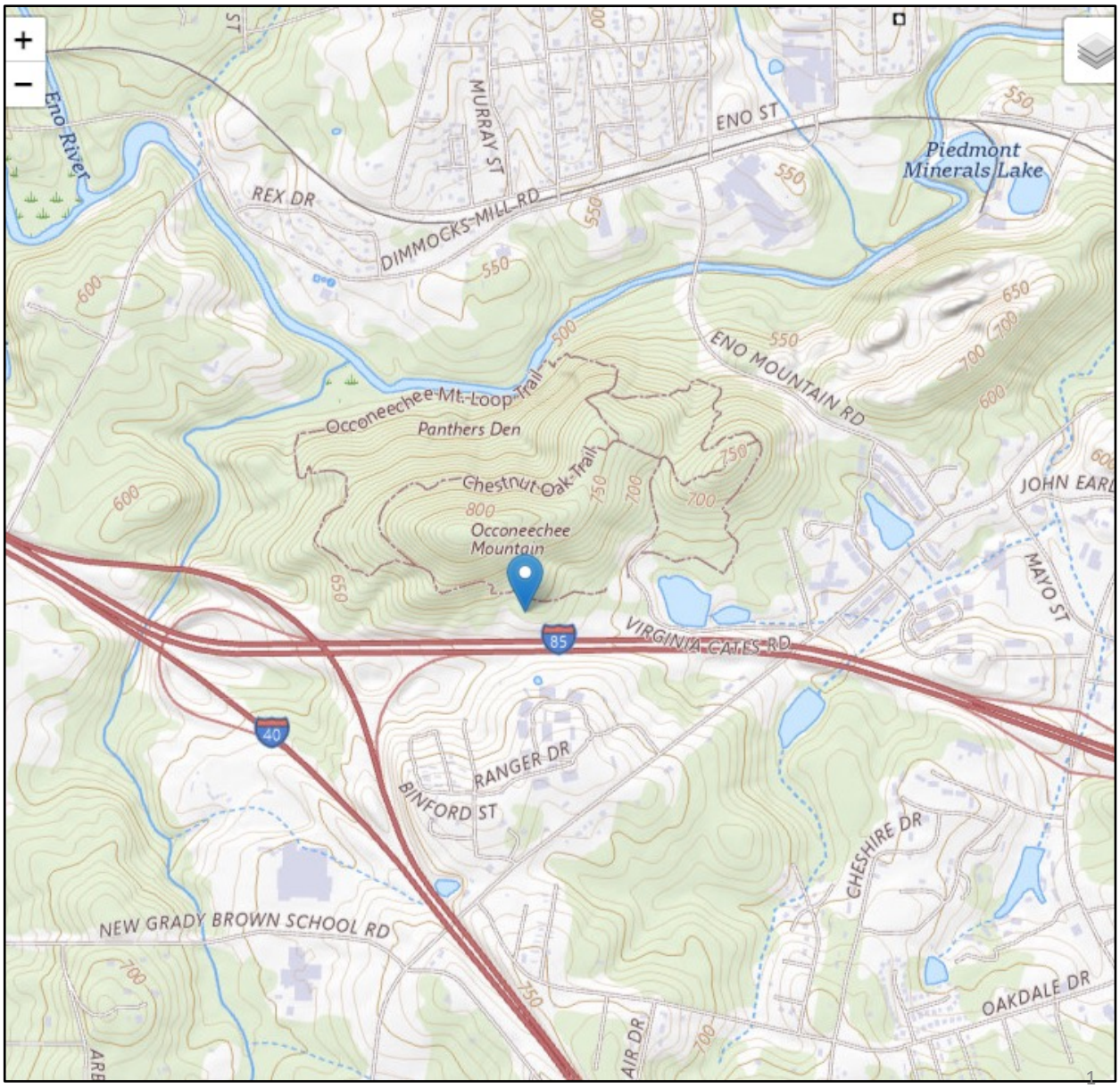
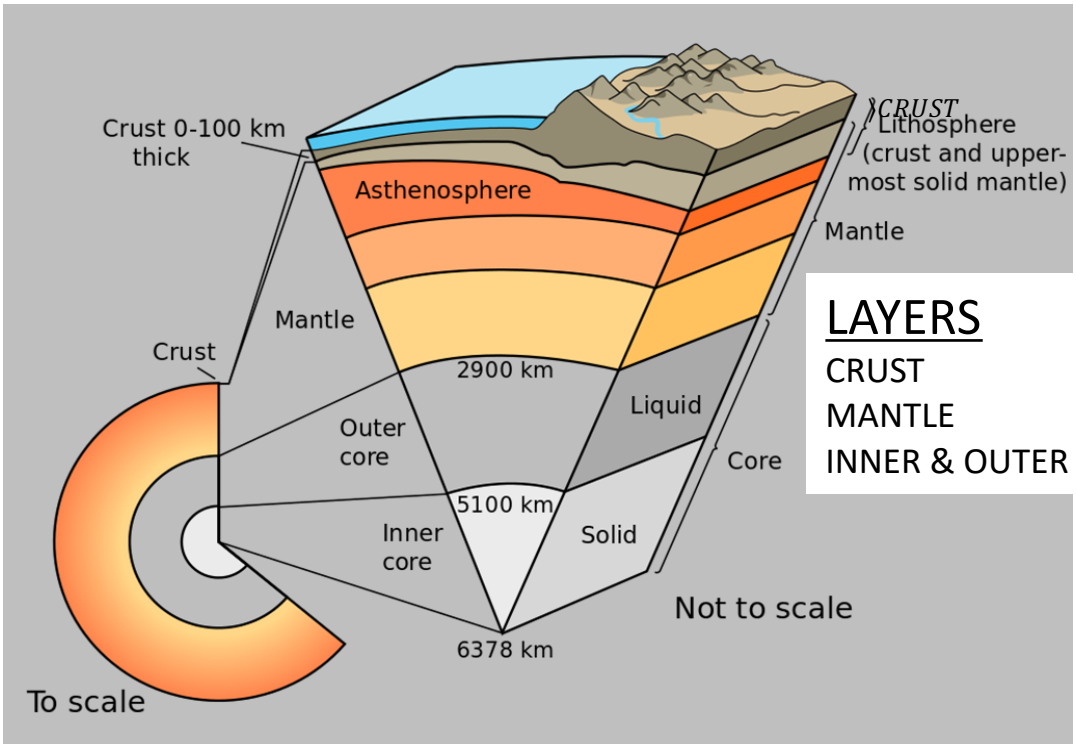
THE GEOLOGY OF OCCONEECHEE MOUNTAIN

Tonya Brami, 2025

through the Orange County, NC Master Naturalist Program



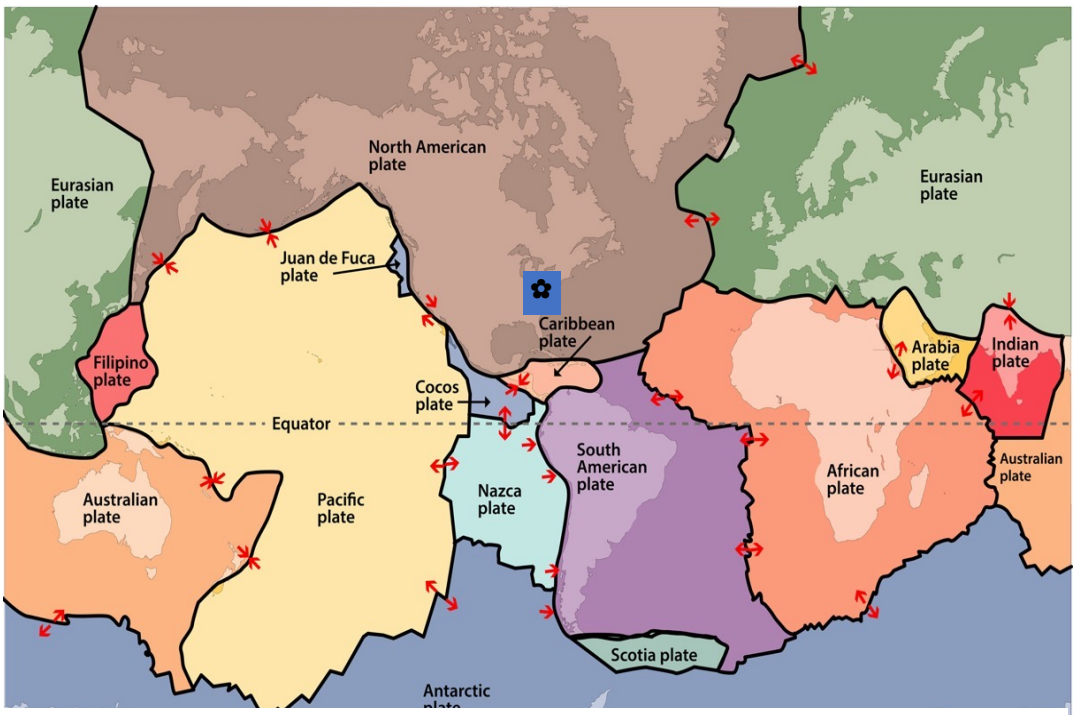
THE EARTH IS MADE UP OF LAYERS



LAYERS

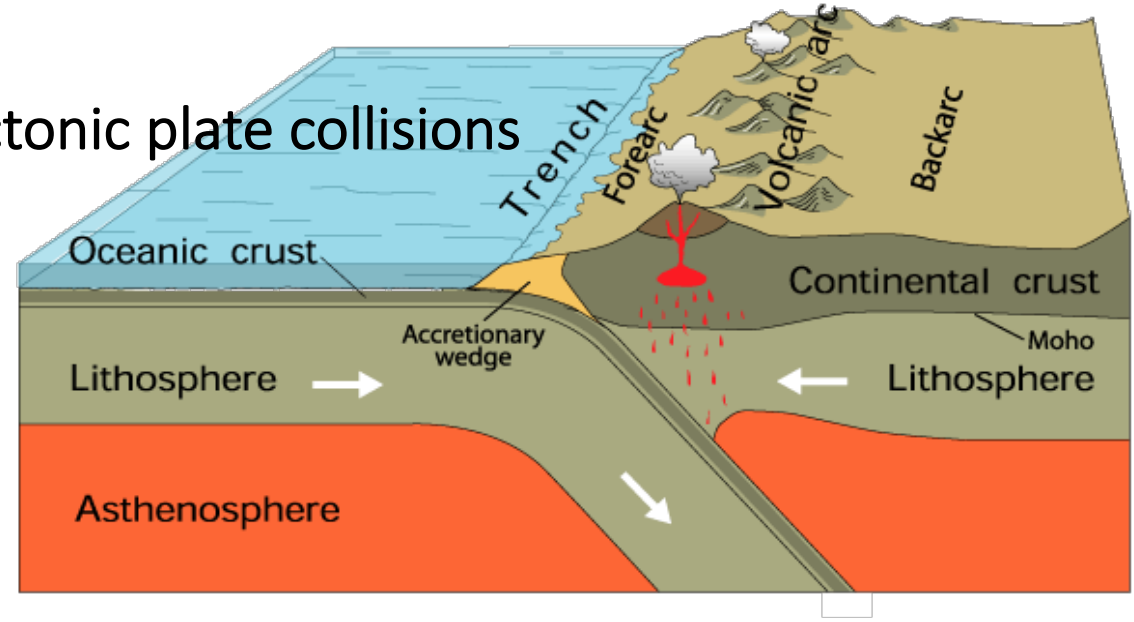
CRUST
MANTLE
INNER & OUTER CORE

THE EARTH'S CRUST IS MADE UP OF TECTONIC PLATES…

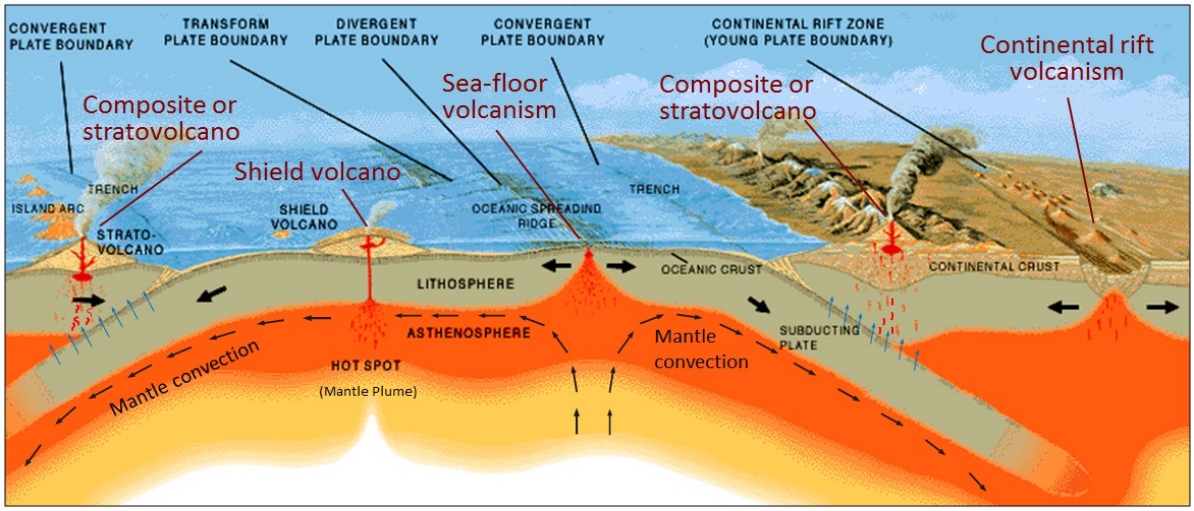


…THAT COLLIDE WITH EACH OTHER, PULL APART, AND SLIDE PAST EACH OTHER OVER MILLIONS OF YEARS

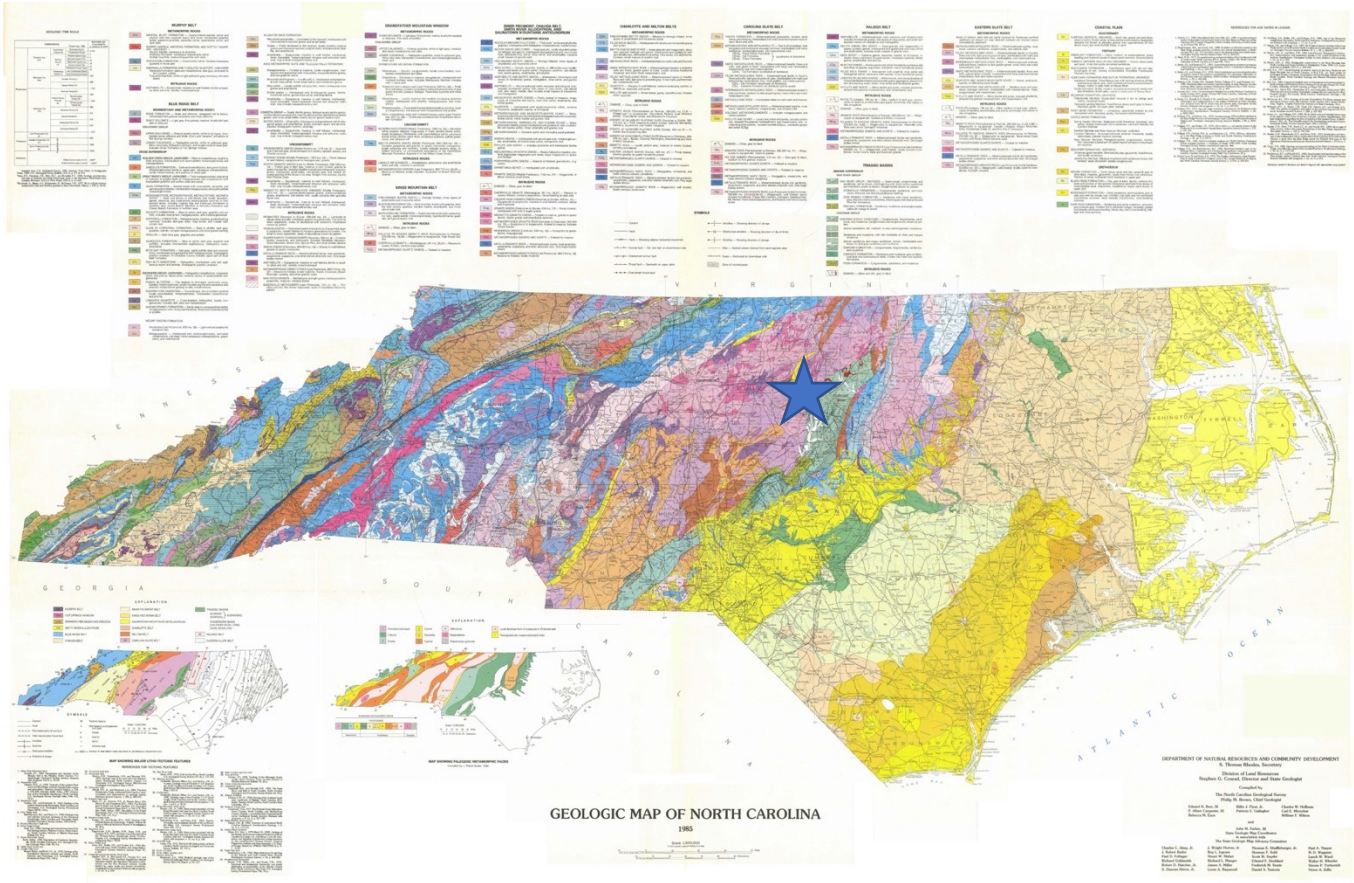
Tectonic plate collisions



- Dense oceanic crust subducts beneath less dense and more buoyant continental crust
- As the rocks reach high temperatures at great depth, they melt, and rise to the surface through pre-existing weaknesses in the overlying rocks
- This molten rock is either gently intruded in to pre-existing rocks (as intrusive magmatic bodies), or they make it to the surface in the form of volcanic eruptions
- Along convergent plate boundaries volcanoes form chains, or island arcs, like today's west coast of South America or Japan



GEOLOGIC EVOLUTION OF NORTH CAROLINA

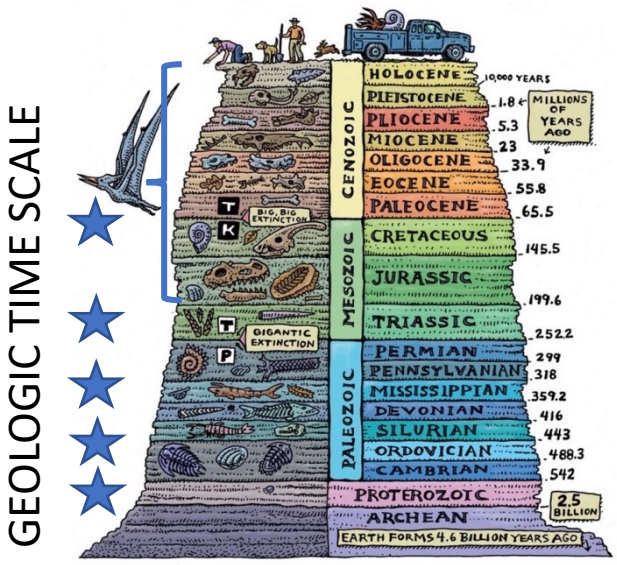


- North Carolina's geology has evolved over hundreds of millions of years.
- The map above is a geologic map, which shows the different rock types exposed at the surface.
- The rocks range from over a billion years old to just 10s of thousands of years old.
- The complex geology of the state is due to a number of tectonic events, when crustal plates collided, forming volcanic island arcs and mountain chains – when the crust was pulled apart by extensional forces, and when erosion, over hundreds of million of years subdued majestic rock landscapes into the verdant, gentle hills, mountains, and beaches we we now enjoy.
- Let's take a quick look at how this all evolved

GEOLOGIC EVOLUTION OF THE PEIDMONT

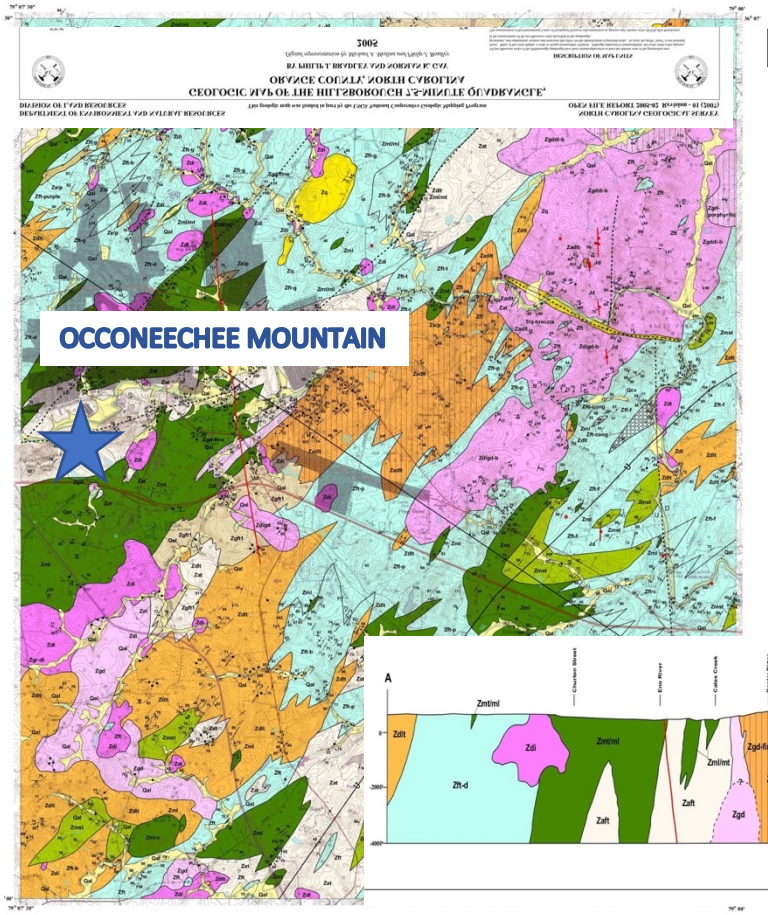
Building Blocks of North Carolina Geology

- **200 ma-present**: Erosion
- **200 ma:** Extensional Event – rifting, Durham Basin
- **300 ma: Alleghenian Orogeny -** Collisional Event- mountain building, intrusives (granite), metamorphism
- **450 ma**: Taconic Orogeny -Collisional Event- island arc, volcanics, mountain building, folding, metamorphism
- **<630 ma: Virgilinan Deformation -** Collisional Event - island arc, volcanics, mountain building (Proto Appalachians) – HYCO FORMATION



- These sorts of tectonic events shaped the geology of North Carolina
- 630 MA: Virgilinian deformation - tectonic plates rammed into each other forming volcanic island arcs in what is now Orange County
  - Some of these eruptions were violent, Mt St Helens style eruptions, with debris flows and lahars, or superheated gas flows filling the areas around the volcanoes with ash*** actual words
  - This period led to the deposition of thousands of feet of volcaniclastic sediments (Hyco Formation) – rocks derived from volcanoes that moved through gravity driven sedimentary processes
- 450-300 MA: Later tectonic collisions led to these rocks being buried, lightly metamorphosed, folded, intruded and uplifted to form a mountain range in the Piedmont

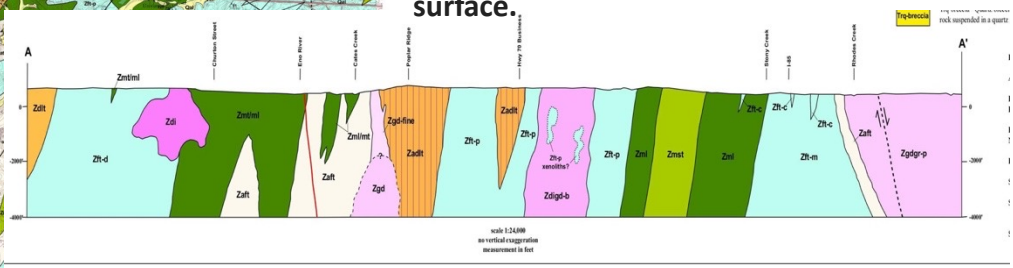
GEOLOGIC EVOLUTION OF HILLSBOROUGH



Occoneechee Mountain contains abundant white, beige, to reddish and tan, massive; sugary to porcelaneous, very fine-to medium-grained quartzite-like rock. Quartzite-like rock is often mixed with micaceous sericite phyllite. The micaceous sericite phyllite gives the otherwise massive quartz-like-like rock some foliation.

The legend for this map can be found on the last page of this document

The cross section below is a slice through the Hillsborough area, showing the upturned and folded rocks as they intersect the surface.



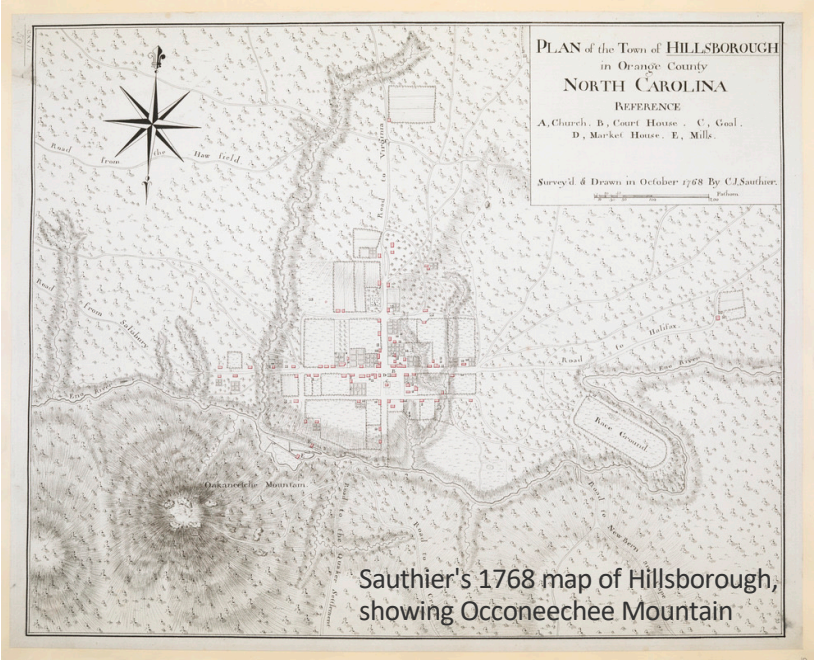
- You can see the impact of those tectonic events in the geologic map of Hillsborough

- Most of the formations trend in a Northeast to Southwest orientation
  - This is an indication of the direction of plate motion during the collisions

- Most of the rocks in Orange County are slightly metamorphosed volcaniclastic rocks – rocks that were deposited during volcanic eruptions, buried deep in the earth, and altered under conditions of great heat and pressure to become the rocks they are today

- In later tectonic events they were uplifted and folded, and in some places had magma intruded into them. But now they have been eroding for hundreds of millions of years to form the landforms we see today

GEOLOGIC EVOLUTION OF OCCONEECHEE MOUNTAIN



Sauthier's 1768 map of Hillsborough, showing Occoneechee Mountain

- Occoneechee Mountain is the highest point in Orange County, with an elevation of 867 feet (264 meters) above mean sea level (msl). Its crest is more than 300 feet (90 meters) above the Eno River.
- Occoneechee Mountain is a monadnock.
  - A monadnock is an erosional remnant of what used to be a larger mountainous landform.
- In fact the entire Piedmont area used to be mountainous, and all that is left after hundreds of millions of years of erosion are the small hills and the larger monadnock features.
- These monadnocks are part of a larger northeast-trending plateau which has been eroded into separate highs.
- The Eno River has cut through this plateau causing steep topography of several hundred feet within close proximity to the river (e.g., Occoneechee Mountain, Poplar Ridge and Cox Mountain).
- Stone Mountain, Pilot Mountain, Hanging Rock, Poplar Ridge, and Crowders Mountain are other monadnocks in the region.

GEOLOGIC EVOLUTION OF OCCONEECHEE MOUNTAIN

Occoneechee Mountain was part of that story…

- It is made up largely of dense siliceous rock along the crest and a sericite phyllite/schist to the northwest.
- Rocks in the quarry include:

  - Sericite phyllite/schist , massive pyrophyllite and siliceous rock. (pyrophyllite is with radial structures are present as fracture fill)

  - Andalusite, topaz, ilmenite, and kaolinite are also present.
- The rocks that make up Occoneechee Mountain were originally volcanic rocks (from the island arcs formed by plate collision) – likely andesite and dacite
- These rocks were altered by superheated fluids in a process called hydrothermal alteration
- This process led to the formation of both the erosion resistant (hard) quartz rich rocks (through silicification) that comprise the spine of the mountain and also the softer rocks and minerals like the phyllites schists, and pyrophyllite







ROCKS AND MINERALS OF OCCONEECHEE MOUNTAIN

- During the Virgilinian event, these rocks were uplifted, folded, and underwent their final round of metamorphism, leading to the rocks we see here today

- The pyrophyllite, sericite, and quartz rock are often white or yellowish-white in color with red mottling (iron oxide staining) common. The resulting quartz rock is very hard and resistant to erosion.

- These rocks weather into a gray mottled color – that's what you see in the outcrops

- These rocks are all part of the Hyco Formation which is shown on the Orange County geological map

- The northwestern face of Occoneechee Mountain is home to an active mine and an abandoned quarry that contains a white rock with one of the softest minerals known in geology – pyrophyllite



A: Sericite and quartz with red and yellow mottled staining

B: Pyrophyllite from Occoneechee Mountain



PYROPHYLLITE

- Occoneechee Mountain is composed of three hills designated from northeast to southwest as Hill Number 1, Hill Number 2 and Hill Number 3 (fig. 14).
- The abandoned quarry is located on the northwest side of Hill Number 3.
- The apex of Hill Number 3 is the highest point in Orange County at 867 feet (264 meters) above sea level.
- The quarry was reportedly opened before the Civil War and used for fill material during construction of nearby railroad tracks and for general fill material in the Hillsborough area.
- In 1906 the quarry was operating under the name of the Southern Broken Stone Company. Active quarrying ceased sometime around 1908 (Eno River Calendar for 1995, Eno River Association).
- The large boulders and rock debris present in the abandoned quarry are from a rockslide that occurred in February 2001 (Wooten et al., 2006).
- An active pyrophyllite mine is present on Hill Number 1; it has been in operation since the 1960s.
- Facts about pyrophyllite: Pyrophyllite is a hydrous aluminum silicate (Al2 Si 4 O 10(OH) 2) with a structure similar to talc.
- It is soft, like talc, with a hardness of 1 (can be scratched with fingernail).
- Pyrophyllite is relatively chemically inert, has a high dielectric strength (a material that has negligible electrical or thermal conductivity) and a high melting point.
- Pyrophyllite is used in the ceramic industry in the production of heat resistant products such as electrical insulators. It is used in soaps, paints and in bleaching powders. The most familiar use for the mineral is as talcum powder.
- North Carolina is a leading producer of raw pyrophyllite in the United States

2001 ROCK SLIDE

Photo after February 17-18, 2001 Occoneechee Mountain rockslide

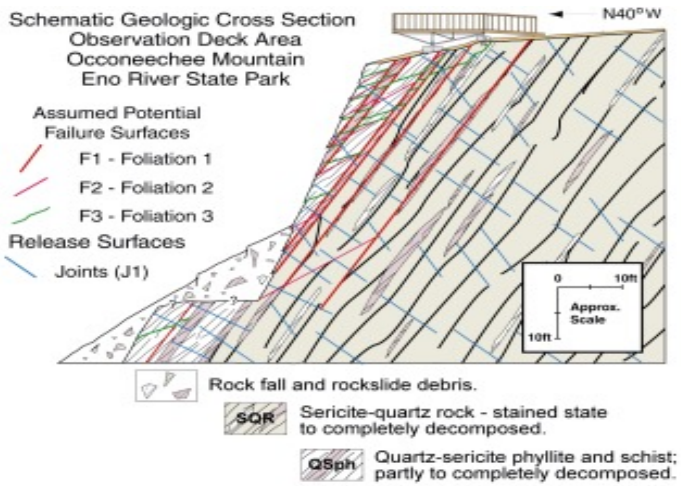


Looking north from the overlook you see a steep cliff on the other side of the protective fencing. There used to be an observation deck north of where you are now standing. February 17-18, 2001 there was a rock slide. You can see the boulders and failure scarps to the north beyond the overlook

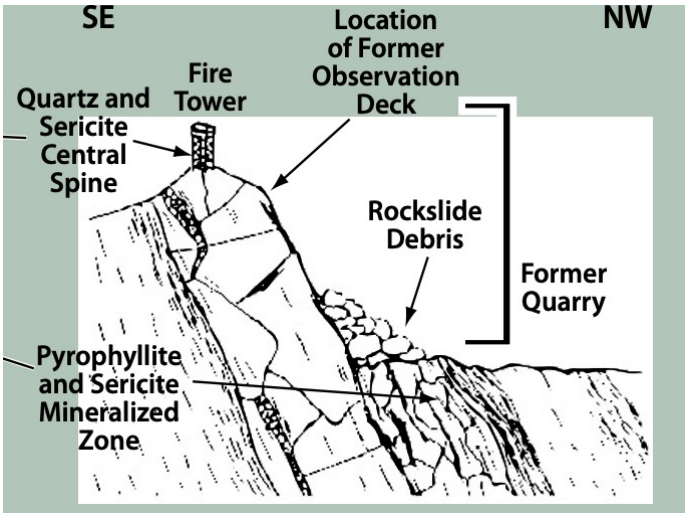
The primary cause of the rock slide was the prior quarry excavation, which intersected three sets of foliation planes that dip out of the slope. Also freeze-thaw cycles and frost wedging likely contributed to destabilization. It was triggered specifically by rainfall and freeze- thaw cycles in the weeks prior to the failure.

Stay off of the boulder field and rock face of the rock slide area

Schematic cross section of foliations and fractures at site of rock slide

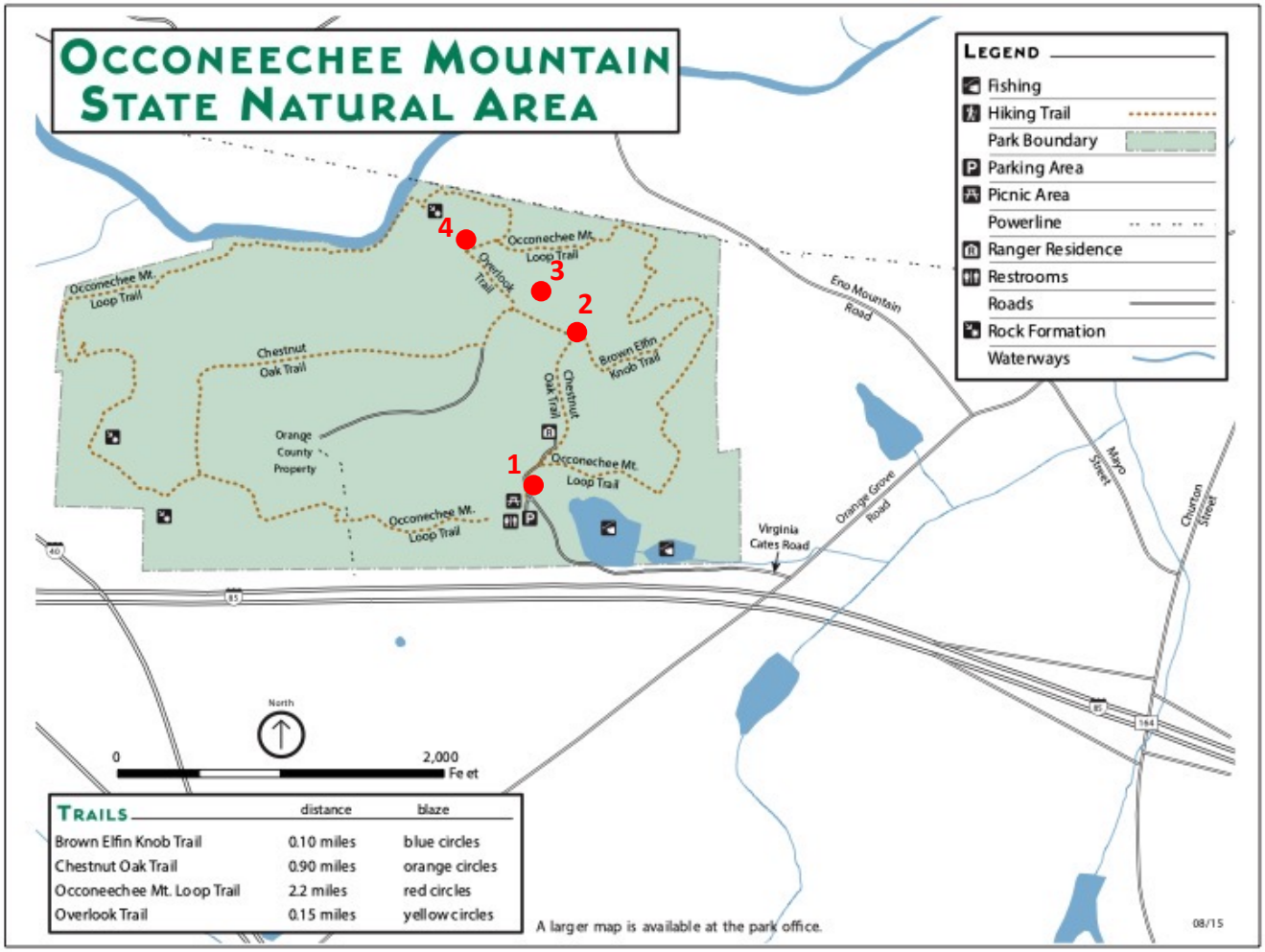


Cross section showing location of rockslide and general mineral distribution



The promontory where the rockslide originated is comprised of foliated and fractured quartz, sericite phyllite. A less foliated, but highly fractured sericite-bearing siliceous rock unit is structurally below the phyllite unit, and holds up the higher slopes of Occoneechee Mountain.

OCCONEECHEE MOUNTAIN GEOLOGIC TRAIL GUIDE



- Geologic points of interest along the trails of Occoneechee Mountain



GEOLOGIC STOPS ALONG THE TRAILS

1. **Near parking lot:**
   Geologic Introduction (use earlier pages from this guide). Take road/trail north out of the parking lot toward Chestnut Oak Trail. Continue until you get to a fork in the road and a bench.

2. **At the bench:**
   - Notice NE-SW orientation
   - Occoneechee Mountain is a ridge, dissected into 5 summits. From southwest to northeast (across the road) you can see them:
     1-2)Two on the other side of Eno River association property, on the southwest side of other creek
     3) Occoneechee Mountain's crest (the highest point of all)
     4) Brown Elfin Knob
     5)Across Eno Mountain Road there used to be a ridge but it no longer exists – it has been mined for the pyrophyllite

3. **At the intersection of the Summit Trail and the Overlook Trail:**
   - Go into woods on the right where there is a large outcrop
   - This rock is very hard – what kinds of rock do you think it might be? The Quartzite-like rock described earlier
   - Does the surface look like quartz? Why not?
   - Fresh surfaces of this rock are hard and milky white – as much quartz rich rock is. But on the surface of these rocks they are grey and mottled. This is the result of hundreds of millions of years of erosion and weathering – once again altering these rocks
   - On the east side of this outcrop you can see foliations (lines in the rocks). These used to be horizontal and have now been folded (see cross section from Hillsborough quadrangle geologic map)

4. **The Overlook:**

- There are different kinds of rocks near the overlook. Some are highly resistant to erosion. They are massive – they are the biggest rocks that stand up the tallest. Those are the hardest rocks – a quartz rich metamorphic rock, which is likely quartzite. If you walk just to the west of those rocks and look down at your feet, you will see something different. These rocks are heavily weathered. They are foliated, and soft. These rocks are quartz-sericite schist and phyllite – another type of metamorphic rock.

- Look north toward the downtown area of Hillsborough. The cliff just beyond the overlook is very steep. That is the scar from the landslide covered earlier in this guide. The rocks that failed were also metamorphic rocks – foliated, softer rocks containing sericite, pyrophyllite and andalusite (this area was the site of an older pyrophyllite mine – and these minerals are still being mined just across Eno Mountain Road)

- From this point, ion a clear day, you can see a white dot off on the horizon to the east. It is a water tower on the other side of Raleigh!

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

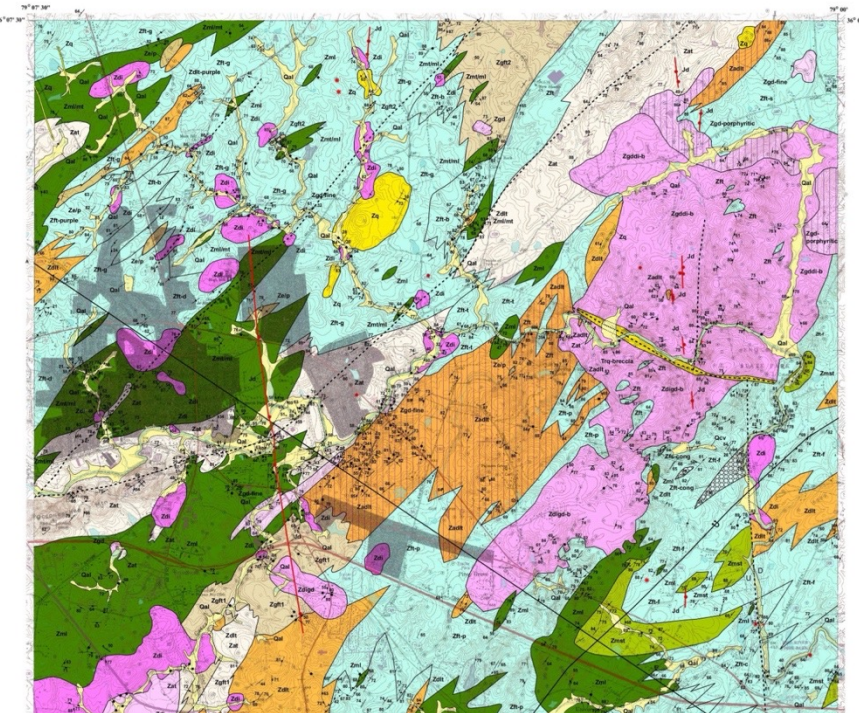
NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE REPORT 2005-02 Revision - 01 (2007)

GEOLOGIC MAP OF THE HILLSBOROUGH 7.5-MINUTE QUADRANGLE, ORANGE COUNTY, NORTH CAROLINA

BY PHILIP J. BRADLEY AND NORMAN K. GAY

Digital representation by Michael A. Medina and Philip J. Bradley

2005



DESCRIPTION OF MAP UNITS

All pre-Mesozoic rocks of the Hillsborough quadrangle have been metamorphosed to at least the chlorite zone of the greenschist metamorphic facies. Many of the rocks display a weak or strong metamorphic foliation. Although subjected to metamorphism, the rocks retain relict igneous, pyroclastic, and sedimentary textures and structures that allow for the identification of protolith rocks. As such, the prefix "meta" is not included in the nomenclature of the pre-Mesozoic rocks described in the quadrangle.

The nomenclature of the International Union of Geological Sciences subcommission on igneous and volcanic rocks (IUGS) after Streckeisen (1973 and 1979) is used in classification and naming of the units. The classification and naming of the rocks is based on relict igneous textures, modal mineral assemblages, or normalized mineral assemblages when whole-rock geochemical data is available. Past workers in the Hillsborough quadrangle (Burke, 1964; Allen and Wilson, 1968; Sykes, 1976; Black, 1977; and Newton, 1983) have used various nomenclature systems for the igneous rocks. The raw data of these earlier workers was recalculated and plotted on ternary diagrams and classified based on IUGS nomenclature. Pyroclastic rock terminology follows that of Fisher and Schmincke (1984).

SEDIMENTARY UNITS

Qal - Alluvium: Unconsolidated clay, silt, sand and gravel to cobble-sized clasts, subrounded to angular, deposited in drainages.

Qcv - Colluvium: Accumulations of angular cobbles and boulders.

INTRUSIVE AND META-INTRUSIVE UNITS

Jd - Olivine diabase: Black to greenish-black; fine- to medium-grained; dense; consists primarily of plagioclase, augite, and olivine. Occurs as dikes up to 80 ft wide. Diabase typically occurs as spheroidally weathered boulders with a grayish-brown weathering rind. Red station location indicates outcrop or boulders of diabase.

Zgd - Granodiorite: Exhibits a variety of colors and textures ranging from grayish-white, fine- to medium-grained hornblende granodiorite; pinkish-white, medium-grained hornblende granodiorite; and gray, fine-grained granodiorite.

Zgd-fine - Fine-grained granodiorite: Light-gray to green; ranges from equigranular very fine-grained granodiorite to very fine-grained porphyritic granodiorite with plagioclase phenocrysts (1 mm to 4 mm). Black colored amphibole, when visible, occurs as phenocrysts (<1 mm to 1 mm) and as intergrowths with plagioclase; amphibole intergrowths distinguish rock from fine-grained tuffs.

Zgddi-b - Granodiorite and diorite: Composite pluton of dominantly medium-grained, hornblende granodiorite; lesser amounts of medium-grained hornblende diorite, fine-grained granodiorite, and diorite. Unit contains abundant xenoliths of volcanic rock and enclaves(?) of fine-grained granodiorite to diorite.

Zdigd-b - Diorite and granodiorite: Composite pluton of dominantly medium-grained hornblende diorite; lesser amounts of medium-grained hornblende granodiorite, fine-grained granodiorite, porphyritic diorite with plagioclase phenocrysts; minor amounts of porphyritic granodiorite with plagioclase phenocrysts, porphyritic granodiorite with potassium feldspar phenocrysts, and gabbro. Unit contains abundant xenoliths of volcanic rocks and enclaves(?) of fine-grained granodiorite to diorite.

Zgd-porphyritic - Porphyritic granodiorite: Greenish-gray with a pinkish-hue; amphibole-bearing; porphyritic granodiorite with plagioclase phenocrysts. Plagioclase phenocrysts are green from saussuritization and range from 2 to 8 mm in a matrix of very fine-grained quartz and alkali-feldspar. Weathered surfaces exhibit a distinct strongly porphyritic texture. Porphyritic rhyolite of Newton (1983).

Zgdgr-p - Granodiorite and granite of Piney Mountain Creek area: Composite pluton of dominantly medium-grained hornblende granodiorite with lesser amounts of medium-grained hornblende granite.

Zgr-di - Granite to diorite: Composite pluton exhibiting a variety of rock types ranging from granite to diorite. Lithologies include gray-pink, medium- to coarse-grained granite; pinkish-white, medium-grained hornblende granodiorite; and dark-gray, fine- to coarse-grained diorite.

Zdi - Diorite: Greenish-gray to gray; medium-grained; equigranular; hornblende diorite. Major minerals include plagioclase and hornblende. Greenish-white plagioclase crystals compose up to 50% of the rock and are typically sericitized and saussuritized.

Zdigd - Diorite and granodiorite: Small plutonic bodies of dominantly medium-grained hornblende diorite with lesser amounts of medium-grained hornblende granodiorite.

Zgb - Gabbro: Fine-grained pyroxene gabbro dike.

METAVOLCANIC UNITS

Ze/p - Mixed epiclastic-pyroclastics: Gray-ish-green to greenish-gray; tuffaceous; sandstones, siltstones and minor phyllite. The siltstones typically are weakly phyllitic. Unit contains lesser amounts of coarse tuff and lapilli tuff.

Zat - Altered tuffs: Very light-gray, light-greenish-gray to white, with red and yellow mottling; altered; felsic tuffs. Alteration of felsic tuffs have produced sericite-quartz phyllite, pods of pyrophyllite, and quartz + pyrophyllite rock; all with common <1 mm to 2 mm diameter cubic pyrite aggregates and goethite-lined molds of pyrite crystals. Fine-grained porphyroblasts of chloritoid (<1 mm) and andalusite (up to 4 mm) are present in some pyrophyllite bearing rocks. Relict lithic clasts and kaolinitized feldspar crystal shards are visible in some outcrops. Relict structures are obliterated in heavily altered rocks. Mapped area contains boulders, up to several feet in diameter, and outcrops of massive milky quartz and quartzite-like rock. Occoneechee Mountain contains abundant white, beige, to reddish and tan; massive; sugary to porcelaneous; very fine- to medium-grained quartzite-like rock. Quartzite-like rock is often mixed with micaceous sericite phyllite. The micaceous sericite phyllite gives the otherwise massive quartzite-like rock a foliation.

Zmst - Matrix supported tuffs: Green-gray to green; weakly foliated to well foliated; matrix supported; polymictic; lapilli tuffs and tuff breccias. Angular to sub-rounded, lithic fragments range from <1 mm up to 1 m diameter. Unit is interpreted as a resedimented syn-eruptive volcaniclastic deposit in which texturally unmodified volcaniclastic debris and entrained texturally more mature accidental clasts are incorporated into a rapidly resedimented package of sediment. May be emplaced via submarine mass flows, subaerial landslides and/or lahars. Outcrop in Few's Ford area of Eno River State Park has been interpreted as a lahar deposit (Allen and Wilson, 1968 and Rochester, 1978).

Zft - Felsic tuffs: Gray-green to green, massive to foliated coarse tuff and lapilli tuff. Locally plagioclase crystal-fragment-rich coarse tuffs are present.

Zft-m - Felsic tuffs west of Mt. Herman Church: Grayish-green to greenish-gray; massive to foliated; thin to thickly layered fine to coarse tuff with lesser amounts of lapilli tuff. 1-5% accessory sulfide minerals commonly present. Outcrops and boulders typically display a white weathering rind.

Zft-c - Felsic tuffs of the Colie quarry area: Greenish-gray; massive to strongly foliated; dense; plagioclase crystal-fragment-rich coarse tuffs. Strong foliation is interpreted to be result of primary volcanic welding and/or compaction. 1-5% accessory sulfide minerals commonly present. Outcrops and boulders typically display a white weathering rind.

Zft-f - Felsic tuffs of the Few's Ford area: Dominantly light-green to dark-green; massive to weakly foliated coarse tuffs. Interlayered with: light-gray to gray; massive to weakly foliated lapilli tuff; a distinctive purple-colored coarse tuff; polymict conglomerate (Zft-cong); and dark-gray to black, cryptocrystalline lava similar in appearance to the lavas present in the Zadlt unit. 1-5% accessory sulfide minerals commonly present.

Zft-cong - Conglomeratic interlayered in felsic tuffs of Few's Ford area (Zft-f): Conglomerate composed of subrounded to rounded; polymictic clasts (up to 4 cm). Clast types include granodiorite and diorite; black, porphyritic lava with plagioclase phenocrysts; and fine to coarse tuff.

Zft-p - Felsic tuffs west of Piney Grove: Dominantly gray to green-gray; massive to weakly foliated; layered in places coarse tuff with lesser amounts of lapilli tuff. Minor interlayers of volcaniclastic sandstone and thinly bedded (possible burrowed?) siltstone are present. 1-5% accessory sulfide minerals commonly present especially near contact zone with the Blackwood Creek phases.

Zft-t - Felsic tuffs east of Temple of Truth Church: Green to gray-green; massive to weakly foliated; layered in places coarse tuff with lesser amounts of lapilli tuff. Plagioclase crystal fragments compose 1-5% of typical sample.

Zft-v - Felsic tuffs of the St. Mary's Church area: Gray-green to gray; massive to weakly foliated coarse tuff with lesser amounts of lapilli tuff. Minor interlayers of very thinly bedded coarse tuff. Crystal fragments, when present, are dominantly plagioclase. Clast types include black, porphyritic lavas with plagioclase phenocrysts similar to the Zdlt lavas and gray fine tuff clasts.

Zft-b - Felsic tuffs of the Blackwood area: Green-gray to gray coarse tuff and lapilli tuff. Plagioclase crystals and crystal fragments are common. Lithic clast types includes dark-gray to black; magnetic; 1 to 70 mm; cryptocrystalline lava, or clasts of porphyritic lava with feldspar phenocrysts. Porphyritic clasts are identical to the porphyritic phases of unit Zdlt. Outcrops and thin sections show a prominent welding and/or compaction foliation with fiamme-shaped clasts. Outcrops typically occur as very resistant fin-like outcrops.

Zft-g - Felsic tuffs of the Governor Burke's Grave area: Dominantly gray, greenish-gray, grayish-green; massive to strongly foliated; fine to coarse tuff and lapilli tuff. Plagioclase crystal fragment-rich coarse tuff and lithic lapilli tuff are common. Minor interlayers of strongly foliated muscovitic sericite phyllite; welded/compacted lapilli tuffs with glassy eye-shaped quartz and altered tuffs. Map scale interlayers of apparent epiclastic rocks (Ze/p) are present in unit.

Zft-d - Felsic tuffs of the Duke quarry area: Unit consists of massive to strongly foliated: greenish-gray to grayish-green, coarse plagioclase crystal tuff; light-green, welded, lapilli-bearing, plagioclase + quartz crystal tuff; greenish-gray to gray-ish-green, matrix supported lithic tuff; and gray microcrystalline ash tuff with pyrite. Minor lithologies include interlayers of amygdaloidal basalt, fine-grained mafic tuffs that have been altered to epidote/chlorite, and epiclastic rocks.

Zft-purple - Purple felsic tuffs: Light-purplish-gray, reddish-light-purple, and gray; slaty cleavage parallel to bedding; matrix supported; polymictic lapilli tuff and tuff breccia. Interlayered with plagioclase- and quartz-crystal coarse tuff; welded tuff, quartz-crystal tuff; and slatey argillites. Lithic clast types include: angular, sericite-rich rock flattened parallel to the foliation; black, subangular to subrounded, porphyritic lava with plagioclase phenocrysts; and green, subangular, mafic tuff and/or lava. Plagioclase occurs in trace to minor amounts as angular fragments of crystals up to 3 mm in size. Welded phases of this unit contain flattened relict pumice fragments that are now altered to chert-like quartz.

Zgft1 - Gray felsic tuff of the Cates Creek area: Gray to dark-gray; massive to foliated fine to coarse tuff. Rare plagioclase crystal fragments are present. 5-10% accessory sulfide minerals commonly present. Rock is relatively featureless.

Zgft2 - Gray felsic tuffs of the upper Little Creek area: Gray to light-greenish-gray; massive to foliated fine tuff. 1-5% accessory sulfide minerals commonly present.

Zq - Quartz bodies: White, beige, red, and tan; sugary to porcelaneous; very fine- to medium-grained quartzite-like rock. Outcrops are usually massive. Quartzite-like rock is occasionally mixed with sericite and/or pyrophyllite. The addition of sericite and/or pyrophyllite gives the otherwise massive quartzite-like rock a foliation. Pyrite is present as cubic crystals and empty cubic molds of crystals (up to 12 mm). Map areas contain boulders (up to several feet in diameter) and outcrops of white colored massive quartz.

Zdlt - Dacitic lavas and tuffs: Distinctive dark-gray to black; siliceous; cryptocrystalline lava, porphyritic lava with plagioclase phenocrysts, and flow banded dacitic lavas. Interlayered with gray to black; welded and non-welded coarse tuff and lapilli tuff. Tuffs often contain black, flattened, fiamme, up to 10 cm, interpreted as flattened pumice. Clast types include black cryptocrystalline lava and porphyritic lava with plagioclase phenocrysts. Differentiation between lavas and massive tuffs is difficult in hand sample in most cases. The lavas are interpreted to have been coherent magma that were extrusive or very shallow intrusions associated with dacitic domes. Tuff interlayers are interpreted as episodic pyroclastic flow deposits and air fall tuffs generated during eruption of domes.

Zdlt-purple - Dacitic lavas with distinctive purple color: Reddish-light-purple to lilac-colored; massive; microcrystalline to cryptocrystalline; porphyritic dacitic lava with plagioclase phenocrysts.

Zadlt - Andesitic to dacitic lavas and tuffs of Poplar Ridge area: Distinctive black; siliceous; massive; cryptocrystalline lava, porphyritic lava with plagioclase phenocrysts (up to 4 mm), and flow banded lava with local amygdules. Interlayed with the lavas are gray to black; welded and non-welded, coarse tuffs, lapilli tuff, and tuff breccia. Tuffs range from massive to strongly welded tuff with fiamme-shaped clasts up to 15 cm. Clast types include: black cryptocrystalline lava and porphyritic lava with plagioclase phenocrysts. The lavas and tuffs are very resistant to weathering and typically have a whitish-gray weathering rind. Differentiation between lava and massive tuff is difficult in hand sample in most cases. The lavas are interpreted to have been coherent magma that were extrusive or very shallow intrusions associated with dacite to andesite domes. Tuffs are interpreted as episodic pyroclastic flow deposits and air fall tuffs generated during eruption of domes.

Zml - Mafic lavas: Green, gray-green, black; amygdaloidal basalt, porphyritic basalt with plagioclase phenocrysts, and microcrystalline basalts. Interlayered with coarse plagioclase crystal tuff and coarse amphibole crystal tuff. Basalts are interpreted to be lava flows or shallow intrusives. The tuffs are fine-grained and contain plagioclase crystal fragments, commonly altered to epidote, and amphibole crystals as 1-2 mm prismatic crystal fragments.

Zml-c - Mafic lava of the Currie Hill area : Distinctive; very dark-gray to black; very fine-grained; magnetic; mafic lava(?). In thin section the rock is composed of a very fine matrix of plagioclase laths and apparent relict amygdules in-filled with epidote and quartz.

Zml/mt - Mafic lava and tuffs: Dominantly very dark-gray, greenish-gray, black; massive; andesitic to basaltic; microcrystalline lava, amygdaloidal lava, and porphyritic lava with plagioclase phenocrysts. This unit contains minor plagioclase crystal-fragment coarse tuffs and amphibole crystal-fragment coarse tuffs. Interpreted pillow structures are present in some mafic lavas.

Zml/mt - Mafic tuffs and lavas: Dominantly dark-green, greenish-gray, gray-ish-green; massive to foliated; fine and coarse tuffs of andesitic(?) to basaltic(?) composition. Unit includes crystal-free, fine tuffs; matrix supported; plagioclase- and amphibole-crystal-fragment coarse tuff, and crystal-lithic lapilli tuffs. Clasts are subangular (up to 5 mm) and dark green. Minor thin mafic lava flows with relict amygdules and interpreted pillow structures are present in unit.

FAULT ROCKS

Trq-breccia - Trq-breccia - Quartz breccia: White; massive to brecciated; vuggy quartz. Typically contains angular clasts of altered volcanic rock suspended in a quartz matrix. Some zones exhibit a lacey pattern of intersecting quartz veins with a matrix of altered wall rock.

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References are available by request