PREPARED IN COOPERATION WITH
UNITED STATES GEOLOGICAL SURVEY

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
Stephen G. Conrad, State Geologist

GEOLOGIC MAP
BALDWIN GAP QUADRANGLE
NORTH CAROLINA-TENNESSEE
GM 220-NW

Base topographic map by USGS-TVA 1959

10,000-foot grids based on North Carolina and Tennessee coordinate systems

Field work jointly supported by Tennessee Valley Authority and State of North Carolina

1,000-meter Universal Transverse Mercator grid ticks, zone 17, shown in blue

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

MAP LOCATION

Geology mapped in 1976-77. Geology of the Chilhowee Group modified after King and Ferguson (1960)

Map preparation and editing by R. J. Floyd, L. S. Wiener, and C. E. Merschat

MAP UNITS

QUATERNARY
- Qal — Alluvium
- Qc — Colluvium

TERTIARY AND QUATERNARY
- QTt — Terrace deposits
- QTc — Older colluvium

MIDDLE-LATE PALEOZOIC
- my — Mylonite
- d — Dikes of intermediate composition

WEST OF FORK RIDGE FAULT

EARLY CAMBRIAN
- Ꞓe — Erwin Formation
- Ꞓh — Hampton Formation
- Ꞓuu, Ꞓul — Unicoi Formation
  - Ꞓuu: Upper unit
  - Ꞓul: Lower unit
  - t — Metatuff
  - gs — Greenstone
  - mp — Metamudstone
  - c — Quartz-pebble metaconglomerate
  - bc — Boulder metaconglomerate

UNCONFORMITY

LATER PRECAMBRIAN
- agg, mag — Aegirine granitic gneiss
  - agg — Massive facies
  - mag — Mylonite gneiss facies
- as — Actinolite schist
- bgb, bhgb — Bakersville (?) Metagabbro
  - bgb — Metagabbroid
  - bhgb — Hypersthene metagabbroid
- p-Ꞓags, p-Ꞓcs, p-Ꞓaa — Ashe Formation
  - p-Ꞓaa — Amphibolite
  - p-Ꞓags — Mica gneiss and schist
  - m — Marble
  - cs — Calc-silicate rock
- Amphibole gneiss (shown only on Fig. 1)

UNCONFORMITY

EARLIER PRECAMBRIAN
- hg — Hornblende gneiss
- gg, gmg — Granitic gneiss
  - gg — Massive facies
  - gmg — Mylonite gneiss facies
- p-Ꞓwrg, p-Ꞓwrm — Grandfather Mountain Granodiorite gneiss
  - p-Ꞓwrg — Massive facies
  - p-Ꞓwrm — Mylonite gneiss facies
- p-Ꞓcc, p-Ꞓcm, p-Ꞓcg, p-Ꞓcs — Cranberry Gneiss
  - p-Ꞓcc — Biotite gneiss and schist
  - p-Ꞓcm — Mylonite gneiss
  - p-Ꞓcg — Quartzo-feldspathic gneiss
  - p-Ꞓcs — Biotite schist

EAST OF FORK RIDGE FAULT
- qv — Quartz veins
- Ø — Pegmatite

DESCRIPTION OF MAP UNITS

Qal — **ALLUVIUM**—Unconsolidated stream deposits of stratified, light-tan to brown sand, silt, and clay containing layers and lenses of well-rounded to subangular, moderately well sorted boulders, cobbles, and pebbles.

Qc — **COLLUVIUM**—Unconsolidated deposits of unstratified, poorly sorted, angular to subangular boulders, cobbles, and pebbles in a silty clay matrix. Present at the base of some debris-avalanche chutes; generally modified by fluvial processes and coalesced with alluvium.

QTt — **TERRACE DEPOSITS**—Unconsolidated deposits of stratified, dark-brown to dark-reddish-brown sand, silt, and clay containing beds and lenses of coarse debris. Commonly underlie flat, benchlike surfaces adjacent to, but topographically higher than, Quaternary alluvium.

QTc — **OLDER COLLUVIUM**—Unconsolidated deposits of unstratified, poorly sorted, dark-brown to dark-reddish-brown colluvium and alluvium. Deposits appear to be older mass-wasting deposits considerably modified and dissected by fluvial processes.

my — **MYLONITE**—Medium-gray to dark-gray or greenish-gray. Composed mostly of sericite and microcrystalline quartz.

d — **DIKES OF INTERMEDIATE COMPOSITION**—Medium-gray to dark-gray or dark-greenish-gray, fine-grained, well-foliated, metamorphosed dikes; most are between 3 and 10 meters thick. Uniform symbol used where location, attitude, and thickness of dikes are difficult to represent accurately at map scale.

WEST OF FORK RIDGE FAULT

Ꞓe — **ERWIN FORMATION**—Metasandstone and quartzite, light-gray to tan. Composed of fine- to medium-grained, rounded to subrounded quartz grains with siliceous cement; minor sericite is present and forms a weak foliation. Contains beds of light-gray- to light-greenish-gray, coarse-grained, conglomeratic metasandstone, and sandy, quartz-pebble metaconglomerate. Approximate thickness 300 meters (King and Ferguson, 1960, pl. 9).

Ꞓh — **HAMPTON FORMATION**—Metamudstone, dark-gray to dark-greenish-gray, thinly bedded, phyllitic. Interlayered with thin lenses and beds of dark-greenish-gray, well-foliated metasiltstone. Estimated thickness 180 meters.

UNICOI FORMATION—Consists of an upper unit of conglomeratic metasandstone, quartzite, and metamudstone; and a more heterogeneous lower unit of interlayered quartz-pebble metaconglomerate, conglomeratic arkosic metasandstone, metasiltstone, metatuff, greenstone, metamudstone, and boulder metaconglomerate.

Ꞓuu — Upper unit—Light- to medium-gray to greenish-gray, medium- to coarse-grained, conglomeratic metasandstone with a siliceous cement; poorly developed sericite foliation. Interbedded with light- to medium-gray, medium- to coarse-grained quartzite, and greenish-gray, fine-grained phyllitic metamudstone. Estimated exposed thickness 300 meters.

Ꞓul — Lower unit—Light- to medium-gray metaconglomerate consisting of quartz pebbles in a coarse-grained sandy matrix with a siliceous cement; interbedded with light-gray to tan conglomeratic arkosic metasandstone and metasiltstone. Estimated exposed thickness 150 meters. Includes diagnostic layers described below.

- *t*, Metatuff—Purple to light-gray, phyllitic. Includes relict fragments or shards which contain muscovite masses that may represent metamorphosed amygdules.
- *gs*, Greenstone—Dark-green metabasalt; well-developed chlorite foliation.
- *mp*, Metamudstone—Dark-gray, phyllitic.
- *c*, Quartz-pebble metaconglomerate—Light-gray, very coarse grained.
- *bc*, Boulder metaconglomerate—Contains rounded boulders as much as a meter or more across in an unsorted matrix of angular to rounded cobbles, pebbles, and fine detritus. Boulders are derived from massive granodiorite gneiss (p-Ꞓwrg); parental material of other clastic fragments also includes layered gneiss, metarhyolite, phyllitic metamudstone, and quartzite.

GRANODIORITE GNEISS—Consists of a massive facies and a mylonite gneiss facies. The mylonitic rocks were derived from the massive gneiss protolith by deformation and recrystallization.

p-Ꞓwrg — Massive facies—Greenish-gray to pinkish-green, massive to protomylonitic, coarse-grained gneiss. Contains about 70 percent microcline, perthite, and plagioclase (An 38), and about 20 percent quartz as large grains with a relict hypidiomorphic-granular texture. The remainder is composed of fine-grained alteration minerals, primarily chlorite, epidote, calcite, magnetite, sericite, and quartz. Numerous small quartz veins and aplite dikes are present.

p-Ꞓwrm — Mylonite gneiss facies—Medium-green to dark-green mylonite schist interlayered with light-pinkish-green to greenish-gray quartzo-feldspathic mylonite gneiss. Contains porphyroclasts of pink and white feldspar and quartz in a fine-grained matrix of sericite, microcrystalline quartz, epidote, chlorite, calcite, and magnetite. Matrix exhibits well-developed mylonitic foliation which is typically crinkled.

EAST OF FORK RIDGE FAULT

qv — **QUARTZ VEINS**—White to light-gray veins of massive milky quartz. Minor sericite is present and imparts a poorly to well-developed foliation. Most veins are too thin (3 to 15 meters) to depict accurately at map scale.

Ø — **PEGMATITE**—Light-gray to creamy-white, coarse- to very-coarse-grained granitic pegmatite consisting of feldspar (60 percent), quartz (25 percent), and muscovite (15 percent) with minor euhedral crystals of garnet and rarely beryl. Too small to show accurately at map scale; location and trend of mapped bodies indicated by Ø.

AEGIRINE GRANITIC GNEISS—Consists of a massive facies and a mylonite gneiss facies. The plutonic protolith intruded earlier Precambrian units; the mylonite gneiss facies was developed by subsequent deformation and recrystallization.

agg — Massive facies—Light-gray, coarse-grained, massive gneiss to protomylonite gneiss. Has a relict hypidiomorphic-granular texture. Composed of coarse-grained perthitic feldspar porphyroclasts (50 percent), some rimmed by graphic intergrowths of quartz and feldspar; aggregates of aegirine (5 percent); and a fine-grained alteration mineral assemblage (45 percent) of microcrystalline quartz, plagioclase (An 34), aegirine, biotite, clinozoisite, and sphene rimming ilmenite.

mag — Mylonite gneiss facies—Light-gray to medium-gray, fine- to medium-grained, well-foliated mylonite gneiss and poorly foliated protomylonite. Contains medium-grained perthitic feldspar porphyroclasts in a foliated alteration mineral assemblage of microcrystalline quartz, biotite, and clinozoisite.

as — **ACTINOLITE SCHIST**—Medium-gray to dark-greenish-gray, medium-grained schist composed mostly of actinolite-tremolite.

BAKERSVILLE (?) METAGABBRO—Metagabbroid and hypersthene metagabbroid dikes mapped at eight localities are thought to be equivalent to the Bakersville Metagabbro.

bgb — Metagabbroid—Dark-gray to black, fine- to medium-grained, massive to crudely foliated. Original minerals highly altered; composed of 10 to 20 percent relict plagioclase and pyroxene in an alteration mineral assemblage of actinolite, garnet, talc, magnetite or ilmenite, and quartz. Weathers spheroidally.

bhgb — Hypersthene metagabbroid—Dark-gray to black, coarse-grained, massive. Composed of about 50 percent subhedral hypersthene; 10 percent plagioclase (as laths, about An 68); 5 percent olivine; and 35 percent alteration products, mainly garnet, actinolite, talc, and magnetite or ilmenite. Texture is automorphic-granular. Derived from olivine norite. Weathers spheroidally.

ASHE FORMATION—Consists primarily of amphibolite and amphibole gneiss. Mica gneiss and schist occurs as interlayers and mappable units throughout the formation. An occurrence of marble and of calc-silicate rock are at the base of the formation. More than 1500 meters of the Ashe Formation is exposed in this quadrangle.

p-Ꞓaa — Amphibolite—Dark-gray to black, fine- to medium-grained amphibolite and amphibole gneiss which grade into coarser grained amphibolite and garnet-biotite amphibole gneiss. Amphibolite consists of three-fourths or more black hornblende and one-fourth or less plagioclase. Small euhedral garnets are locally present. Amphibole gneiss consists of about equal amounts of hornblende (40 percent) and plagioclase (40 percent); the remainder is composed of various amounts of garnet, biotite, quartz, and magnetite or ilmenite.

p-Ꞓags — Mica gneiss and schist—Interlayered light-gray, medium-grained biotite gneiss and light-gray, coarse-grained muscovite-biotite-garnet schist. Gneiss contains biotite, plagioclase, potassic feldspar, quartz, and garnet. Schist contains fine-grained biotite, coarse-grained muscovite, coarse garnet, plagioclase, potassic feldspar, quartz, and kyanite.

m — Marble—White to pink, medium-grained; composed mostly of dolomite (90 percent) and accessory minerals including diopside, amphibole, mica (pale-green, pale-brown, and clear varieties), garnet, hornblende, sphene, and possibly epidote, scapolite, and magnetite. Marble was observed at only one place (North Carolina Coordinates 973,000N., 1,213,200E.).

cs — Calc-silicate rock—Light-gray to white, coarse-grained, massive to poorly foliated. Composed of about 85 percent highly fractured milky quartz and feldspar as coarse grains as much as 2 cm across, and about 15 percent black amphibole, biotite, allanite, and quartz as fine grains. Calc-silicate rock was observed at only one locality (North Carolina Coordinates 978,400N., 1,221,900E.).

AMPHIBOLE GNEISS—Medium-green to dark-green, medium- to coarse-grained dikes of amphibole gneiss and schist. Contains relict plagioclase and dark-green hornblende in a fine-grained alteration assemblage of green amphibole, chlorite, epidote, microcrystalline quartz, and magnetite or ilmenite. Thicknesses of dikes range from about 1 meter to 30 meters. Individual bodies are too small and discontinuous to show at map scale (see Figure 1).

hg — **HORNBLENDE GNEISS**—Light-greenish-gray, coarse-grained, massive gneiss to protomylonite. Composed of relict perthitic feldspar, hornblende, and quartz in a fine-grained alteration mineral assemblage of biotite, clinozoisite, quartz, and sericite. Relict texture is hypidiomorphic-granular.

GRANITIC GNEISS—Consists of a massive facies and a mylonite gneiss facies. The plutonic protolith intruded the Cranberry Gneiss and includes xenoliths of the Cranberry. The mylonitic rocks were developed by subsequent deformation and recrystallization of the massive gneiss.

gg — Massive facies—Light-gray, coarse-grained, massive gneiss to protomylonite. Consists of relict perthitic feldspar, plagioclase, and quartz in a fine-grained metamorphic mineral assemblage of actinolite, chlorite, muscovite, biotite, clinozoisite, quartz, and sericite. Relict texture is hypidiomorphic-granular. Numerous small quartz veins and leucocratic dikes are present.

gmg — Mylonite gneiss facies—Light-gray to medium-gray, medium- to coarse-grained mylonite gneiss and schist. Contains relict perthitic feldspar, plagioclase, and quartz porphyroclasts in a well-foliated metamorphic mineral assemblage of actinolite, chlorite, muscovite, biotite, clinozoisite, and quartz.

CRANBERRY GNEISS—Dominated by well-layered biotite gneiss and schist, generally of granitic composition. Other rock types mapped are poorly layered quartzo-feldspathic gneiss, mylonite gneiss, and biotite schist. Most workers previously have grouped all the earlier Precambrian rocks under the term Cranberry Gneiss (or Granite); the name here is limited to rocks in lateral and lithologic continuity with the Cranberry in the type area.

p-Ꞓcc — Biotite gneiss and schist—Well-layered, medium- to dark-gray; contains alternating segregation bands of biotite-rich quartzo-feldspathic gneiss and biotite schist. Gneiss layers are mostly coarse grained and are composed of perthitic feldspar, potassic feldspar, biotite, quartz, and sphene; in part altered to an assemblage of chlorite, biotite, clinozoisite, quartz, and tremolite. Schist layers are mostly medium grained and contain biotite, clinozoisite, and quartz.

p-Ꞓcm — Mylonite gneiss—Dominated by biotite-muscovite mylonite gneiss, which is interlayered with biotite schist and biotite mylonite gneiss. The biotite-muscovite mylonite gneiss is light to medium gray, medium to coarse grained, and is composed of porphyroclasts of relict perthite, plagioclase, potassic feldspar, and quartz in an alteration assemblage of chlorite, biotite, muscovite, clinozoisite, and quartz. The biotite schist is dark greenish gray and fine grained; at places it contains feldspar porphyroclasts. The biotite mylonite gneiss is medium to dark gray and coarse grained; contains feldspar porphyroclasts.

p-Ꞓcg — Quartzo-feldspathic gneiss—Poorly layered, light-gray, coarse-grained; contains only minor biotite.

p-Ꞓcs — Biotite schist—Black, medium-grained, well-foliated schist. Consists mostly of biotite, clinozoisite, and quartz.

SUMMARY OF MAJOR METAMORPHIC, PLUTONIC, AND DEFORMATIONAL EVENTS

The earlier Precambrian Cranberry Gneiss, the oldest rock unit in this region (Rb/Sr age = 1227 m.y.; Fullagar and Odom, 1973, p. 3070; Fullagar and others, 1979), was intruded by the protolith of the granitic gneiss unit (Rb/Sr age = 1063 m.y.; Fullagar and Odom, 1973, p. 3070-3072). Apparently, the entire terrane was also metamorphosed at about this time. This complex of events is coeval with the Grenville orogenic event in Canada. Subsequent Paleozoic metamorphic activity has largely obliterated the original metamorphic mineral composition, but biotite appears to have been the principal mafic constituent of the Cranberry Gneiss; hence, its metamorphic grade probably did not exceed upper amphibolite facies.

In later Precambrian time the existing gneisses were intruded by plutons of the aegirine granitic gneiss. Abundant dikes of amphibole gneiss (see Figure 1) are also present in the older rocks and may represent metamorphosed feeders for the mafic metavolcanic rocks of the unconformably overlying Ashe Formation.

An earlier mid-Paleozoic deformational event produced major folds throughout the region and metamorphism at this same time was also of widespread, regional significance. Rocks which are now east of the Fork Ridge fault attained amphibolite facies intensity; by contrast, rocks west of the fault were brought only to greenschist facies.

During a later mid-Paleozoic deformational event the amphibolite-facies terrane on the east was thrust over the greenschist-facies terrane on the west along the major Fork Ridge fault. Folding, mylonitization and concomitant recrystallization at greenschist facies conditions apparently also occurred at this time.

In later Paleozoic time additional thrust faulting and development of minor folds occurred.

FIGURE 1—Index map showing area containing abundant dikes of amphibole gneiss (shaded pattern).

STRUCTURAL FEATURES

[Where structural symbols are combined, their intersection marks the point of observation]

CONTACTS AND FAULTS

- Contact—dashed where approximately located; short-dashed where inferred
- Thrust fault—dashed where approximately located; short-dashed where inferred; queried where existence is uncertain. Sawteeth on upper plate of earlier Paleozoic fault; ←on upper plate of later Paleozoic fault

PLANAR FEATURES

- 27 — Strike and dip of later mid-Paleozoic mylonitic foliation—inclined; vertical; horizontal
- 34 — Strike and dip of earlier mid-Paleozoic foliation—inclined; vertical
- 44 — Strike and dip of compositional layering developed during middle Paleozoic—inclined; vertical
- 41, 68, 59, 82, 42 — Strike and dip of bedding—inclined, vertical, overturned; top known from sedimentary features; inclined, parallel to foliation, overturned parallel to foliation
- 50 — Strike and dip of segregation layering developed in earlier Precambrian units—inclined; vertical

FOLDS

- 5 — Bearing and plunge of axis of late Paleozoic minor fold
- 2 — Orientation of later folds of mid-Paleozoic age—axial trace of major isoclinal synform. Bearing and plunge of axis of minor fold
- 25
- 1 — Orientation of earlier folds of mid-Paleozoic age—axial trace of major isoclinal synform, antiform; axial trace of major synform, antiform.
- 1
- 40 — Bearing and plunge of axis of minor fold
- 30 — Bearing and plunge of axis of minor fold developed in earlier Precambrian units

MINERAL RESOURCES

- Large inactive pit
- Small inactive pit
- Inactive quarry
- x — Prospect or occurrence
- 4 — Map numbers refer to descriptions in Mineral Resources Summary
- fe — Feldspar
- Fe — Iron
- m — Marble
- mi — Mica
- py — Pyrite
- sg — Sand and gravel

TABLE 1—Quarries, pits, prospects, and occurrences (names unknown).[1]

Map Number	Classification	Mineral Commodity
1	Quarry	Marble
2	Pit	Mica and feldspar
3	Pit	Mica and feldspar
4	Prospect	Mica (?)
5	Prospect	Iron
6	Occurrence	Iron
7	Occurrence	Iron
8	Prospect	Pyrite
9	Occurrence	Pyrite
10	Occurrence	Pyrite
11	Occurrence	Pyrite
12	Occurrence	Pyrite (?)
13	Pit	Sand and gravel
14	Pit	Sand and gravel

[1]All inactive or abandoned.

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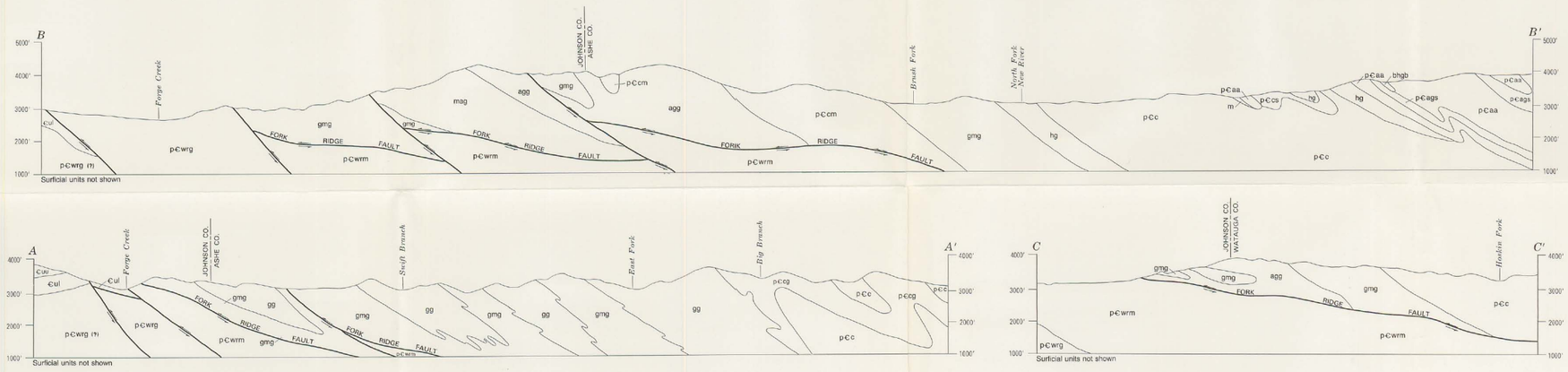

GEOLOGIC MAP OF THE BALDWIN GAP QUADRANGLE, NORTH CAROLINA-TENNESSEE

By

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1983