NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES
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This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE MAP 2011-01

MAP UNITS

CARBONIFEROUS

- pegmatite

Brevard Zone

- bzsp — Sericite Phyllite
- bzggp — Mylonitic Granitic Gneiss/Phyllonite

SILURIAN

Table Rock Plutonic Suite

- SOtrg — Muscovite-Biotite Granitoid Gneiss
- SOgm — Mixed Unit

ORDOVICIAN

Henderson Granitic Gneiss

- Ohg — Henderson Gneiss
- Ohgmy — Mylonitic Henderson Gneiss
- Ohbg — Biotite Granodioritic gneiss

Poor Mountain Formation

- Opm — Amphibolite and metagraywacke

CAMBRIAN

Chauga River Formation

- OЄcr — Muscovite-quartz schist

NEOPROTEROZOIC

Ashe Metamorphic Suite/Tallulah Falls Formation

- Zagsi — Schistose metagraywacke

ROCK DESCRIPTIONS

pegmatite – White to very light gray, mottled; non-foliated; very coarse-grained; equigranular; granoblastic. Bodies are lenticular to tabular. Thickness of bodies ranges from decimeters to meters. Pegmatite consists primarily of plagioclase, potassium feldspar, quartz, muscovite, and minor, biotite and garnet. Pegmatites typically crosscut layering and foliation of other rock units but are sometimes foliated and concordant with country rock. Some pegmatites may have originated from the intrusion of Table Rock plutonic suite granites into Henderson granitic gneiss.

Brevard Mylonite Zone

Sericite phyllite (bzsp) – Dark gray to light olive gray, to greenish gray; fine- to coarse-grained; lepidoblastic to porphyroblastic; strongly foliated; mylonitic. Composed of sericite, quartz, feldspar, and accessory graphite, chlorite, and opaque minerals. Lenticular muscovite-aggregate porphyroblasts flattened in the mylonitic foliation planes impart a distinctive "fish scale" or "button" appearance. Locally interlayered with mylonitic metagraywacke and schistose metagraywacke, sericite-chlorite phyllonite and sulfidic graphitic schist.

Mylonitic Granitic Gneiss/Phyllonite (bzggp) – Medium light gray to yellowish gray; fine- to medium-grained; inequigranular; locally porphyroclastic; strongly foliated; mylonitic, locally protomylonitic. Consists of plagioclase, quartz, potassiam feldspar, sericite, muscovite, biotite, epidote and trace accessory minerals. Rounded to elongated feldspar porphyroclasts are common. Interpreted to be fault slices of mylonitic Henderson Gneiss interlayered with sericite phyllite by Brevard Zone deformation.

Table Rock Plutonic Suite

Table Rock Granitic Gneiss (SOtrg) – White to medium-gray to very light gray; medium- to coarse-grained; equigranular; granoblastic; weakly foliated to foliated, locally mylonitic; consists of approximately 35% quartz, 30% plagioclase, 28% potassium feldspar, 4% biotite, 3% muscovite and minor amounts of opaques, epidote and chlorite. Tentatively correlated with the 438 Ma intrusives into the Henderson Gneiss of Lemmon (1973).

Mixed unit (SOgm) – An interlayered unit consisting of nearly equal amounts of protomylonitic Henderson Gneiss and Table Rock plutonic suite granitic gneiss with minor biotite gneiss and mylonite. It is characterized by its outcrop-scale heterogeneity in contrast with both the Henderson and Table Rock gneisses. It is interpreted to be a mixed intrusive suite with Table Rock gneiss intruding the Henderson gneiss (with both undergoing subsequent Paleozoic deformation/metamorphism).

Henderson Granitic Gneiss

Henderson Gneiss (Ohg) – Medium-gray to medium-bluish-gray to mottled black and white; inequigranular; medium- to coarse-grained matrix with large megacrysts (augen) of microcline variable in size and abundance; protomylonitic to mylonitic to granoblastic to lepidoblastic; massive to well foliated; dominantly biotite granite that ranges to tonalite; consists of approximately 1 to 35% potassium feldspar, 28 to 35% plagioclase, 10 to 33% quartz, 1 to 20% biotite, 1 to 20% muscovite, 0 to 10% epidote group minerals, 0 to 5% opaques and trace amounts of titanite, zircon and apatite; locally pegmatitic and migmatitic. Locally microcline augen exceed one inch in length. The augen structures are produced by a high temperature protomylonitic overprint. Makes up the largest granite pluton in western North Carolina and is approximately 447 million years old (Moecher et al., 2011).

Mylonitic Henderson Gneiss (Ohgmy) – Light-gray to medium-gray, fine- to medium-grained, inequigranular, mylonitic, consists of microcline, quartz, plagioclase, muscovite, biotite with minor epidote group minerals, and sericite. The sericite is a product of mylonitization associated with faulting and is derived from feldspars.

Biotite granodioritic gneiss (Ohbg) – Medium gray to dark gray; fine to medium-grained; equigranular; granoblastic to lepidoblastic; foliated; consists of plagioclase, quartz, potassium feldspar, biotite and minor accessory minerals; Interpreted to be a compositional variation of and interfoliated with the Henderson Gneiss. Locally mylonitic.

Poor Mountain Formation

Amphibolite and metagraywacke (Opm) – Interlayered unit consisting of amphibolite, metagraywacke, biotite gneiss, biotite schist and quartz-sericite schist; migmatitic; compositional layers are grenerally meter-scale, fine- to medium-grained, well foliated to mylonitic; Amphibolite consists of approximately 40% hornblende, 40% plagioclase feldspar, 15% epidote, 5% biotite and trace amounts of opaque minerals. Quartz-sericite schist consists of approximately 55% quartz, 40% sericite and 5% opaques, mostly pyrite. Metagraywacke consists of quartz, plagioclase, biotite, muscovite and minor trace minerals.

Chauga River Formation

Metasiltstone (OЄcr) – Olive-gray to dark-gray to black; fine- to medium-grained; granular to inequigranular; foliated to mylonitic; consists of plagioclase, biotite, quartz, muscovite, potassium feldspar and minor garnet. A diagnostic feature of this unit are small muscovite porphyroblasts within a fine-grained, dark matrix. Locally interlayered with muscovite-biotite schist and metagraywacke.

Ashe Metamorphic Suite/ Tallulah Falls Formation

Schistose metagraywacke (Zagsi) – Medium-gray to dark-gray; foliated to non-foliated; fine- to medium-grained; equigranular to inequigranular; lepidoblastic to weakly granoblastic to porphyroblastic; locally migmatitic; consists of quartz, plagioclase, muscovite, biotite, epidote, chlorite and trace opaque minerals; thickness of layering ranges from several millimeters to several centimeters to several meters; commonly interlayered with metagraywacke and minor garnet-mica schist.

[1]Mineral percentages are based upon visual estimates of selected samples.

References Cited

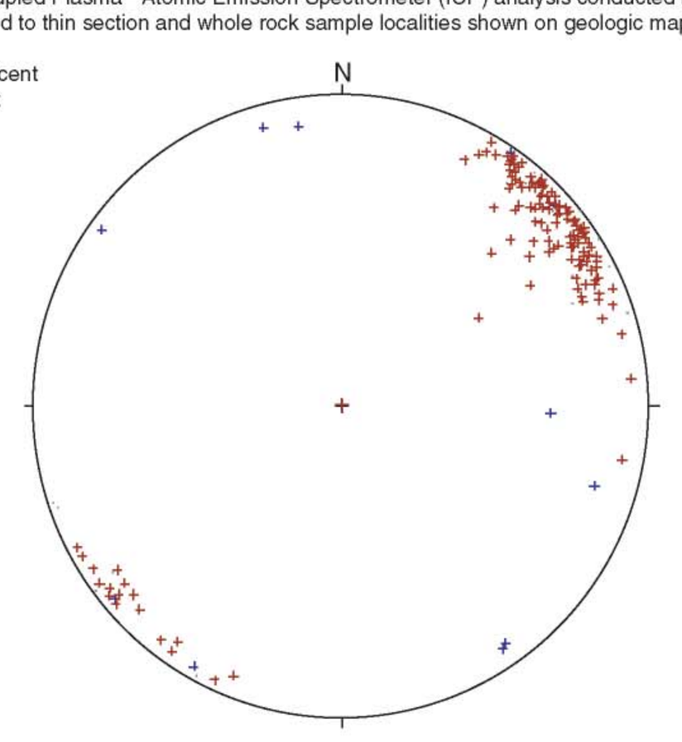
Moecher, D., Hietpas, J., Samson, S., and Chakraborty, S., 2011, Insights into southern Appalachian tectonics from ages of detrital monazite and zircon in modern alluvium: Geosphere; v. 7; no. 2; p. 1-19.

Lemmon, R.E., 1973, Geology of the Bat Cave and Fruitland quadrangles and the origin of the Henderson Gneiss, western North Carolina [Ph.D. dissertation]: Chapel Hill, Unversity of North Carolina, 145 p.

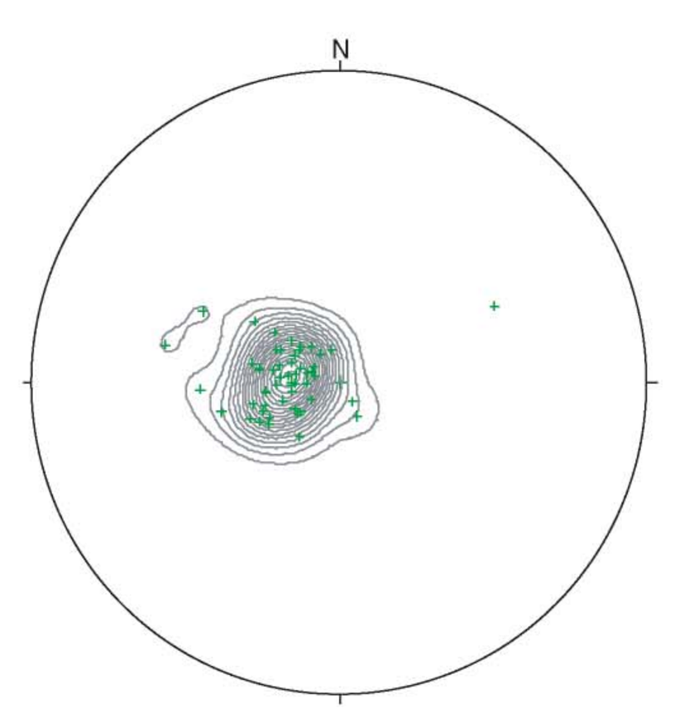
WHOLE ROCK ICP ANALYSIS[1] OF SELECTED SAMPLES

SAMPLE[2]	COORDINATES (State Plane NAD 83 m)	ROCK TYPE	MAP UNIT	OXIDES IN PERCENT: SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	ELEMENTS IN PPM[3]: Cu	Ba	Zn	Ni	Co	Sr	Zr	Ce	Y	Nb	Sc	LOI[4]	SUM[5]
TS 83	162,731N; 278,068E	augen gneiss	Ohg	69.62	13.84	4.13	0.91	1.8	3.35	4.72	0.66	0.18	0.08	0.008	<5	654	115	<20	<20	139	389	116	31	18	7	0.5	100
TS 89	162,807N; 278,992E	augen gneiss	Ohg	70.2	14.04	3.21	0.58	0.68	1.91	5.99	0.46	0.23	0.06	<0.002	13	503	125	<20	<20	85	284	66	24	24	7	2.5	99.99
TS 201	161,756N; 271,895E	mylonitic granitic gneiss	SOgm	77.22	12.18	0.7	0.05	0.19	1.1	7.08	0.07	0.01	<0.01	0.007	23	61	15	<20	<20	25	64	<30	30	39	1	1.3	100.01
TS 264	159,053N; 271,095E	mylonitic augen gneiss	bzggp	69.83	15.17	2.5	0.62	0.99	2.21	4.69	0.35	0.13	0.06	<0.002	<5	777	52	<20	<20	149	185	55	12	17	6	3.3	100
TS 271	168,185N; 278,763E	augen gneiss	Ohg	71.15	14.33	2.4	0.51	1.55	3.33	4.88	0.4	0.12	0.05	0.008	<5	551	45	<20	32	132	262	96	64	16	7	1.1	100.01
TS 333	171,917N; 276,527E	granitic gneiss	SOtrg	75.53	12.5	1.23	0.15	0.42	3.08	5.61	0.18	0.03	0.04	<0.002	16	113	61	<20	35	34	133	<30	15	45	3	1.2	100.03
TS 344	172,420N; 275,454E	amphibolite	Opm	47.4	16.22	11.02	7.85	10.24	3.18	0.36	1.31	0.11	0.25	0.034	23	76	89	94	57	203	89	<30	27	<5	37	1.8	99.83
TS 347	167,761N; 276,148E	quartz sericite schist	Opm	74.42	14.02	2.7	0.79	0.03	0.24	4.66	0.2	0.01	0.03	<0.002	7	764	48	<20	36	11	111	37	15	7	7	2.8	100.01
TS 365	168,577N; 273,000E	granitic mylonite	SOgm	74.78	14.37	2.52	0.5	0.05	0.11	4.89	0.35	0.03	0.02	0.006	<5	189	42	<20	36	6	229	62	9	22	7	2.3	100.01
TS404	159,962N; 273,959E	mylonitic augen gneiss	Ohg	69.39	15.18	3.68	0.84	0.44	3.52	4.06	0.67	0.2	0.07	<0.002	6	1095	90	<20	37	176	413	85	42	20	8	1.7	99.98
TS 408	160,203N; 274,701E	mylonitic augen gneiss	Ohg	76.44	12.65	1.07	0.15	0.75	2.87	5.35	0.14	0.05	0.02	0.005	<5	111	23	<20	33	29	122	130	13	<5	2	0.5	100.03
TS 425	160,986N; 277,419E	granitic gneiss	SOgm	60.27	17.13	5.74	2.74	3.47	2.9	2.83	0.86	0.26	0.08	0.006	9	766	79	<20	42	421	287	107	22	17	13	3.5	99.95
TS 483	163,457N; 269,460E	granitic gneiss	SOtrg	76.73	12.41	1.11	0.12	0.51	3.68	4.79	0.14	0.02	0.03	0.007	14	38	12	<20	35	21	127	37	22	47	3	0.4	99.97
TS 499	164,332N; 269,378E	tonalitic gneiss	Opm	74.35	13.92	2.14	0.47	2.44	4.47	0.84	0.18	0.05	0.09	<0.002	12	359	37	<20	35	113	95	<30	10	6	6	1	100.03
TS 526	164,903N; 272,548E	granitic gneiss	SOtrg	76.06	12.76	1.1	0.11	0.52	2.62	5.49	0.13	0.03	0.02	0.009	<5	100	30	<20	32	33	111	42	34	16	4	1.1	100.04
TS 555	172,689N; 271,945E	biotite granitic mylonite	OЄcr	62.9	16.27	7.45	1.96	1.87	2.62	3.61	1.08	0.25	0.1	0.008	37	879	113	23	42	174	361	36	20	18	16	1.7	99.98
TS 631	169,691N; 270,996E	quartz sericite mylonite	Ohgmy	74.81	14.1	2.3	0.41	0.04	0.12	4.86	0.33	0.03	0.03	0.006	<5	184	26	<20	36	10	203	95	45	18	7	2.9	100.02
TS 708	160,917N; 277,604E	quartz vein	Ohg	97.84	0.58	0.71	0.02	0.03	0.02	0.11	0.06	0.03	<0.01	<0.002	<5	23	14	<20	39	8	173	<30	8	<5	<1	0.6	100.05
TS 716	160,024N; 277,861E	granitic gneiss	Ohg	71.86	15.8	0.89	<0.01	0.1	0.19	6.38	0.05	0.03	<0.01	0.009	6	120	17	<20	37	5	222	<30	59	67	3	4.6	100.02
TS 735	159,962N; 278,129E	granitic gneiss	SOgm	76.01	12.9	1.37	0.2	0.67	3.34	4.51	0.15	0.1	0.03	<0.002	<5	273	21	<20	34	72	88	42	22	21	4	0.7	100.03
TS 793	166,490N; 275,095E	amphibole gneiss	Ohg	46.64	18.95	9.36	7.88	9.41	2.75	0.76	1.28	0.19	0.14	0.007	35	118	70	99	66	354	102	<30	18	5	23	2.4	99.85
TS 819	171,910N; 273,036E	mylonitic granitic gneiss	SOgm	67.67	15.33	2.35	1.06	3.56	4	3.84	0.41	0.09	0.07	0.009	<5	669	42	<20	34	122	204	103	35	23	4	1.5	100
TS 826	170,582N; 272,298E	brecciated granitic gneiss	SOtrg	74.86	13.55	1.07	0.1	0.61	3.74	5.42	0.1	0.02	0.03	<0.002	<5	128	14	<20	35	34	83	44	16	39	3	0.5	100.03
TS 836	165,575N; 275,762E	granitic gneiss	SOtrg	77.02	12.24	1.18	0.15	0.51	3.46	4.41	0.17	0.04	0.04	0.01	30	121	44	<20	35	35	113	36	10	29	3	0.7	100.02

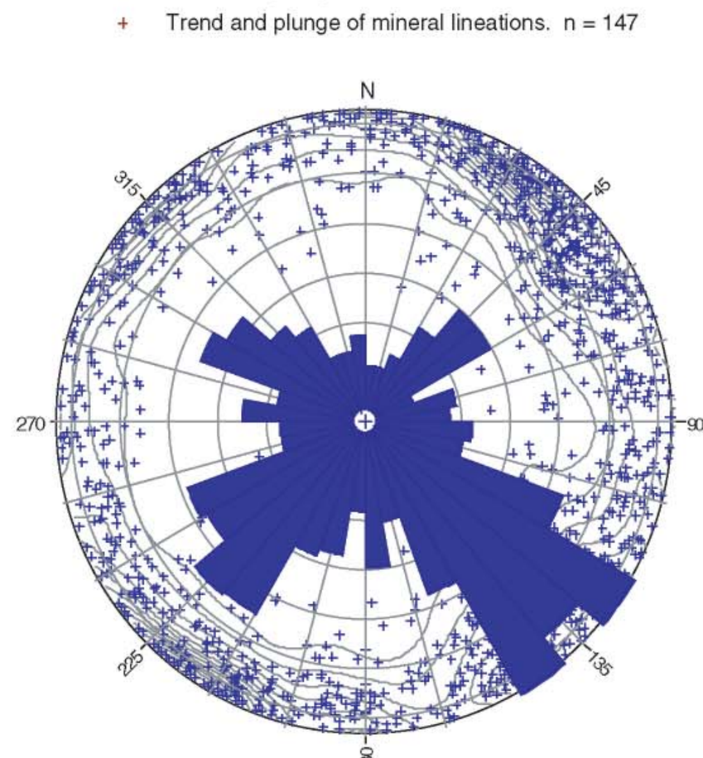
[1]Whole Rock Inductively Coupled Plasma - Atomic Emission Spectrometer (ICP) analysis conducted by Acme Analytical Laboratories, LTD., 852 E. Hastings St., Vancouver, BC
[2]Sample numbers correspond to thin section and whole rock sample localities shown on geologic map
[3]PPM = parts per million
[4]LOI = loss on ignition in percent
[5]SUM = Sum total in percent



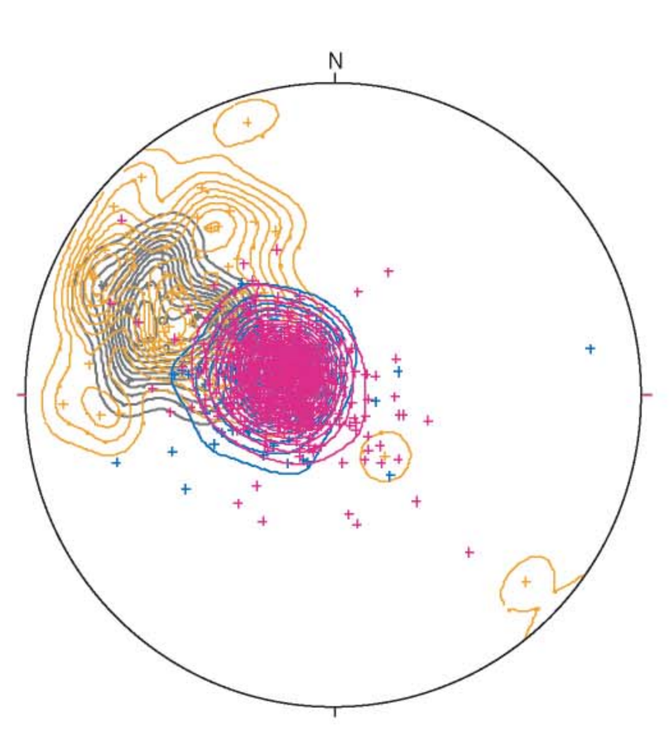
+ Trend and plunge of minor fold axes. n = 12
+ Trend and plunge of mineral lineations. n = 147



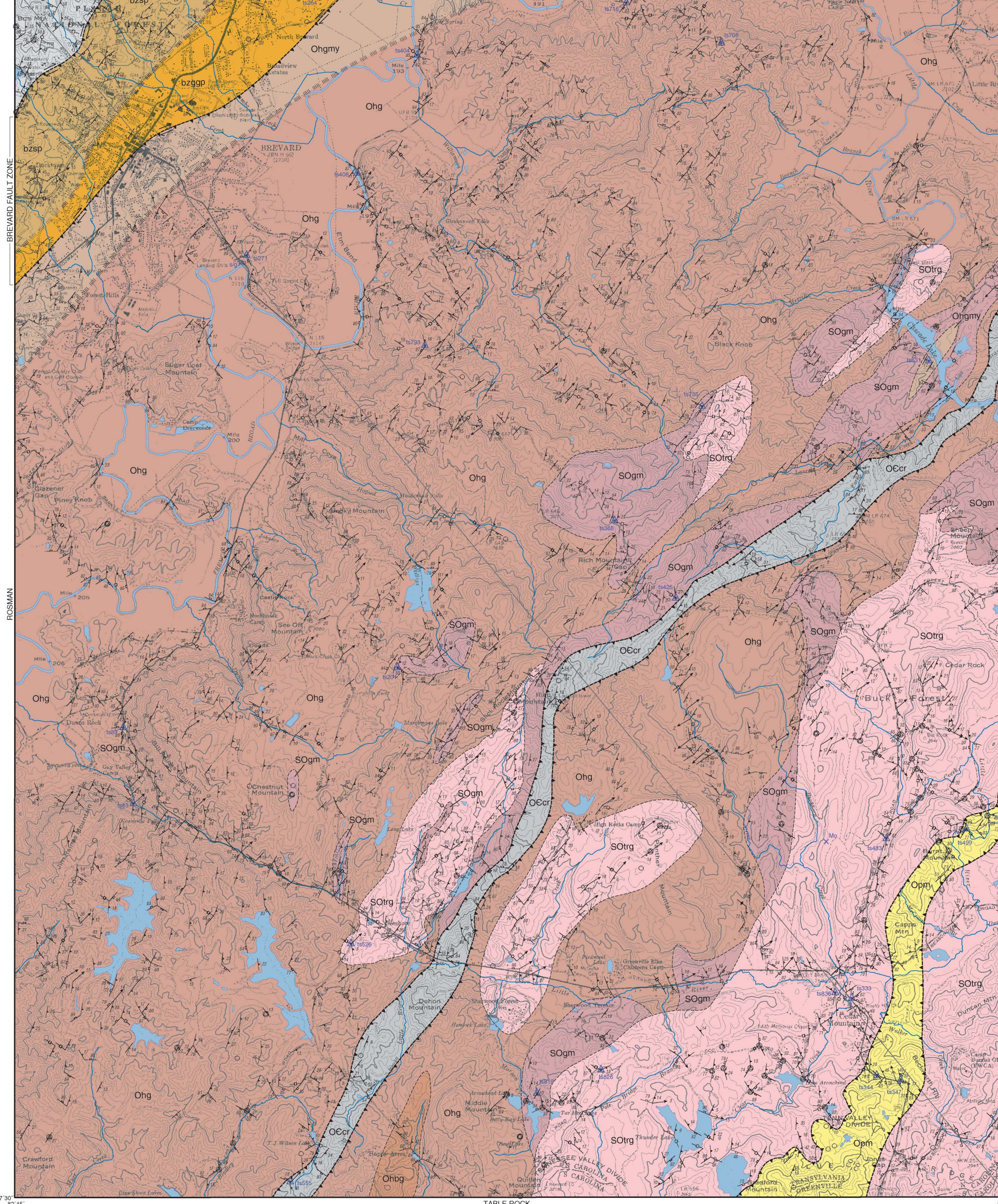
+ Poles to non-mylonitic foliations. n = 53



+ Contoured poles to joints with unidirectional Rose diagram inset. n = 1322



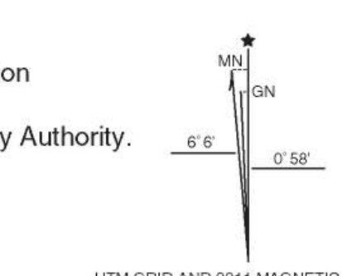
Poles to mylonitic foliations. n = 1117
- Ashe Metamorphic Suite/Tallulah Falls Formation n = 17
- Brevard Zone Lithologies n = 52
- Henderson Granitic Gneiss n = 701
- Table Rock Plutonic Suite/Poor Mountain Formation n = 177



Contours derived from 20-foot pixel resolution LiDAR digital elevation data provided by the North Carolina Floodplain Mapping Program.
Other planimetric data mapped and edited by the Tennessee Valley Authority.
Published by the Geological Survey.

Control by NOS/NOAA, USGS, and TVA

Revised by TVA in 1966 by photogrammetric methods using aerial photographs taken 1966 and by reference to TVA-USGS quadrangle dated 1940. Map field checked by TVA, 1967

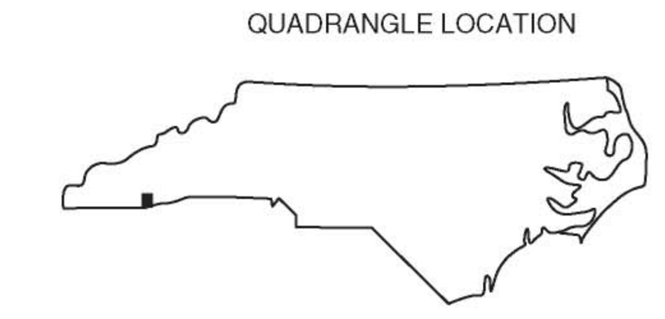


UTM GRID AND 2011 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1983

QUADRANGLE LOCATION



BREVARD, N.C.-S.C.
1965
PHOTOREVISED 1981

This Open-File Map is preliminary. It has been reviewed internally for conformity with North Carolina Geological Survey mapping standards and with the North American Stratigraphic Code. Further revisions or corrections to this Open File map may occur.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G10AC00425. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government.

STRUCTURAL FEATURES

CONTACTS

Solid line – located in field to within 150 meters
Short-dashed – location inferred; querried where uncertain

- Thrust Fault (teeth on upper plate)
- Thrust Fault with reactivated Strike-Slip motion (teeth on upper plate; arrows indicate relative motion)
- Stratigraphic Contact
- Gradational Contact

STRIKE AND DIP OF PLANAR FEATURES

Observation sites are centered on the strike bar, or at the intersection point of multiple symbols.

- 52 Foliation
- 29 Mylonitic Foliation
- Vertical Foliation
- 78 Axial Plane
- Vertical Joint
- 88 Joint
- 34 Minor Fault

BEARING AND PLUNGE OF LINEAR FEATURES

- 15 Small Fold Axis
- 8 Slickenlines
- 6 Mineral Lineation
- 1 Crenulation

NON-STRUCTURAL FEATURES

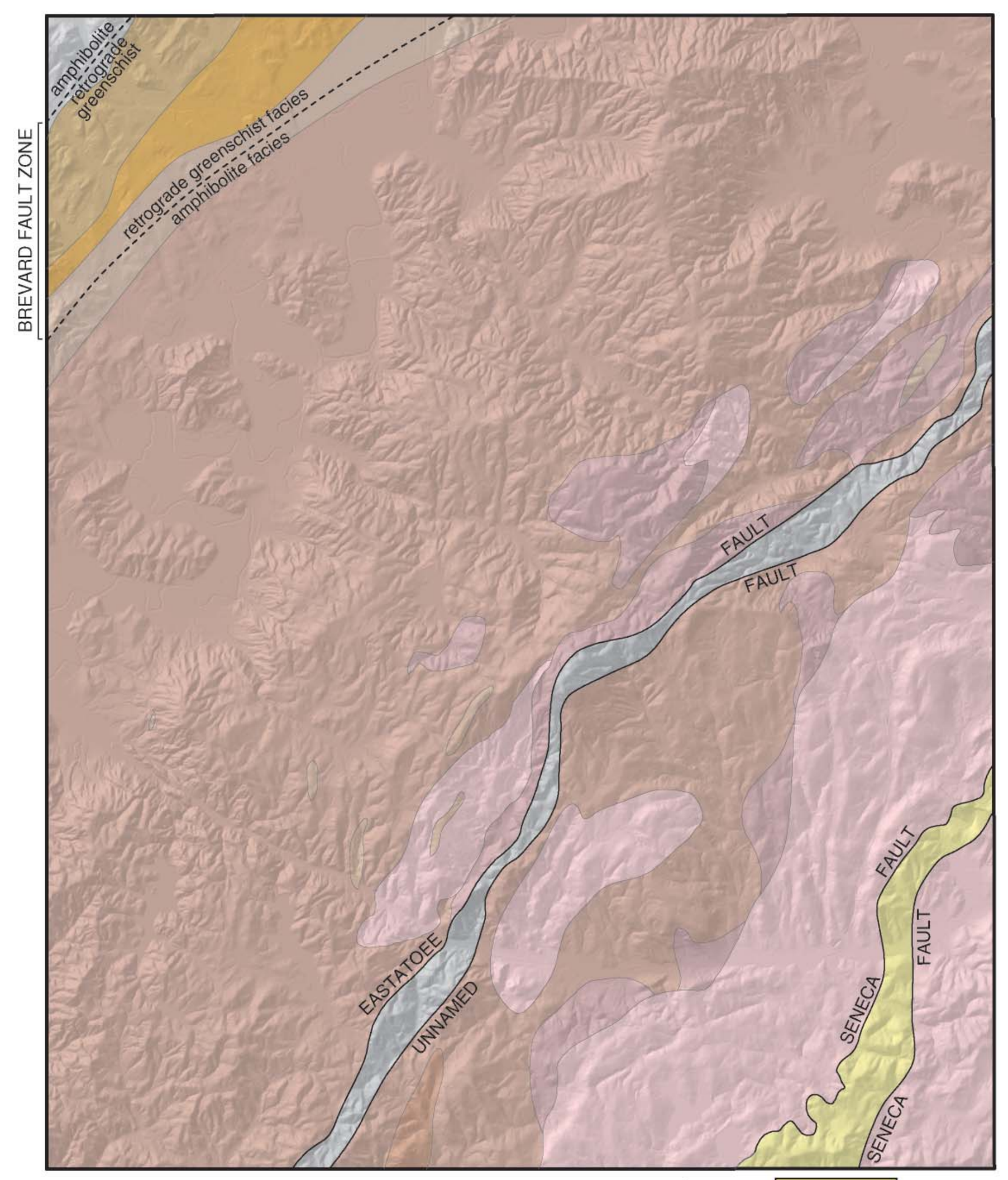
- Float station

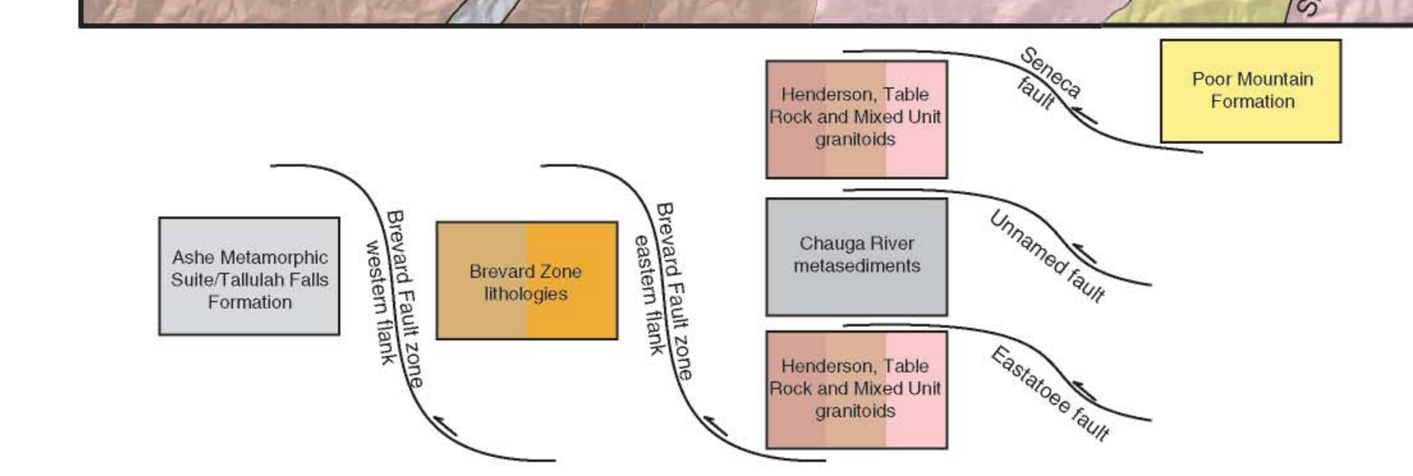
MINERAL RESOURCES

- ts631 Thin section sample site.
- Mine or quarry
- Prospect

COMMODITY LETTER SYMBOLS:
- s/g sand and gravel
- Mo Molybdenum

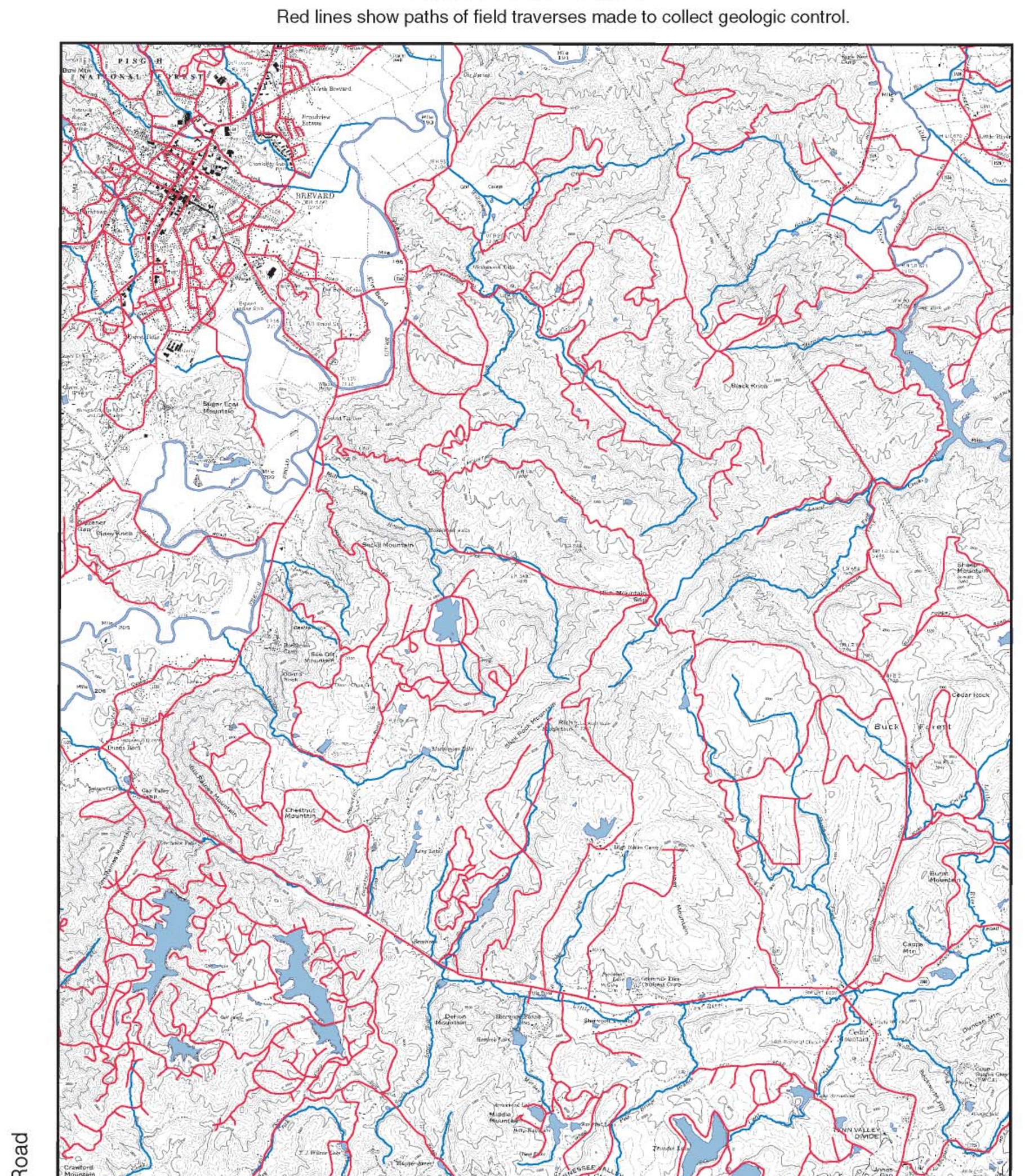
TECTONIC AND METAMORPHIC CONDITIONS



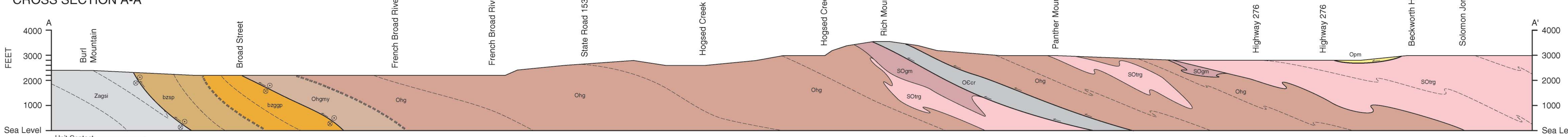


TRAVERSE MAP

Red lines show paths of field traverses made to collect geologic control.



CROSS SECTION A-A´



Unit Contact
Fault Contact
relative thrust motion
relative motion away from viewer
relative motion towards viewer
Gradational Contact
Form Lines

Bedrock Geologic Map of the Brevard 7.5-minute Quadrangle, North Carolina

By
Bart L. Cattanach and G. Nicholas Bozdog

Geology mapped from August 2010 to June 2011. Map preparation, digital cartography and editing by G. Nicholas Bozdog and Bart L. Cattanach.
2011