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Division of Energy, Mineral and Land Resources
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North Carolina Geological Survey
Open File Report 2024-03

Burnsville 7.5-minute Quadrangle, Open File Report 2024-03

CORRELATION OF MAP UNITS

DEVONIAN

Spruce Pine Plutonic Suite

- Dspp — Pegmatite

CAMBRIAN

Ashe Metamorphic Suite

- Za — undivided
- Zakg — kyanite gneiss
- Zaa — amphibolite
- Zah — hornblende-biotite gneiss
- Zad — dunite bodies
- Zau — altered ultramafic bodies

stratigraphic relations uncertain

NEOPROTEROZOIC

WESTERN BLUE RIDGE ROCKS
Crossnore Complex

- Zbg — Bakersville metagabbro

MESOPROTEROZOIC

Mesoproterozoic Basement Complex

- Ye — Earlies Gap gneiss

INTRODUCTION

The Burnsville 7.5-minute quadrangle lies in Yancey and Mitchell counties, western North Carolina. Within the quadrangle is the town of Burnsville and a portion of Pisgah National Forest. U.S. Highway 19 E and N.C. Highway 197 are the major transportation corridors on the quadrangle. The major water features are the Cane River and North Toe River. Total elevation relief is 2,820 feet (860 m) with a low of 2,160 feet (658 m) along the North Toe River and a high of 4,890 feet (1490 m) at Bowlens Pyramid. Pisgah National Forest covers a third of the quadrangle, located in the northwest corner and southern portion of the quadrangle.

GEOLOGIC OVERVIEW

Bedrock of the Burnsville quadrangle is within the Fries/Spruce Pine thrust sheet of the eastern Blue Ridge portion of the Tugaloo terrane and remobilized Grenville basement rock of the Pumpkin Patch thrust sheet (Trupe, 1997; Hatcher and others, 2007). The two sheets are separated by the Holland Mountain/Burnsville fault. The Fries/Spruce Pine thrust sheet contains Neoproterozoic metasedimentary and mafic rocks of the Ashe Metamorphic Suite. These rocks are thick sequences of complexly deformed and metamorphosed clastic sediments deposited in marine rift basins. Interspersed with these sediments are lesser amounts of mafic volcanic rocks and ultramafic rocks thought to have originated as oceanic crust at a spreading center (Misra and Conte, 1991; Raymond and Abbott, 1997). These metasedimentary lithologies were complexly deformed and metamorphosed to amphibolite facies conditions during Taconic orogenesis. Amphibolite facies metamorphism associated with Acadian/Neoacadian orogenesis overprints older fabrics (Johnson and others, 2001).

The Pumpkin Patch thrust sheet contains Mesoproterozoic metaplutonic and metavolcanic basement rocks (Merschat, 2003), possible paragneisses, and Neoproterozoic Bakersville plutonic rocks (Adams, 1995). These polydeformed gneissic layered rocks experienced amphibolite to granulite facies conditions. The metadiabase dikes in the Bakersville Intrusive Suite which cross-cut the gneissic layering have been metamorphosed.

Numerous Devonian-aged granodioritic bodies and pegmatites of the Spruce Pine Plutonic Suite intrude the Ashe Metamorphic Suite (Brobst, 1962; Kish, 1983, 1989). These bodies are typically concordant with, but locally cross-cut metamorphic foliation on the quadrangle. Xenoliths of foliated metasedimentary rocks are locally present within the bodies. Metasedimentary lithologies near pegmatites are commonly more micaceous and coarse-grained than those where pegmatites are absent.

Brittle fractures of likely Mesozoic or younger age strike in all directions but display a prominent NW-SE orientation.

DESCRIPTION OF MAP UNITS[1]

WESTERN TUGALOO TERRANE

Spruce Pine Plutonic Suite

Pegmatite — White to very light-gray, mottled; non-foliated to weakly foliated; very coarse-grained; equigranular to inequigranular; granoblastic. Bodies are lenticular to tabular. Thickness of bodies ranges from decimeters to tens of meters. Pegmatite occurs as sill-like or cross-cutting bodies within the Ashe Metamorphic Suite. Mineralogically similar to Spruce Pine granodiorite (Swanson and Veal, 2010). Consists of plagioclase feldspar, quartz, potassium feldspar, and muscovite. Accessory minerals vary greatly upon locality and include biotite, garnet, apatite, epidote group minerals, pyrite, chalcopyrite, pyrrhotite, beryl, samarskite, columbite, autunite, and torbernite.

Ashe Metamorphic Suite

Undivided — Heterogeneous unit consisting of interlayered layers and lenses of laterally and vertically grading sedimentary and mafic volcanic rocks metamorphosed to kyanite and sillimanite grade. Rock types include metawacke, schistose metawacke, schist, amphibolite, and minor calc-silicate. Thickness of layering ranges from centimeters to meters. Where possible Za was mapped and subdivided based on dominant rock type.

Metawacke — medium-light-gray to medium-dark-gray; medium- to coarse-grained; weakly foliated to foliated; equigranular to inequigranular; granoblastic to lepidoblastic; locally migmatitic; consists of quartz, plagioclase feldspar, biotite, muscovite, garnet, epidote, staurolite, chlorite, opaques with trace potassium feldspar and zircon; thickness of layering ranges from decimeters to meters; interlayered with other Za lithologies.

Schistose Metawacke — medium-gray to dark-gray; fine- to medium-grained; well foliated; equigranular to inequigranular; granoblastic to lepidoblastic to porphyroblastic; locally migmatitic; consists of quartz, plagioclase feldspar, muscovite, biotite, garnet, minor sillimanite or kyanite, and accessory minerals; interlayered with other Za lithologies.

Schist — Very light-gray to greenish-gray to medium-gray; fine- to coarse-grained; strongly foliated; inequigranular; lepidoblastic to porphyroblastic; locally migmatitic; consists of muscovite, sericite, quartz, biotite, garnet, plagioclase feldspar, sillimanite or kyanite, chlorite, and trace opaques; interlayered with other Za lithologies.

Kyanite gneiss — Highly altered and heterogeneous unit characterized by an abundance of kyanite and/or muscovite porphyroblasts. Typical rock is mottled light-gray to brown; coarse-grained; foliated; equigranular to inequigranular; porphyroblastic; locally migmatitic; consists of biotite, plagioclase, quartz, muscovite, kyanite and/or sillimanite, garnet, and minor accessory and trace minerals; kyanite porphyroblasts up to 15 cm; felsic interlayers may be due to metasomatism or migmatization; interlayered with other Za lithologies.

Amphibolite — Dark-green to black; fine- to coarse-grained; weakly to strongly foliated; equigranular; granoblastic to nematoblastic; consists of hornblende, plagioclase feldspar, epidote group minerals, quartz, garnet, chlorite, relict pyroxene, titanite, magnetite, and opaque minerals. Interlayered with other Ashe Metamorphic Suite lithologies and locally intruded by pegmatite. Can occur as a minor rock type throughout the other map units, where it may represent a metamorphosed volcanic rock.

Hornblende-biotite gneiss— Dark gray; medium- to coarse-grained; well foliated; non-layered to well-layered; granoblastic to nematoblastic to lepidoblastic; consists of quartz, plagioclase, biotite, hornblende, potassium feldspar, and minor accessory minerals. Interlayered with amphibolite, calc-silicate, and felsic gneiss.

Dunite — Grayish-yellow-green; fine- to medium-grained, semi massive to massive; consists of forsterite, minor enstatite and bronzite, and disseminated chromite; when altered, serpentine minerals, anthophyllite, talc, and vermiculite replace olivine as disseminated grains, and in interior veins and peripheral areas.

Altered Ultramafics — Dark-green to silvery-grayish-green; fine- to medium-grained; non-foliated to strongly foliated; equigranular; granoblastic to nematoblastic to lepidoblastic; consists of tremolite/actinolite, pyroxene, hornblende, chlorite, talc, serpentine, relict olivine, opaques, plagioclase feldspar, magnetite, and other accessory minerals. These mineralogical variations could not be mapped at a 1:24,000 scale. Amphibolite within and adjacent to this unit occurs as a metamorphic alteration of the ultramafic or mafic rock. Thickness of amphibolitic alteration is variable. Contains inclusions of other variations of altered mafic and ultramafic rock.

WESTERN BLUE RIDGE ROCKS

Crossnore Complex

Bakersville metagabbro — Dark-gray to black, fine- to very coarse-grained, massive to well-foliated, metagabbro, metadiabase, and metabasaltic dikes. Locally altered to amphibolite, epidote-biotite schist, or garnet-biotite schist. Consists of hornblende, plagioclase, garnet, relict clinopyroxene, epidote, sphene, biotite, and minor accessory minerals.

Mesoproterozoic Basement Complex

Earlies Gap gneiss — Heterogeneous unit of biotite-hornblende gneiss, granitic gneiss, biotite granitic gneiss, and layered biotite granitic gneiss, interlayered with magnetite-bearing granitic gneiss, amphibolite, and calc-silicate. Medium- to dark-gray to light-pinkish gray; coarse-grained; massive to well-foliated; equigranular; granoblastic to lepidoblastic; locally mylonitic, protomylonitic and migmatitic.

[1]Mineral abundances are listed in decreasing order of abundance based upon visual estimates of hand samples and thin-sections.

WHOLE ROCK ICP ANALYSIS OF SELECTED SAMPLES

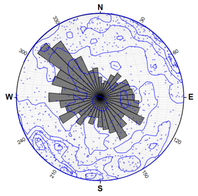
Sample	Rock Type	Map Unit	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	LOI	SUM
JRB141	Biotite Granitic Gneiss	Ye	59.32	14.18	8.9	1.8	4.32	2.99	4.17	1.46	0.59	0.1	0.004	1.4	99.54
BC-591	Amphibolite	Za	43.02	15.55	13.84	8.16	10.82	2.59	0.49	1.59	0.14	0.2	0.037	1.3	99.73
JRB44	Metawacke Sequence	Za	50.67	21.13	12.15	3.27	1.33	1.3	3.74	1.16	0.24	0.21	0.013	4.5	99.76
BC-427	Amphibolite	Zaa	73.93	10.76	4.18	0.82	3.84	2.91	0.57	1.14	0.21	0.05	0.004	1.4	99.87
BC-294	Granitic Orthogneiss	Zah	57.97	16.3	7.99	3.24	4.28	3.01	3.68	1.38	0.12	0.09	0.008	1.5	99.73
BC-592	Paragneiss	Zakg	47.16	23.7	14.88	4.03	1.37	1.18	2.98	1.54	0.26	0.21	0.017	2.3	99.7
JRB158	Amphibolite	Zakg	46.58	12.74	11.89	13.67	11.17	1.13	0.26	0.21	0.02	0.23	0.17	1.6	99.7
JRB74	Metagabbro	Zbg	48.96	14.55	16.37	5.77	8.03	2.83	1.07	3.04	0.48	0.22	0.011	0.3	99.72

Sample	Ba	Ni	Sc	Be	Co	Cs	Ga	Hf	Nb	Rb	Sn	Sr	Ta	Th	U	V	W	Zr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Mo	Cu	Pb	Zn	Ni	As	Cd	Sb	Bi	Ag	Au	Hg	Tl	Se
JRB141	45	98	44	<1	47.8	<0.1	19.3	3.1	2.7	4.9	1	121.9	0.2	<0.2	0.2	343	<0.3	116.9	31	6.7	16.7	2.51	13	3.9	1.46	5.27	0.9	5.73	1.24	3.56	0.49	3.18	0.49	0.4	29.5	0.7	31	37.8	<0.5	<0.1	<0.1	<0.1	<0.1	<0.5	<0.01	<0.1	<0.5
BC-591	380	<20	11	<1	10.7	<0.1	23.4	36.8	47.6	102.1	6	481.2	1.4	5.2	0.8	92	0.7	1675.2	74.8	183.6	419.3	51.19	200.1	32.19	5.21	23.76	2.99	14.86	2.7	7.17	0.95	5.83	0.83	1.6	8.5	4.2	115	6.3	<0.5	<0.1	<0.1	<0.1	<0.1	<0.5	<0.01	0.6	0.8
JRB44	45	98	44	<1	47.8	<0.1	19.3	3.1	2.7	4.9	1	121.9	0.2	<0.2	0.2	343	<0.3	116.9	31	6.7	16.7	2.51	13	3.9	1.46	5.27	0.9	5.73	1.24	3.56	0.49	3.18	0.49	0.4	29.5	0.7	31	37.8	<0.5	<0.1	<0.1	<0.1	<0.1	<0.5	<0.01	<0.1	<0.5
BC-427	73.93	10.76	4.18	0.82	3.84	2.91	0.57	1.14	0.21	0.05	0.004	1.4	99.87	380	<20	11	<1	6.3	<0.1	11.5	10.9	22.9	21.1	2	211.7	1	7.8	1	82	0.6	470.7	38.4	16.8	46.8	6.78	31.2	8.07	2.13	8.15	1.25	7.66	1.47	4.18	0.57	3.52	0.52	1.2	33.7	0.9	13	6.5	<0.5	<0.5	<0.1	<0.1	<0.1	<0.5	<0.01	0.3	<0.5
BC-294	57.97	16.3	7.99	3.24	4.28	3.01	3.68	1.38	0.12	0.09	0.008	1.5	99.73	1700	47	15	<1	24.1	0.4	21.2	13	11.4	120.1	<1	418	0.4	22.9	0.6	145	<0.5	470.2	23.8	97.2	136.3	16.51	55.3	7.45	3.02	5.41	0.67	3.76	0.84	2.91	0.47	3.73	0.67	0.4	19.2	4.9	81	37	<0.5	<0.5	<0.1	<0.1	<0.1	<0.5	<0.01	0.3	<0.5
BC-592	1002	33	28	<1	19.6	0.6	31.8	10.9	26.6	125.2	<1	162.4	1.1	33	4.5	191	<0.5	411.4	87.8	138.5	278.2	34.14	127.3	23.06	2.73	18.76	2.61	15.55	3.25	9.91	1.42	8.96	1.39	1.1	36	2.6	171	27	<0.5	<0.5	<0.1	<0.1	<0.1	<0.5	<0.01	0.6	<0.5
JRB158	45	318	45	<1	69.8	<0.1	8.9	0.3	3.4	5.4	<1	24.3	0.2	0.2	0.1	271	<0.5	11.8	4.8	3.3	5.6	0.64	2.3	0.46	0.14	0.84	0.1	0.79	0.2	0.67	0.1	0.82	0.13	0.3	11.8	0.8	20	62.9	<0.5	<0.5	<0.1	<0.1	<0.1	<0.5	<0.01	0.1	<0.5
JRB74	622	34	29	<1	56.9	0.2	23.6	6	17.2	18.9	2	383.1	1	1.9	0.4	313	<0.5	246.2	43.8	25.5	56.1	7.68	35	7.88	2.81	8.8	1.34	8.05	1.69	4.79	0.62	3.83	0.61	0.9	21.5	0.7	63	24.4	<0.5	<0.5	<0.1	<0.1	<0.1	<0.5	<0.01	0.1	<0.5

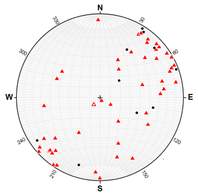
Whole Rock Inductively Coupled Plasma - Atomic Emission/Mass Spectrometer analysis conducted by Bureau Veritas, 9050 Shaughnessy St, Vancouver, BC Canada V6P 6E5.
Sample numbers correspond to thin section and whole rock sample localities shown on geologic map.
State Plane Coordinate System
LOI = Loss on ignition in percent
SUM = Sum total in percent
PPM = Parts per million. Ni analyzed by Bureau Veritas LF200 and AQ200 procedures.
Oxide values are in weight percent and trace element values are in PPM.

SCHMIDT EQUAL AREA STEREONET DATA

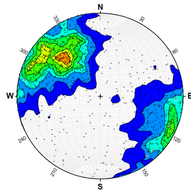
Stereonets created using Stereonet 10 (Allmendinger, et al., 2012; Cardozo and Allmendinger, 2013.)



Contoured poles and rose diagram of joints. Joint count = 770.



Bearing and plunge of fold hinges in black. Fold hinge count = 24.
Lineations in red. Lineation count = 47. Some fold hinges may be covered by lineation.



Contoured poles to foliation. Count = 1133.

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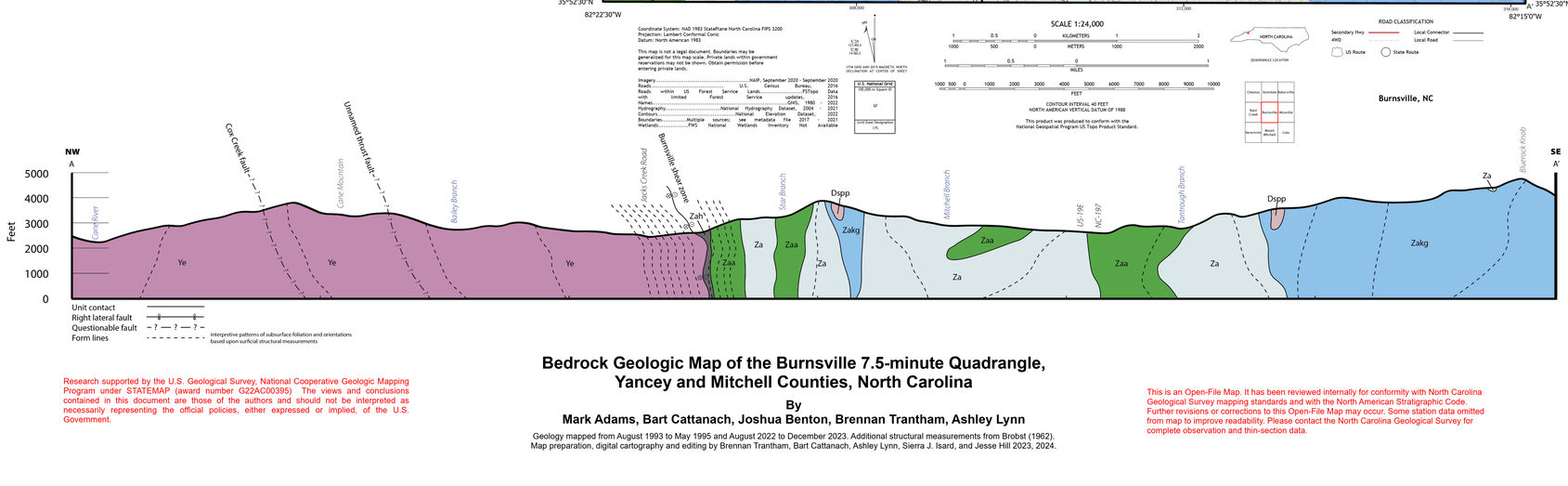
Unit contact
Right lateral fault
Questionable fault
Form lines
interpretive patterns of subsurface foliation and orientations based upon surficial structural measurements



EXPLANATION OF MAP SYMBOLS

CONTACTS

Zone of Confidence: 300m

- Contact—Identity and existence certain, location inferred
- Right lateral fault—Identity and existence certain, location inferred.
- Gradational contact—Identity and existence certain, location inferred.
- Thrust fault (2nd option)—Identity and existence questionable, location inferred. Saw teeth on upper (tectonically higher plate).

PLANAR FEATURES

(For multiple observations at one locality, symbols are joined at the "tail" ends of the strike lines)

- Inclined metamorphic or tectonic foliation—Showing strike and dip
- Inclined metamorphic or tectonic foliation, for multiple observations at one locality—Showing strike and dip
- Vertical metamorphic or tectonic foliation—Showing strike
- Vertical metamorphic or tectonic foliation, for multiple observations at one locality—Showing strike
- Vertical mylonitic foliation—Showing strike
- Inclined mylonitic foliation—Showing strike and dip
- Inclined compositional layering—Showing strike and dip
- Small, minor inclined joint—Showing strike and dip
- Small, minor inclined joint, for multiple observations at one locality—Showing strike and dip
- Small, minor vertical or near-vertical joint, for multiple observations at one locality—Showing strike
- Small minor vertical or near-vertical joint—Showing strike
- Inclined mylonitic foliation, for multiple observations at one locality—Showing strike and dip
- Vertical mylonitic foliation, for multiple observations at one locality—Showing strike
- Minor brittle fault—Showing strike and dip

LINEAR FEATURES

- Inclined aligned-mineral lineation—Showing bearing and plunge
- Inclined slickenline, groove, or striation on fault surface—Showing bearing and plunge
- Inclined fold hinge of generic (type or orientation unspecified) small, minor fold—Showing bearing and plunge
- Inclined generic (origin or type not known or not specified) lineation or linear structure—Showing bearing and plunge

OTHER FEATURES

- Burnsville Shear Zone
- Float station
- Thin section and whole rock analysis sample location
- Prospect (pit or small open cut)
- Abandoned sand, gravel, clay, or placer pit
- Abandoned open pit, quarry, or glory hole
- Abandoned adit or tunnel entrance

NATURAL RESOURCES

MIC - Mica SDG - Sand and gravel STN_C - Crushed stone STN - Stone
TLC - Talc CU - Copper FLD - Feldspar BE - Beryl MN - Manganese MBL - Marble

TECTONIC MAP

- Location where chlorite was observed
- Location where kyanite was observed
- Location where garnet and chlorite were observed
- Location where garnet was observed
- Location where kyanite and garnet were observed

TRAVERSE MAP

Hillshade derived from a six meter pixel resolution LiDAR (Light Detecting And Ranging) digital elevation model.
Red lines show paths of field traverses.

Bedrock Geologic Map of the Burnsville 7.5-minute Quadrangle, Yancey and Mitchell Counties, North Carolina

By
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Geology mapped from August 1993 to May 1995 and August 2022 to December 2023. Additional structural measurements from Brobst (1962).
Map preparation, digital cartography and editing by Brennan Trantham, Bart Cattanach, Ashley Lynn, Sierra J. Isard, and Jesse Hill 2023, 2024.