NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES
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NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE MAP 2009-04

MAP UNITS

pegmatite

Pzmg — migmatite

PALEOZOIC

Brevard Zone

zone of brecciation

bzsp — Sericite Phyllite

bzggp — Mylonitic Granitic Gneiss/Phyllonite

SILURIAN

Table Rock Plutonic Suite

SOmbg — Muscovite-Biotite Granitoid Gneiss

ORDOVICIAN

Henderson Granitic Gneiss

Ohg — Henderson Gneiss

Ohgmy — Mylonitic Henderson Gneiss

Ohgf — Fine-grained Henderson Gneiss

Ohbg — Biotite Granodioritic gneiss

Ohgg — Granitic gneiss

Ohlbg — Layered biotite granitoid gneiss

Ohgm — Mixed Unit

CAMBRIAN

Chauga River Formation

ЄZmq — Muscovite-quartz schist

ЄZg — Metagraywacke

NEOPROTEROZOIC

Ashe Metamorphic Suite/Tallulah Falls Formation

Zag — Metagraywacke

Zagsi — Schistose metagraywacke

STREAM SEDIMENT HEAVY MINERAL ANALYSIS

Stream sediment heavy mineral analysis was conducted from November 2007 through January 2008 to aid geologic mapping, better define conditions of metamorphism, and inventory minerals of potential economic significance. Procedure: In the field, approximately 13.6 kg of stream sediment material is panned to approximately 300 g of heavy mineral concentrate at each sample locality (scintillation data are also collected at the sample site). In the laboratory, concentrate is washed and passed through heavy liquid separation using tetrabromoethane, and scanned with short- and long-wave ultraviolet illumination using an Ultra-violet Products Inc. Model UVGL-48 Mineralight Lamp. Magnetite is removed with a hand magnet. A sample split is grain mounted on a standard 27x46 mm glass slide and approximately 200 grains are identified and counted with the aid of a petrographic microscope and 1.67 index of refraction oil. Results of stream sediment heavy mineral analysis are tabulated below.

Mineral abbreviations used in table: Mg-magnetite; Gt-garnet; Zr-zircon; Bt-biotite; Rt-rutile; Aug-augite; Chl-chlorite; Ep-epidote group minerals; St-staurolite; Au-Gold; Hbl-hornblende; Ky-kyanite; Crn-corundum; Ttn-titanite; Tur-tourmaline; Py-pyrite; Ud-unidentified; Ilm-ilmenite and other black opaque minerals; Hem-hematite and other red opaque minerals; Lx-leucoxene.

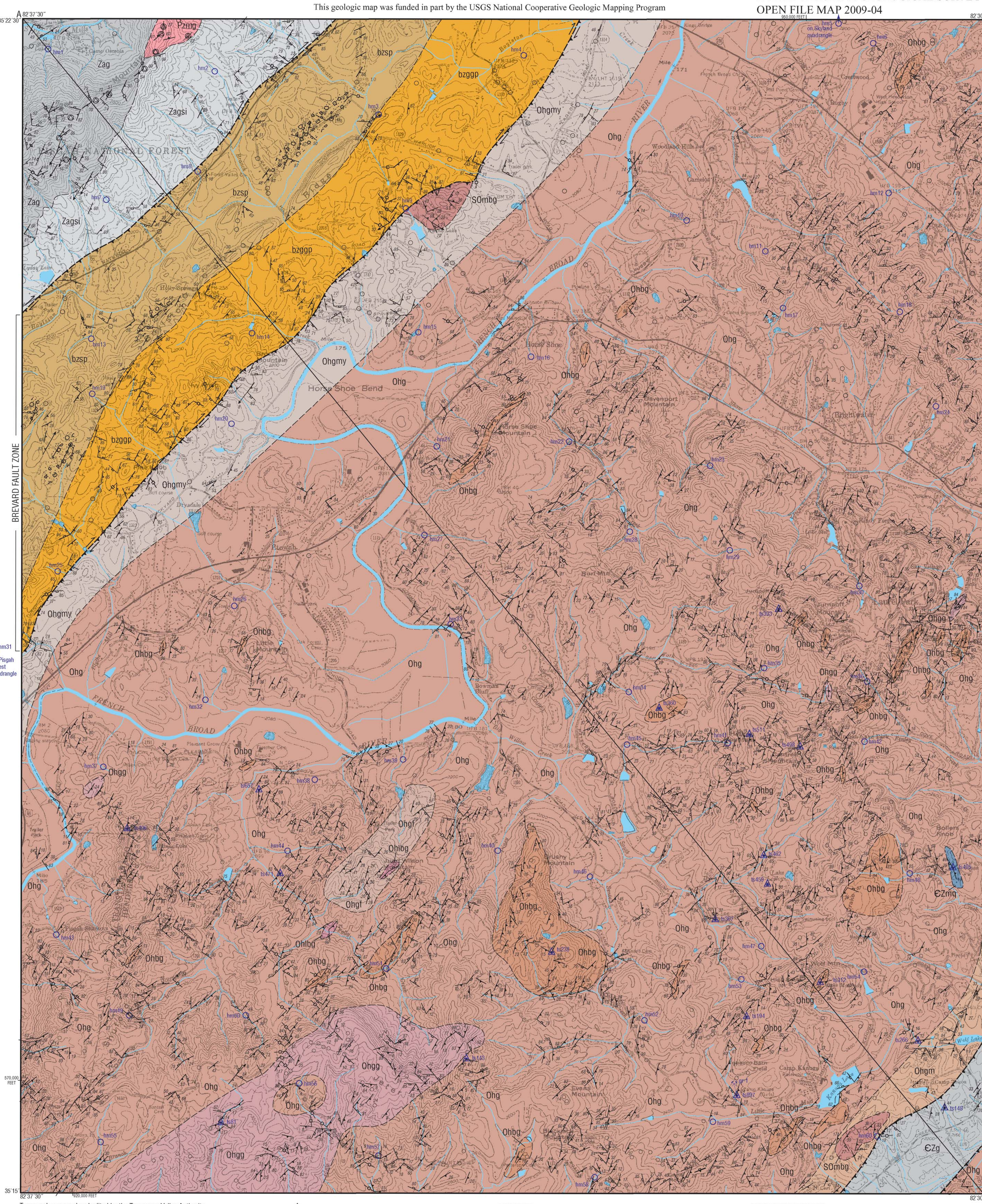
SAMPLE[1]	(State Plane, NAD 83 Meters)	MAP UNITS DRAINED[2]	% HM IN SAMPLE[3]	PERCENT HEAVY MINERALS IN SAMPLE[4]																			
				Mg	Gt	Zr	Bt	Rt	Agt	Chl	Ep	St	Au	Hbl	Ky	Ttn	Cru	Tur	Pyt	Ud	Ilm	Hem	Lx
hm-1	185,913N; 280,617E	Zag	0.16	2.50	9.26	22.91	0.49	0.98	0.00	0.00	15.11	0.00	0.00	0.00	1.46	0.00	0.00	2.44	0.00	0.00	43.39	0.00	1.46
hm-2	185,580N; 282,574E	Zagsi, Pzmg	0.62	7.90	5.07	12.89	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.00	0.00	0.00	0.00	4.60	0.00	0.00	67.69	0.46	0.00
hm-3	185,004N; 284,491E	bzggp	0.88	75.44	0.12	1.23	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.00	12.77	8.11	0.37	0.37
hm-4	185,650N; 286,227E	bzggp	0.14	10.08	3.60	39.11	0.00	0.00	0.00	0.00	10.34	0.00	0.00	0.00	0.00	0.45	0.00	6.29	4.95	0.00	22.03	0.00	3.15
hm-5	186,065N; 289,965E	unknown	1.38	5.44	0.00	24.59	0.00	0.00	0.00	0.00	65.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.26	0.00	0.47
hm-6	185,646N; 290,360E	Ohg	0.75	4.80	0.00	8.09	0.00	0.00	0.00	0.00	69.50	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	7.14
hm-7	184,115N; 281,244E	Zag, Zagsi	0.21	10.53	9.80	50.28	0.00	0.00	0.00	0.00	4.69	0.00	0.00	0.43	0.85	0.00	0.00	0.85	0.00	2.13	17.04	0.43	2.98
hm-8	184,405N; 282,334E	Zagsi, bzsp	0.19	4.17	0.48	44.08	0.96	0.00	0.00	0.00	1.92	0.00	0.96	0.00	0.00	0.48	0.00	4.31	0.00	0.00	39.77	0.00	2.88
hm-9	183,891N; 284,778E	bzggp	0.52	5.06	0.47	17.56	1.42	0.00	0.00	0.00	32.76	0.00	0.00	0.95	0.00	0.95	0.00	0.95	3.80	2.85	28.01	0.00	5.22
hm-10	183,629N; 288,085E	Ohg	0.21	22.92	0.00	38.15	3.08	0.00	0.00	0.00	8.09	0.77	0.00	0.77	4.24	0.00	0.00	0.39	0.00	1.16	15.03	0.00	5.40
hm-11	183,230N; 289,002E	Ohg	0.72	35.29	0.00	16.82	4.85	0.00	0.00	0.00	25.24	0.00	0.00	0.00	0.65	0.00	1.62	0.00	0.00	0.65	12.94	0.00	1.94
hm-12	183,875N; 290,481E	Ohg	0.45	41.19	1.40	17.08	3.64	0.00	0.00	0.00	13.44	0.00	0.00	10.64	1.40	0.56	0.00	0.00	0.00	0.00	7.84	0.00	2.80
hm-13	182,478N; 281,011E	bzsp	0.81	0.69	0.99	11.42	0.00	0.00	0.00	0.00	6.95	0.00	0.00	1.49	3.48	1.49	0.00	4.47	0.00	0.00	63.06	0.00	5.96
hm-14	182,475N; 282,909E	bzggp	0.68	0.63	0.47	15.14	0.00	0.00	0.00	0.00	70.03	0.00	0.00	0.47	0.00	0.00	0.00	0.47	0.00	0.00	5.68	0.00	7.10
hm-15	182,420N; 284,871E	Ohgmy, Ohg	1.11	3.93	0.00	26.42	0.00	0.00	0.00	0.00	48.52	0.00	0.00	6.24	0.96	2.40	0.00	0.00	0.00	0.00	9.61	0.00	1.92
hm-16	182,083N; 286,191E	Ohg	0.54	3.10	6.30	44.57	0.48	0.00	0.00	0.00	32.46	0.00	0.00	0.48	0.48	4.36	0.00	0.00	0.00	0.00	4.36	0.00	3.39
hm-17	182,555N; 289,186E	Ohg	0.62	60.70	0.20	10.81	2.36	0.00	0.00	0.00	15.92	0.00	0.00	1.38	0.39	6.88	0.00	0.00	0.00	0.00	1.38	0.00	0.00
hm-18	182,462N; 290,561E	Ohg	0.25	25.31	2.85	33.79	6.76	0.00	4.98	0.00	10.31	0.00	0.00	1.07	0.00	4.98	0.00	0.00	0.00	0.00	7.47	0.00	2.49
hm-19	181,827N; 281,000E	bzsp	2.87	84.18	0.00	1.02	0.85	0.00	0.26	0.00	4.34	0.00	0.00	1.11	0.00	0.77	0.00	1.11	0.00	0.00	3.32	2.13	0.94
hm-20	181,418N; 282,629E	Ohgmy	1.69	0.09	0.00	20.93	0.48	0.00	0.00	0.00	63.75	0.00	0.00	0.00	0.00	2.85	0.00	0.00	0.00	9.52	2.38	0.00	0.00
hm-21	181,067N; 285,043E	Ohg	0.99	67.07	0.63	9.41	0.94	0.00	1.25	0.00	14.11	0.00	0.00	0.63	0.16	2.20	0.00	0.00	0.00	0.00	2.82	0.00	0.78
hm-22	181,070N; 286,607E	Ohg	0.25	18.45	0.00	42.41	0.00	0.00	0.00	0.00	13.05	0.00	0.00	0.00	0.00	2.45	0.00	0.00	0.00	3.26	10.19	0.82	9.38
hm-23	180,727N; 288,258E	Ohg	0.46	60.32	0.40	15.28	0.40	0.00	0.00	0.00	15.87	0.00	0.00	1.39	0.00	2.18	0.00	0.00	0.00	0.00	1.79	0.20	2.18
hm-24	181,333N; 290,946E	Ohg	0.65	62.84	1.30	16.17	1.30	0.00	0.00	0.00	6.69	0.00	0.00	0.00	0.00	2.60	0.00	0.00	0.00	0.19	5.57	2.04	1.30
hm-25	179,749N; 280,515E	bzggp, bzsp	0.89	21.62	1.95	19.50	6.63	0.39	0.00	0.00	15.99	0.00	0.00	3.51	2.34	1.17	0.00	1.95	0.00	3.12	14.04	0.00	7.80
hm-26	179,267N; 282,588E	Ohg	0.12	52.11	0.72	25.86	0.96	0.00	0.00	0.00	5.99	0.00	0.00	0.00	0.48	0.72	0.00	0.00	0.00	0.00	7.90	0.00	5.27
hm-27	180,022N; 284,858E	Ohg	0.23	25.50	2.48	24.83	7.10	0.00	0.00	0.00	11.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	21.29	0.00	7.10
hm-28	179,980N; 287,284E	Ohg	0.78	47.92	0.25	11.57	3.02	0.00	0.00	0.00	15.60	0.00	0.00	11.57	0.00	4.28	0.00	0.00	0.00	0.00	3.27	1.01	1.51
hm-29	179,724N; 288,472E	Ohg	0.61	26.81	2.93	34.76	0.00	0.00	0.00	1.10	13.54	0.00	0.00	0.37	0.00	2.56	0.00	0.00	0.00	0.00	11.34	0.00	6.59
hm-30	179,249N; 289,967E	Ohg	0.23	12.05	2.64	18.03	0.00	0.00	0.00	0.00	13.63	0.00	0.00	0.88	0.00	7.48	0.00	0.88	0.00	0.00	27.27	2.64	14.51
hm-31	176,268N; 285,597E	unknown	1.36	5.98	1.88	6.11	0.47	0.00	0.00	0.47	18.33	0.00	0.00	0.00	0.00	0.00	0.00	1.88	0.00	4.23	41.37	2.82	16.45
hm-32	176,351N; 283,115E	Ohg	0.41	20.94	1.97	58.60	0.79	0.00	0.00	0.39	2.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.41	0.79	2.36
hm-33	178,821N; 279,742E	Ohg	0.42	44.17	0.00	23.51	0.80	0.00	0.00	0.00	19.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	5.08	0.53	6.41
hm-34	178,170N; 282,208E	Ohg, Ohbg	0.38	15.17	3.69	29.97	0.46	0.00	0.00	1.38	33.19	0.00	0.00	3.23	0.00	0.00	0.00	0.46	0.00	0.00	10.14	0.00	2.31
hm-35	178,958N; 285,133E	Ohg	0.34	24.86	0.00	4.88	3.01	0.38	0.00	21.79	24.05	0.00	0.00	4.13	0.00	5.64	0.00	0.38	0.00	0.00	5.26	0.00	5.64
hm-36	178,089N; 287,207E	Ohg	0.20	26.32	0.00	13.63	0.00	0.00	0.00	2.95	25.42	0.00	0.00	2.21	0.00	4.79	0.00	0.00	0.00	0.00	16.95	1.47	6.26
hm-37	178,111N; 290,025E	Ohg, Ohgg	1.93	69.56	0.14	13.58	0.43	0.14	0.00	5.86	5.14	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	2.86	0.29	1.57
hm-38	178,315N; 288,816E	Ohg	0.48	3.54	1.44	67.19	0.48	0.00	0.00	0.96	17.28	0.00	0.00	0.00	0.00	6.24	0.00	0.48	0.00	0.00	0.96	0.00	1.44
hm-39	177,418N; 280,976E	Ohg, Ohgf	0.80	43.95	0.55	18.32	0.00	0.27	0.00	1.09	21.33	0.00	0.00	3.28	0.00	6.84	0.00	0.00	0.00	0.27	3.28	0.27	0.55
hm-40	177,180N; 283,465E	Ohg, Ohbg	0.40	44.89	1.10	17.27	0.00	0.00	0.00	8.50	12.06	0.00	0.00	1.37	0.00	1.10	0.00	0.00	0.00	0.00	12.61	0.27	0.82
hm-41	177,384N; 284,515E	Ohg	0.56	12.48	0.00	6.42	0.00	0.00	0.00	11.00	17.41	0.00	0.00	26.58	0.00	9.16	0.00	0.00	0.00	0.00	16.50	0.46	0.00
hm-42	175,833N; 290,448E	Ohg	0.27	6.67	11.01	0.00	0.00	0.00	0.00	15.41	15.85	0.00	0.00	5.28	0.00	10.13	0.00	0.00	0.00	1.76	29.94	1.32	1.76
hm-43	177,445N; 288,355E	Ohg	0.50	41.45	2.33	22.72	0.00	0.00	0.00	3.20	17.48	0.00	0.00	1.17	0.00	5.83	0.00	0.00	0.00	0.58	2.91	0.58	1.75
hm-44	177,403N; 289,971E	Ohg, Ohgf	0.23	25.45	0.00	15.28	0.00	0.00	0.00	8.20	32.05	0.00	0.00	1.49	0.00	13.42	0.00	0.00	0.00	1.12	1.12	0.75	1.12
hm-45	175,461N; 280,350E	Ohg	0.76	61.52	0.36	9.89	0.36	0.00	0.00	7.55	7.01	0.00	0.00	1.44	0.00	2.70	0.00	0.00	0.00	0.00	7.19	0.72	1.26
hm-46	175,923N; 286,675E	Ohg, Ohbg	0.63	48.06	2.08	17.92	0.00	0.00	0.00	2.60	7.01	0.00	0.00	0.52	0.00	2.86	0.00	0.00	0.00	0.00	17.66	0.78	0.52
hm-47	177,470N; 287,165E	Ohg	0.28	1.13	0.00	22.63	0.00	0.00	0.00	4.43	13.28	0.00	0.00	0.49	0.00	6.39	0.00	0.00	0.00	0.00	49.19	0.00	2.46
hm-48	174,651N; 288,419E	Ohg, Ohbg	1.02	5.26	0.47	18.00	0.00	0.00	0.00	0.47	6.63	0.00	0.00	1.42	0.00	4.74	0.00	0.00	0.00	0.00	61.11	0.00	1.89
hm-49	175,037N; 288,664E	Ohg	0.32	27.54	3.93	21.06	0.00	0.00	0.00	1.78	26.41	0.00	0.00	0.71	0.00	10.35	0.00	0.00	0.00	0.00	4.64	1.43	2.14
hm-50	174,692N; 289,868E	Ohg	0.59	54.83	0.23	12.65	0.00	0.00	0.00	2.26	7.45	0.00	0.00	2.48	0.00	5.42	0.00	0.00	0.00	0.00	11.74	0.23	2.71
hm-51	174,432N; 282,554E	Ohbg, Ohg	0.25	13.75	3.98	31.85	0.00	0.44	0.00	18.13	10.17	0.00	0.00	0.44	0.00	4.42	0.00	0.00	0.00	0.00	15.48	0.44	0.88
hm-52	174,477N; 281,175E	Ohg	1.39	43.86	0.28	10.84	0.28	0.56	0.00	3.89	9.17	0.00	0.00	5.56	0.00	2.78	0.00	0.00	0.00	1.39	18.90	0.28	2.22
hm-53	172,995N; 280,789E	Ohg	2.50	2.59	0.00	9.74	0.00	0.00	0.00	1.46	9.74	0.00	0.00	16.56	0.00	3.90	0.00	0.00	0.00	0.00	51.63	0.97	3.41
hm-54	173,606N; 283,158E	Ohg	1.60	1.04	0.49	15.83	0.00	0.49	0.00	0.00	12.87	0.00	0.00	0.49	0.00	2.97	0.00	0.00	0.00	0.00	65.31	0.00	0.49
hm-55	172,376N; 286,604E	Ohg	0.31	21.51	0.38	25.78	0.00	0.00	0.00	1.15	16.93	0.38	0.00	0.77	0.00	5.00	0.00	0.00	0.00	0.00	26.93	0.00	1.15
hm-56	172,720N; 284,060E	Ohg, Ohgg	1.60	3.77	2.84	18.96	0.00	0.00	0.00	0.00	7.58	0.00	0.00	0.00	0.00	3.79	0.00	0.00	0.00	0.00	62.58	0.00	0.47
hm-57	172,982N; 288,026E	Ohg, Ohgg	0.14	4.76	1.38	18.86	0.00	0.00	0.00	4.14	11.04	0.00	0.00	0.00	0.00	5.06	0.00	0.00	0.00	0.00	52.45	0.00	2.30
hm-58	174,208N; 287,261E	Ohg	0.40	1.69	0.49	21.63	0.00	0.00	0.00	5.41	7.37	0.00	0.00	0.49	0.00	7.86	0.00	0.00	0.00	0.00	53.58	0.00	1.47
hm-59	174,927N; 284,230E	Ohg	0.33	1.19	0.49	41.01	0.00	0.00	0.00	0.99	10.87	0.00	0.00	0.00	0.00	2.96	0.00	0.00	0.00	0.00	41.01	0.00	1.48
hm-60	172,745N; 289,955E	Ohgm, Sombg	0.10	10.67	0.00	25.46	0.00	0.00	0.00	12.51	23.23	0.00	0.00	4.47	0.00	7.15	0.00	0.45	0.00	0.00	10.27	1.34	4.47

[1]Sample numbers correspond to stream sediment heavy mineral sample localities shown on geologic map
[2]Up to three most dominant map units contributing to the drainage basin, listed in decending order of map area
[3]Percentage of heavy minerals in 13.6 kg stream sediment sample
[4]Point count percentages of heavy minerals from processed samples

WHOLE ROCK ICP ANALYSIS[1] OF SELECTED SAMPLES

SAMPLE[2]	NC COORDINATES (State Plane NAD 83 meters)	ROCK TYPE	MAP UNIT	OXIDES IN PERCENT											ELEMENTS IN PPM[3]												LOI[4]	SUM[5]
				SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Cu	Ba	Zn	Ni	Co	Sr	Zr	Ce	Y	Nb	Sc	Ta		
ts81	173,173N; 282,215E	biotite granitic gneiss	Ohgg	75.08	13.02	1.1	0.14	0.73	3.23	5.35	0.11	0.086	0.02	<0.002	<5	95	8	<20	25	41.2	52	44	29	24	5	<20	0.5	99.4
ts143	173,822N; 285,139E	biotite quartz monzodioritic mylonitic gneiss	Ohg	78.38	8.53	4.27	0.63	0.66	1.24	4.1	0.54	0.13	0.07	0.003	15	474	55	<20	23	91.1	274	198	33	28	8	<20	0.7	99.4
ts148	173,048N; 290,765E	metagraywacke to metasiltstone	CZg	65.2	15.04	6.34	1.83	2.09	2.49	3.52	0.94	0.19	0.09	0.007	9	736	95	<20	<20	206	326	<30	20	25	13	<20	1.5	99.39
ts194	174,205N; 288,463E	biotite protomylonitic granitic gneiss	Ohg	69.73	14.97	2.48	0.5	1.74	3.55	5.18	0.36	0.116	0.04	<0.002	<5	725	32	<20	<20	160.9	197	53	23	17	6	<20	0.6	99.4
ts238	175,045N; 286,187E	biotite granodioritic gneiss	Ohbg	77.1	12.19	1.89	0.27	1.7	4.56	0.72	0.18	0.039	0.04	<0.002	<5	26	25	<20	<20	45.5	114	141	57	28	5	<20	0.7	99.44
ts266	173,849N; 290,478E	biotite granitic mylonitic gneiss	Ohg	69.7	15.07	3.28	0.8	2.23	3.69	4.11	0.55	0.164	0.05	<0.002	<5	655	42	<20	<20	181.7	327	97	35	23	8	<20	0	99.81
ts312	174,580N; 289,347E	biotite granitic gneiss	Ohbg	72.15	13.63	2.06	0.37	0.98	2.26	5.44	0.19	0.267	0.02	<0.002	23	941	19	<20	21	347.4	69	31	19	13	5	<20	1.9	99.46
ts360	177,879N; 287,558E	calc-silicate granofels	Ohbg	60.85	18.77	3.85	0.5	8.41	5.27	0.35	0.29	0.082	0.1	<0.002	30	439	40	<20	<20	751.4	209	78	29	29	5	<20	0.8	99.45
ts367	175,367N; 288,136E	granitic mylonitic gneiss	Ohg	71.74	14.39	1.62	0.05	0.82	2.6	7.07	0.22	0.046	0.02	<0.002	<5	219	9	<20	<20	77.2	55	44	10	12	2	<20	0.8	99.4
ts392	179,163N; 288,884E	biotite granitic protomylonitic gneiss	Ohg	70.11	13.85	3.3	0.73	1.78	3.13	4.93	0.49	0.216	0.07	<0.002	<5	540	51	<20	30	151.3	231	81	39	26	8	<20	0.7	99.45
ts393	178,999N; 289,008E	biotite granitic protomylonitic gneiss	Ohg	65.54	15.74	4.34	1.12	2.58	3.37	5.04	0.72	0.24	0.08	<0.002	<5	1137	65	<20	23	255.2	361	134	34	28	10	<20	0.5	99.49
ts459	175,763N; 288,765E	granitic protomylonitic gneiss	Ohg	71.03	15.56	0.86	0.08	0.73	2.74	5.84	0.06	0.096	0.02	<0.002	<5	673	10	<20	32	146.1	33	39	7	8	3	<20	2.4	99.49
ts462	176,097N; 288,732E	biotite tonalitic gneiss	Ohg	68.25	12.68	7.24	1.63	1.8	2.02	2.69	1	0.171	0.09	0.007	14	580	83	<20	22	167.1	421	78	35	26	12	<20	1.7	99.41
ts471	176,084N; 283,016E	biotite granitic mylonitic gneiss	Ohg	65.14	16.38	3.99	0.85	2.25	3.21	5.17	0.63	0.158	0.06	<0.002	8	2111	70	<20	20	304.8	512	177	38	26	12	<20	1.1	99.33
ts496	176,677N; 281,230E	biotite granitic mylonitic gneiss	Ohg	65.54	14.97	4.85	0.86	2.5	3.77	4.78	0.86	0.256	0.1	<0.002	6	1124	83	<20	<20	217.1	554	194	55	36	13	<20	0.7	99.45
ts498	177,367N; 289,206E	mus. bio. granodioritic protomylonitic gneiss	Ohg	73.15	13.73	1.66	0.35	1.05	3.43	4.93	0.18	0.075	0.03	<0.002	<5	311	24	<20	24	101	97	51	27	24	5	<20	0.8	99.46
ts511	177,532N; 288,611E	biotite tonalitic gneiss	Ohg	69.23	14.64	3.73	0.96	1.64	4.28	2.38	0.4	0.13	0.05	0.003	<5	373	44	<20	22	216.1	210	59	17	15	7	<20	1.9	99.43
ts541	177,463N; 289,280E	muscovite quartz schist	Ohg	81.06	10.04	2.14	0.45	0.02	0.1	3.35	0.34	0.005	0.02	<0.002	<5	200	19	<20	24	4.9	172	44	5	21	5	<20	1.9	99.46
ts657	177,081N; 282,801E	granitic gneiss	Ohg	74.83	12.84	1.51	0.08	0.64	3.47	4.74	0.1	0.036	0.03	<0.002	13	63	32	<20	<20	17.3	111	<30	58	53	4	<20	1.2	99.51
ts897	173,279N; 288,315E	biotite granitic protomylonitic gneiss	Ohg	69.4	14.56	2.98	0.71	1.91	3.62	4.82	0.49	0.145	0.06	<0.002	<5	678	43	<20	<20	161.8	270	87	33	28	7	<20	0.6	99.44

[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



Topography mapped and edited by the Tennessee Valley Authority
Published by the Geological Survey

Control by NOS/NOAA, USGS, and TVA

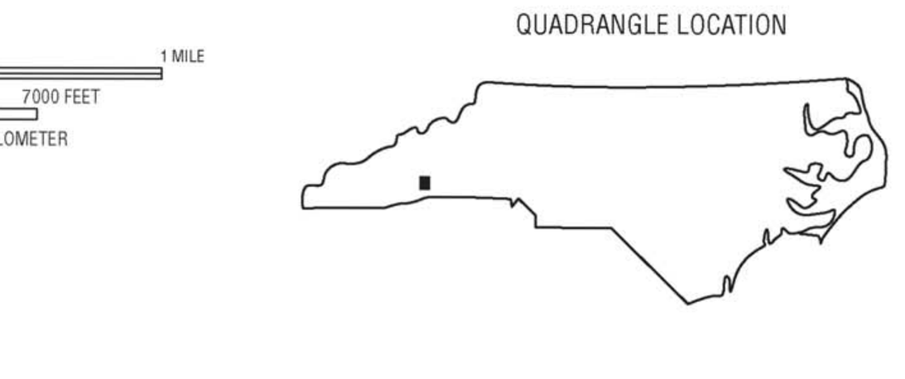
Revised by photogrammetric methods from aerial photographs taken 1962
Field checked 1965

UTM GRID AND 2009 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

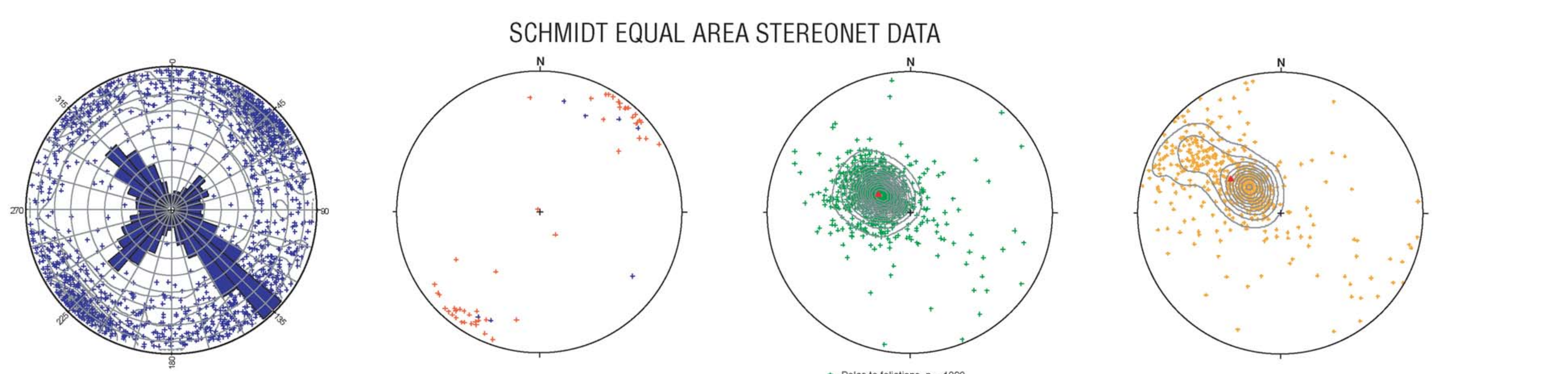
CONTOUR INTERVAL 40 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION



HORSE SHOE, N.C.
1965
PHOTOREVISED 1991

SCHMIDT EQUAL AREA STEREONET DATA



ROCK DESCRIPTIONS[1]

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 less common, biotite and garnet. Pegmatites typically crosscut layering and foliation of other rock units. The absence of large igneous intrusive bodies in this area as a source for pegmatitic material suggests that these pegmatites were probably derived from local melting during regional high-grade metamorphism.

migmatite – White to very light-gray, non-foliated to weakly foliated; medium- to coarse-grained; equigranular; granoblastic; occurs commonly as thin layers and lenses; (thickness of layering ranges from centimeters to decimeters) within other rock types (most commonly metagraywacke) and small mappable bodies; locally gradational with pegmatite; consists of plagioclase feldspar, potassium feldspar, quartz, muscovite, sericite, and biotite. Migmatite (neosome) was most likely derived from local melting during regional high-grade metamorphism.

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 are flattened in the mylonitic foliation planes and give rise to 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, epidote, biotite, and trace accessory minerals. Rounded to elongated feldspar porphyroclasts are common. Interpreted to be a fault slice of mylonitic Henderson Gneiss interlayered with sericite phyllite by Brevard Zone deformation.

Table Rock Plutonic Suite

Muscovite-Biotite Granitoid Gneiss (SOmbg) – White to very light gray, medium to coarse- grained, equigranular, granoblastic, massive to weakly foliated, consists of potassium feldspar, plagioclase, quartz, biotite, and muscovite. Unit contains outcrops of Henderson Gneiss. Tentatively correlated with the 438 Ma intrusives into the Henderson Gneiss of Lemmon (1973).

Henderson Granitic Gneiss

Henderson Gneiss (Ohg) – Medium-gray to medium-bluish-gray; 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 3 to 42% potassium feldspar, 23 to 43% plagioclase, 14 to 37% quartz, 2 to 13% biotite, 0 to 5% muscovite, 0 to 4% epidote group minerals, 0 to 5% opaques, 0 to 1% hornblende and titanite, and trace zircon and apatite; locally pegmatitic and migmatitic. Locally the 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 490 million years old (Carrigan et al., 2001).

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

Fine-grained Henderson Gneiss (Ohgf) – Medium-gray to medium-bluish-gray; inequigranular; fine- to medium-grained matrix with small 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 potassium feldspar, plagioclase, quartz, biotite, muscovite, epidote group minerals, opaques, hornblende, titanite, and trace zircon and apatite; locally pegmatitic and migmatitic. The augen structures are produced by a high temperature protomylonitic overprint.

Biotite granodioritic gneiss (Ohbg) – Medium gray to dark gray; fine to medium-grained; equigranular; granoblastic to lepidoblastic; weakly foliated; consists of approximately 43% plagioclase, 32% quartz, 10% potassium feldspar, 5% biotite, 2% muscovite, 2% epidote, 1% opaques, and the alteration minerals sericite (3%) and epidote (2%); locally pegmatitic and migmatitic. Interpreted to be a compositional variation of the Henderson Gneiss. Locally interfoliated with typical Henderson Gneiss, layered biotite granitoid gneiss, and granite. Mapped with rare calc-silicate granofels on a ridge east of Bowman Bluff and with a rare amphibolite lens. Locally mylonitic.

Granitic gneiss (Ohgg) – Very light gray to light gray; fine- to medium-grained; equigranular; granoblastic to lepidoblastic; weakly foliated, locally mylonitic; consists of approximately 36% plagioclase, 28% potassium feldspar, 28% quartz, 4% biotite, 2% muscovite, 1% epidote and 1% opaques. Interlayered with Henderson Gneiss and biotite granodiorite. Interpreted to be a compositional variation of the Henderson Gneiss or later intrusive.

Layered biotite granitoid gneiss (Ohlbg) – Light-gray to medium-gray; medium- to coarse-grained; equigranular to inequigranular; well foliated, locally mylonitic; consists of quartz, potassium feldspar, plagioclase, biotite, minor muscovite, and other accessory minerals. Interlayered with other variations of the Henderson Gneiss and biotite granodioritic gneiss.

Mixed unit (Ohgm) – An interlayered unit consisting of nearly equal amounts of protomylonitic Henderson Gneiss, granitic gneiss, and biotite granodioritic gneiss. It is characterized by its heterogeneity in contrast with the Henderson Gneiss.

Chauga River Formation

Muscovite-quartz schist (ЄZmq) – Light-gray to olive-gray to dark-gray; medium- to coarse-grained; granular to inequigranular; foliated to mylonitic; consists of quartz, muscovite, and epidote. Occurs in a small lens-like body.

Metagraywacke (ЄZg) – Medium-light-gray to medium-dark-gray; fine-grained; equigranular to inequigranular; lepidoblastic to mylonitic; foliated; consists of approximately 38% quartz, 35% plagioclase, 17% biotite, 9% muscovite, 1% opaques, and trace apatite. Interlayered and gradational into muscovite-biotite schist.

Ashe Metamorphic Suite/ Tallulah Falls Formation

Metagraywacke (Zag) – Medium-light-gray to medium-dark-gray; weakly foliated to well foliated; medium- to coarse-grained; equigranular to inequigranular; granoblastic to lepidoblastic; locally migmatitic; consists of plagioclase, quartz, biotite, muscovite, minor opaques, epidote and apatite; thickness of layering ranges from several decimeters to several meters. Interlayered at all scales with schistose metagraywacke, garnet-mica schist, and conglomeratic metagraywacke.

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

Carrigan, C.W., Bream, B.R., Miller, C.F., and Hatcher, R.D., Jr., 2001, Ion microprobe analysis of zircon rims from the eastern Blue Ridge and Inner Piedmont, NC-SC-GA: Implications for the timing of Paleozoic metamorphism in th esouthern Appalachians: Geological Society of America Abstracts with Programs, v. 33, p. A42.

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.

STRUCTURAL FEATURES

CONTACTS

Solid line – located in field to within 15 meters;
long-dashed – approximately located to within 75 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

STRIKE AND DIP OF PLANAR FEATURES

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

Foliation

Vertical Joint

Mylonitic Foliation

Joint

BEARING AND PLUNGE OF LINEAR FEATURES

Small Fold Axis

Lineation

NON-STRUCTURAL FEATURES

Float station

MINERAL RESOURCES

hm52 — Stream sediment heavy mineral and scintillation sample site. Sample numbers correspond to stream sediment heavy mineral analyses listed in table.

ts194 — Thin section sample site.

Abandoned mine or quarry

COMMODITY LETTER SYMBOLS:

gr granite

gr-1: Mineral resource number, referred to in accompanying Mineral Resource Summary. Commodity indicated by letter symbol.

MAP SHOWING ELEMENTS OF METAMORPHIC CONDITIONS

Metamorphic minerals observed in stream sediment heavy mineral samples and thin sections shown. Sample site localities shown on geologic map.

Heavy mineral sample site

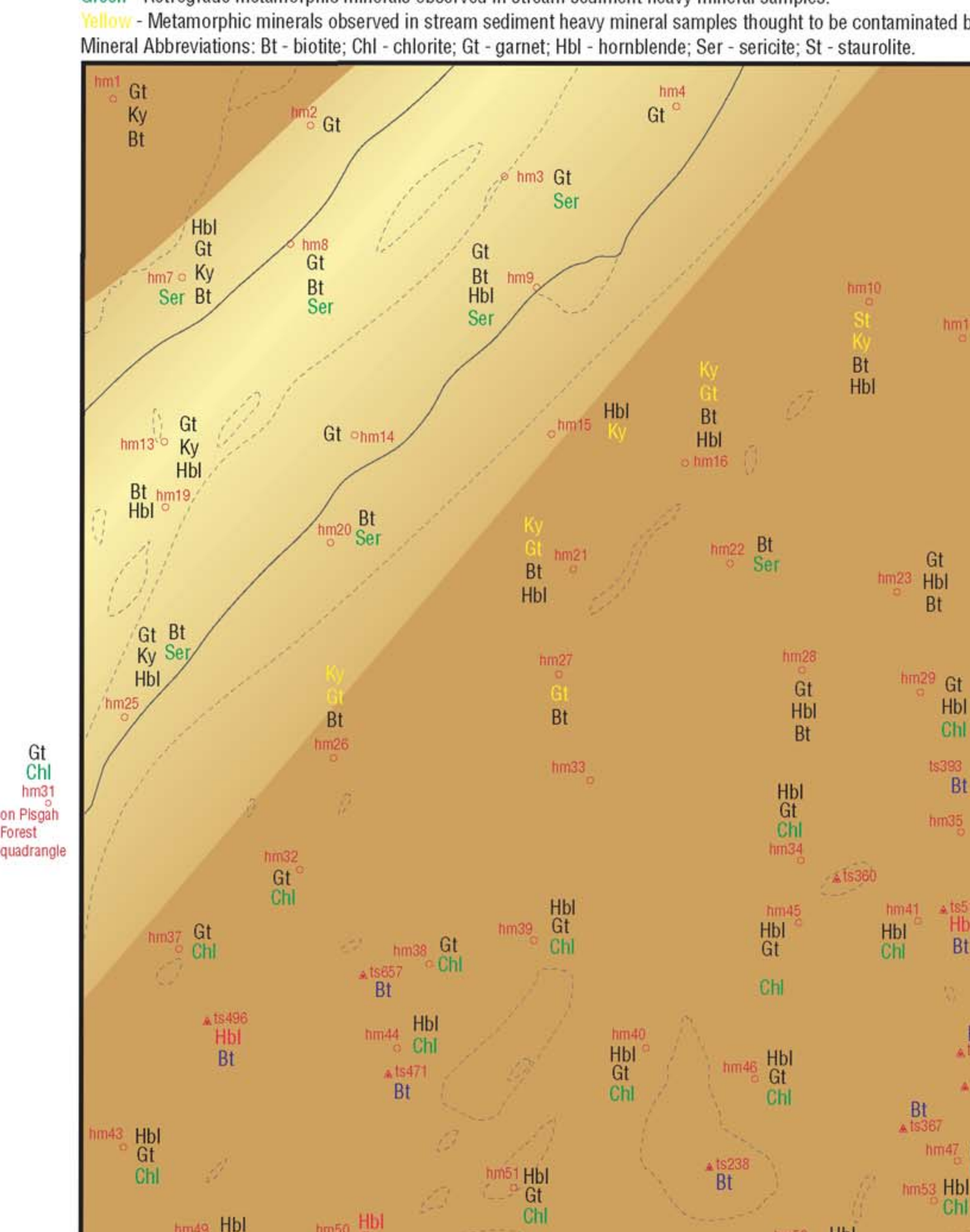
Thin section sample site

Metamorphic Zones (from thin section and stream sediment heavy mineral data)

Area of amphibolite facies metamorphism

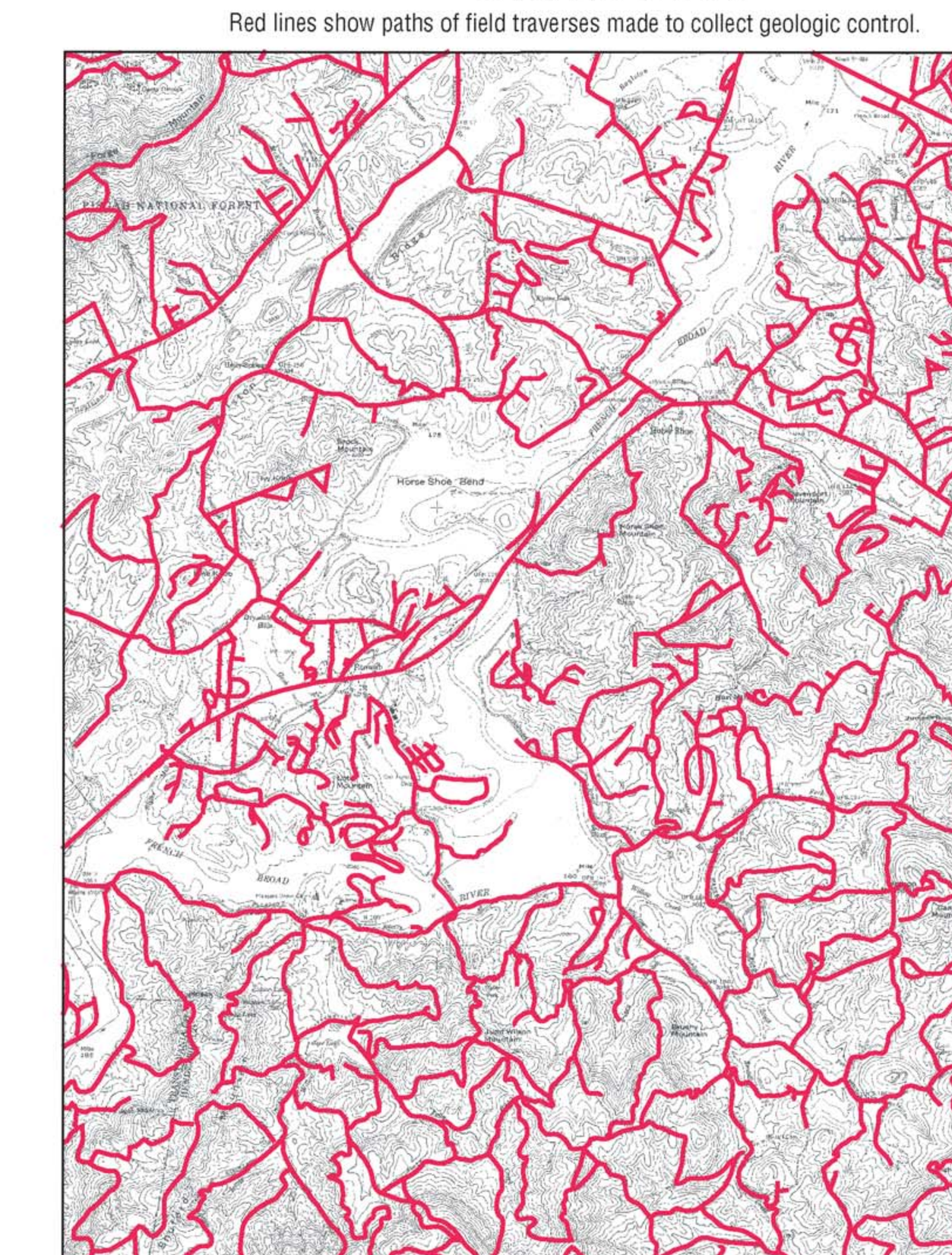
Area of retrograde greenschist facies metamorphism

Red - Prograde metamorphic minerals observed in thin sections;
Blue - Primary igneous minerals observed in thin sections.
Black - Prograde metamorphic minerals observed in stream sediment heavy mineral samples.
Green - Retrograde metamorphic minerals observed in stream sediment heavy mineral samples.
Yellow - Metamorphic minerals observed in stream sediment heavy mineral samples thought to be contaminated by stream terrace deposits.
Mineral Abbreviations: Bt - biotite; Chl - chlorite; Gt - garnet; Hbl - hornblende; Ser - sericite; St - staurolite.



TRAVERSE MAP

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



This Open-File Map is preliminary. It has not been externally reviewed for conformity with the North Carolina Geological Survey Geologic Map Series editorial standards or with the North American Stratigraphic Code. Further revisions or corrections to this Open File map may occur prior to its release as a North Carolina Geological Survey map.

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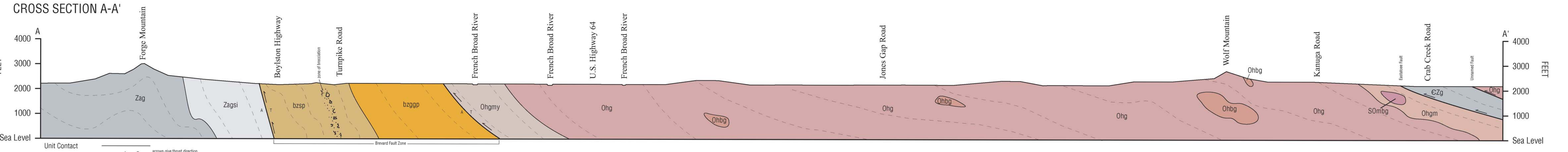
CROSS SECTION A-A'



Unit Contact
Fault Contact
Form Lines

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

By
Bart L. Cattanach and Carl E. Merschat

Geology mapped from September 2007 to June 2009. Map preparation, digital cartography and editing by G. Nicholas Bozdog, Bart L. Cattanach and Carl E. Merschat.
2009