BEDROCK GEOLOGIC MAP OF THE LEICESTER 7.5-MINUTE QUADRANGLE, NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES

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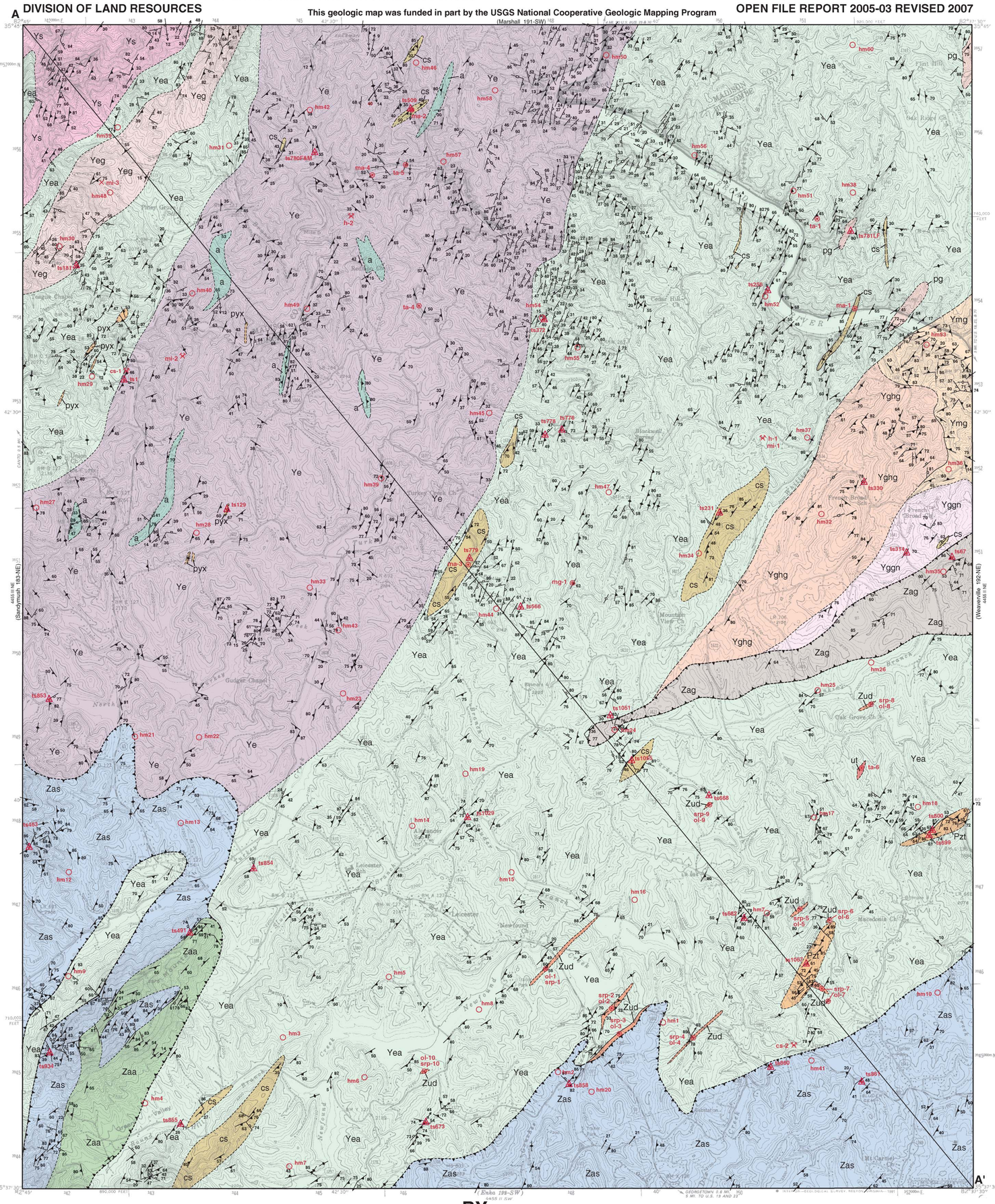

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Additional geologic data collected by Leonard Wiener, Al Carpenter and Jerry Bundy, 1968-1970.
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QUADRANGLE LOCATION

UTM GRID AND 1990 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT HALF INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP UNITS

PALEOZOIC

- Pzt — Trondhjemite
- Pegmatite

LATE PROTEROZOIC — Stratigraphic Relationships Uncertain

Ashe Metamorphic Suite:
- Zud — Ultramafic Dunite
- Zag — Metagraywacke
- Zaa — Amphibolite
- Zas — Schist

MIDDLE PROTEROZOIC — Stratigraphic Relationships Uncertain

- Ys — Sandymush Felsic Gneiss
- Ymg — Interlayered Mafic Gneiss
- Yghg — Garnet Hornblende Granofels
- Yeg — Earlies Gap Granitic Gneiss
- Ye — Earlies Gap (cs) calc-silicate (pyx) altered pyroxenite (a) amphibolite
- Yea — Earlies Gap Amphibolitic Gneiss (pyx) pyroxenite (a) amphibolite (ut) ultramafic talc (pg) pyroxene granulite
- Yggn — Granulitic Granitic Gneiss (cs) calc-silicate

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

STRUCTURAL FEATURES

CONTACTS

Solid line – located in field to within 15 meters; long-dashed – approximately located to within 75 meters; short-dashed – inferred; queried where uncertain

Thrust Fault (teeth on upper plate)

Stratigraphic Contact

STRIKE AND DIP OF PLANAR FEATURES

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

Foliation; Joint; Vertical Foliation; Vertical Joint; Mylonitic Foliation; Brecciated Surface; Vertical Mylonitic Foliation; Axial Plane of Small Fold

BEARING AND PLUNGE OF LINEAR FEATURES

Small Fold Axis; Lineation; Axis of Crenulation Cleavage

MINERAL RESOURCES

Occurrence; Prospect; Abandoned mine or quarry

COMMODITY LETTER SYMBOLS:

- h Halloysite
- cs Crushed stone
- fill Fill material
- mg Magnetite
- mi Mica
- ol Olivine
- srp Serpentine
- ta Talc
- ma Marble

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

hm34: Stream sediment heavy mineral and scintillation sample site. Sample numbers correspond to stream sediment heavy mineral analyses listed in table to lower left.

ts67: Thin section sample site.

DESCRIPTION OF MAP UNITS[1]

PALEOZOIC

TRONDHJEMITE - Very light gray to medium light gray to very pale orange; fine- to medium-grained; mostly unfoliated thin dikes and sills; thicknesses range from several centimeters to a meter to small mappable bodies. Composition varies from tonalite to quartz diorite and consists of 69 to 76% plagioclase, 15 to 19% quartz, 7 to 9% biotite, 1 to 2%muscovite, 1% opaques, trace zircon, apatite, and titanite. Numerous bodies in the SE quarter of the map, but too small and discontinuous to show at map scale. The larger bodies may contain xenoliths of intruded rock.

PEGMATITES - White to mottled white and pink; coarse-grained; dominantly crosscutting; lenticular to tabular; thickness ranges from centimeters to meters; consists of plagioclase, k-feldspar, quartz, biotite, muscovite and other minor minerals. Not mapped.

LATE PROTEROZOIC

DUNITES (Zud) - Pale olive to dusky yellow; dusky yellow when weathered; unaltered to highly altered. Unaltered dunite is composed of olivine (forsterite) and minor chromite, whereas altered dunite contains various amounts of serpentine minerals, talc, anthophyllite, vermiculite, and opaques. Deeply weathered areas are characterized by a nickeliferous saprolite and a dusky-red to very dark-red soil with reisual chalcedonic fragments. The dunites in the Juno area are small, highly altered and weathered.

ASHE METAMORPHIC SUITE

Ashe Metagraywacke (Zag) - Metagraywacke rock type of the variable Ashe metamorphic suite. Interlayered with garnet muscovite schist, biotite gneiss and amphibolite. Medium light gray; granoblastic to lepidoblastic; medium- to coarse-grained, weakly foliated; medium to thick layered; locally migmatitic; consists of 54% quartz, 25% plagioclase, 10% biotite, 6% muscovite, 4% garnet, 1% black opaque minerals, and traces of apatite and zircon.

Ashe Schist (Zas) - Composed of repetitive layers of kyanite-garnet-mica schist, garnet-mica schist, schistose metagraywacke, metagraywacke, and rare thin amphibolites and calc-silicates. These rock types were not mapped separately. The kyanite-garnet-mica schist is light gray to medium light gray; strongly foliated; fine- to medium-grained; equigranular to inequigranular; lepidoblastic to weakly granoblastic to porphyroblastic; locally migmatitic and consists of 25 to 31% quartz, 14 to 30% plagioclase, 20 to 25% biotite, 10 to 19% muscovite, 3 to 9% kyanite, 4 to 5% garnet, 1 to 2% opaques, trace apatite. The schistose metagraywacke is medium-gray to medium dark-gray; weakly foliated to strongly foliated; medium to fine-grained; equigranular to inequigranular; granoblastic to weakly lepidoblastic; locally migmatitic; consists of 32 to 58% quartz, 17 to 39% plagioclase; 13 to 24% biotite; 2 to 11% muscovite, 0 to 2% garnet; 1% opaques; trace to 1% zircon; and trace to 1% titanite.

Ashe Amphibolite (Zaa) - Dark-green to black; equigranular; fine- to medium-grained; strongly foliated; nematoblastic; thickness of layering varies from centimeters to meters; consists of 41% plagioclase, 37% hornblende, 18% epidote, 3% titanite, 1% opaques, and a trace zircon.

MIDDLE PROTEROZOIC

SANDYMUSH FELSIC GNEISS (Ys) - Thick, monotonous repetitive sequence of layered rocks dominated by biotite granitic gneiss to quartz dioritic gneiss with interlayers of biotite schist and amphibolite. Very light gray to pale orange to medium light gray; medium- to coarse-grained; granoblastic to lepidoblastic, locally protomylonitic; well foliated; layer thicknesses range from millimeter to meter scale; consists of quartz, plagioclase, potassium feldspar, biotite, epidote group minerals, muscovite, opaques and trace amounts of garnet, sphene, apatite, and zircon.

INTERLAYERED MAFIC GNEISS (Ymg) - Heterogeneous unit consisting of amphibolite, medium-grained garnet hornblende granofels, layered biotite granitic gneiss and calc-silicate interlayered on a scale of decimeters to meters. Color varies with rock type; locally migmatitic and granulitic; medium- to coarse-grained; massive to well foliated; composition varies with rock type but is generally more mafic than the layered biotite granitic gneiss.

GARNET HORNBLENDE GRANOFELS (Yghg) - Grayish black to black with dusky red garnets; granoblastic, coarse- to very coarse- grained; massive to weakly foliated; sample consists of 67% hornblende, 20% garnet, 7% plagioclase, 6% quartz, and traces of pyroxene, black opaque minerals, and rutile.

GRANULITIC GRANITIC GNEISS (Yggn) - Biotite granitic gneiss exhibiting coarse, granular texture typical of granulite facies metamorphism. Interfayered with calc-silicate and biotite hornblende granitic gneiss. Calc-silicate bodies (cs) depicted separately where mappable.

biotite granitic gneiss - Yellowish gray to medium gray; coarse-grained; granoblastic to lepidoblastic to clotty; foliated; locally migmatitic; consists of 42-51% plagioclase, 14-26% quartz, 12-23% biotite, trace-18% garnet, 0-6% hornblende, trace-3% black opaques, trace-1% sphene, 0-1% red opaques, and trace amounts of zircon and apatite.

calc-silicate - Very light gray to very pale green to pinkish gray with dark yellowish orange splotches on weathered surfaces; medium- to coarse-grained, granoblastic, weakly foliated to well foliated; Epidosite layers present locally consist almost entirely of epidote with minor quartz and alteration minerals.

MIDDLE PROTEROZOIC continued

EARLIES GAP BIOTITE GNEISS (Ye) - A hetrogeneous unit that includes numerous varieties of biotite gneiss and layered biotite granitic gneiss, interlayered with amphibolite (a), calc-silicate granofels (cs), altered pyroxenite (pyx), minor muscovite-biotite gneiss, and rare marble. Biotite granodiorite gneiss to biotite tonalitie gneiss is dominant; biotite granitic gneiss to quartz diorite gneiss is very similar to portions of the Sandymush Felsic Gneiss (ys). The "wavy" appearance of the layers of coarse-grained biotite granodiorite gneiss to biotite tonalite gneiss are distinctive of this unit. These biotite gneisses are very light gray to medium light gray; lepidoblastic to equigranular granoblastic; locally mylonitic and migmatitic; strongly foliated; layer thicknesses range from centimeters to meters; consist of plagioclase, quartz, biotite, k-feldspar, epidote group minerals, muscovite, opaques, garnet, apatite, and chlorite.

Biotite granitic gneiss - Predominantly medium light gray to very light gray; lepidoblastic to granoblastic; medium- to coarse-grained; well foliated; samples consist of 0-50% hornblende, 21-41% plagioclase, 22-40% quartz, 0-16% potassium feldspar, 5-13% biotite, 0-2% garnet, trace-1% black opaques, trace-1% epidote, 0-1% sericite, 0-1% sphene, and trace amounts of zircon and red opaque minerals.

calc-silicate - Very light gray to very pale green to pinkish gray with dark yellowish orange splotches on weathered surfaces; medium- to coarse-grained, granoblastic, weakly foliated to well foliated; calc-silicate sample from Ybgg consists of 62% carbonate, 16% diopside, 5% quartz, 5% talc, 5% epidote, 4% biotite, 2% potassium feldspar, and 1% plagioclase feldspar.

amphibolite - Dark gray to greenish black; medium- to coarse-grained; granoblastic to nematoblastic; massive to well foliated; consists of hornblende, plagioclase, quartz, biotite, black opaque minerals, and epidote.

altered pyroxenite - Interpreted to be retrograded ultramafic assemblages where pyroxene has been altered to green amphibole and chlorite. Grayish green to dusky green; fine- to medium-grained; granoblastic to nematoblastic; massive to slightly foliated; sample consists of 49% diopside, 45% quartz, 3% black opaques, 2% plagioclase, 1% garnet, and traces of red opaques and apatite.

EARLIES GAP AMPHIBOLITIC GNEISS (Yea) - Heterogeneous unit containing amphibolite-rich layered biotite-hornblende tonalitic to quartz dioritic gneiss and layered biotite granitic gneiss. Amphibolite bodies (a), altered pyroxenite bodies (pyx), and calc-silicate (cs), pyroxene granulite (pg), and altered ultramafic (ut) were identified and mapped separately where possible. . Calc-silicate bodies represent initial compositional variations within the protolith. Diopside within the calc-silicate bodies may indicate relict granulite facies metamorphism. Pyroxene granulite bodies are interpreted to be un-retrograded areas within the varied layered biotite hornblende gneiss unit that preserve relict granulite facies mineralogy, textures, and even foliation. The biotite-hornblende gneisses medium light gray to grayish black; medium- to coarse-grained; granoblastic to lepidoblastic to nematoblastic; well foliated; consists of 18 to 67% plagiclase, 0 to53% hornblende, 5 to 47% quartz, 11to35% biotite, 0 to 7% epidote group minerals, 0 to3% garnet, 0 to 1% opaques, 0 to1% titanite, trace zircon, and apatite.

amphibolite - Dark gray to greenish black; medium- to coarse-grained; granoblastic to nematoblastic; massive to well foliated; consists of 50% hornblende, 31% plagioclase, 5% biotite, 10% quartz, 2% epidote group minerals, 1% titanite, and a trace zircon.

altered- pyroxenite - Interpreted to be retrograded ultramafic assemblages where pyroxene has been altered to green amphibole and chlorite. Grayish green to dusky green; fine- to medium-grained; granoblastic to nematoblastic; massive to slightly foliated; consists of 57% actinolite, 15% plagioclase, 11% biotite, 6%, garnet, 5% quartz, 2% talc, 1% opaques, and a trace chlorite and zircon.

calc-silicate - Very light gray to very pale green to pinkish gray with dark yellowish orange splotches on weathered surfaces; medium- to coarse-grained, granoblastic, weakly foliated to well foliated; consists of 8 to 45% epidote group minerals (epidote and clinozoisite), 0 to 42% plagioclase, 0 to 42% actinolite, 10 to 40 % quartz, 2 to 6% diopside, 0 to 15% hornblende, 0 to10% talc, 0 to 7% garnet, 0 to 2% titanite, 0 to 1% opaques, and a trace zircon. Epidosite layers present locally consist almost entirely of epidote with minor quartz and alteration minerals.

pyroxene-granulite - Consists of mafic and felsic phases. Color varies with protolith; coarse-grained; granoblastic with clots of hornblende and pyroxene throughout the matrix; massive to well foliated; consists of 53% plagioclase, 21% biotite, 7% perthite, 7% hornblende, 5% hypersthene, 4% diopside, 2% epidote group minerals, 1% quartz, 1% black opaques, 1% sphene, and trace amounts of apatite.

altered ultramafic - Very pale green to grayish green; foliated; consists of talc with minor chlorite and black opaques; float.

EARLIES GAP GRANITIC GNEISS (Ygg) - Granitic orthogneiss with minor interlayers of biotite granitic gneiss. Very pale orange to yellowish gray; coarse-grained; granoblastic to protomylonitic, gneissic foliation defined by asymmetric quartz and feldspar grains and micas; massive to moderately foliated; consists of 63% feldspar, 28% quartz, 6% biotite, 3% epidote group minerals, and trace amounts of muscovite and titanite.

[1]Mineral percentage is based on modal analyses and visual estimates of selected samples.

WHOLE ROCK ICP ANALYSIS[1] OF SELECTED SAMPLES

SAMPLE[2]	COORDINATES (State Plane, NAD 83 Meters)	ROCK TYPE	MAP UNIT	OXIDES IN PERCENT SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	ELEMENTS IN PPM[3] Ba	Cu	Zn	Ni	Co	Sr	Zr	Ce	Y	Nb	Sc	Ta	LOI[4]	SUM[5]
L-67	221,528N; 281,380E	muscovite-biotite gneiss	Zag	79.76	8.62	4.07	1.07	1.03	0.95	1.86	0.85	0.13	0.05	0.004	528	<20	40	<20	<20	138	571	76	38	17	7	<20	1.2	99.77
L-314	221,603N; 280,820E	pyroxene biotite gneiss	Yggn	46.62	13.97	14.84	3.35	7.93	2.64	2.15	3.92	2.22	0.17	0.003	1874	<20	245	<20	27	682	1908	554	79	92	26	<20	1.5	100
L-314B	221,603N; 280,820E	granulitic biotite granitic gneiss	Yggn	64.92	15.32	6.73	2.13	3.15	3.05	2.14	0.7	0.19	0.09	0.016	786	41	100	41	<20	260	240	163	27	<10	15	<20	0.8	99.44
L-1	223,999N; 271,600E	layered biotite granitic gneiss	Ye	72.35	12.78	3.49	0.87	2.17	2.9	3.51	0.34	0.11	0.08	0.002	1343	<20	50	<20	<20	318	195	48	40	<10	11	<20	0.8	99.64
L-129	222,412N; 272,762E	garnet-quartz rock	Ye	49.45	1.31	33.72	7.41	0.54	0.05	0.02	5.81	0.22	1.16	0.028	51	97	317	49	53	<10	60	<20	28	581	65	<20	0.1	99.99
L-780F	226,630N; 273,961E	felsic layered bgg	Ye	75.95	11.03	3.37	0.62	1.36	3.3	2.59	0.23	0.01	0.03	0.002	881	64	44	<20	<20	92	340	356	11	<10	2	<20	0.8	99.52
L-780M	226,630N; 273,961E	mafic layered bgg	Ye	57.66	15.3	8.8	4.26	7.77	3.57	0.44	0.85	0.16	0.11	0.023	106	26	74	42	21	332	105	48	28	<10	26	<20	0.4	99.43
L-181	225,373N; 271,061E	mylonitic granitic gneiss	Yeg	76.62	12.08	2.04	0.17	0.72	3.23	4.51	0.16	0.03	0.02	0.002	442	<20	30	<20	<20	73	228	59	13	<10	2	<20	0.1	99.79
L-231	222,161N; 278,621E	calc-silicate	cs	66.43	14.58	3.51	0.66	6.46	3.48	2.63	1.85	0.07	0.06	0.003	1392	<20	34	<20	<20	226	161	222	70	261	6	<20	0.1	100.12
L-509	227,097N; 275,128E	clotted amphibole quartz rock	cs	17.68	3.21	2.27	4.8	43.5	0.35	0.82	0.12	0.05	0.24	0.002	127	27	79	<20	<20	107	40	71	18	<10	3	<20	26.7	99.8
L-779	221,695N; 273,567E	calc-silicate	cs	67.33	12.59	4.05	1.86	7.89	2.3	1.89	0.41	0.27	0.1	0.014	1398	<20	264	<20	<20	178	88	51	13	<10	17	<20	0.7	99.63
L-256	224,779N; 279,288E	granulitic biotite granitic gneiss	Yea	53.46	16.87	10.07	3.6	6.85	4.25	1.46	1.24	0.39	0.15	<.001	442	26	86	<20	22	586	82	109	46	<10	29	<20	1	99.51
L-372	224,545N; 276,609E	mylonitic amphibolite	Yea	46.36	15.75	13.62	5.69	8.76	2.83	1.9	2.75	0.46	0.16	0.004	452	51	110	45	46	510	174	59	29	10	20	<20	1.1	99.58
L-566	221,118N; 276,210E	layered amphibolite/calc-silicate	Yea	65.39	14.33	6.7	2.23	6.11	2.32	0.2	0.94	0.23	0.09	0.011	203	63	39	24	<20	733	277	107	45	20	13	<20	1.3	100.04
L-776	223,218N; 276,768E	layered bgg	Yea	72.51	10.58	5.03	3.36	1.2	2.84	2.22	0.28	0.03	0.06	<.001	645	<20	82	<20	<20	197	475	68	44	17	7	<20	1.3	99.6
L-778	223,169N; 276,585E	fine-grained granitic gneiss	Yea	70.7	15.44	2.05	0.37	2.78	3.78	3.32	0.14	<.01	0.02	<.001	3593	<20	<20	<20	<20	779	150	38	<10	<10	1	<20	0.4	99.53
L-330	222,464N; 280,344E	garnet homblendite	Yea	47.41	14.16	12.41	11.51	10.65	1.41	0.16	0.9	0.07	0.17	0.063	34	83	78	160	56	31	44	23	22	<10	51	<20	0.6	99.58
L-LF	225,463N; 280,300E	felsic granulite	pg	53.29	16.19	9.26	3.62	5.92	3.61	3.42	2.19	0.84	0.15	0.002	1173	22	69	<20	21	481	340	143	63	72	22	<20	0.6	99.37
L-463	218,469N; 270,263E	kyan.-garn.-mica schist	Zas	55.46	22.76	8.13	2.31	1.72	2.48	3.45	0.84	0.23	0.15	0.009	708	27	166	8	17	214	191	181	65	22	21	5	2.2	99.94
L-491	217,389N; 272,135E	layered amphibolite	Zaa	48.23	14.94	10.68	8.7	11.9	2.25	0.44	1.11	0.08	0.17	0.035	71	15	102	143	68	156	84	5	20	7	35	5	1.3	99.92
L-668	218,782N; 273,385E	calc-silicate granofels	Yea	58.54	16.43	6.51	2.51	9.87	2.87	0.42	0.88	0.29	0.11	0.008	131	19	74	27	35	785	474	177	33	16	13	8	1.4	100.06
L-673	215,035N; 274,847E	altered pyroxenite	Yea	48.45	16.39	10.63	8.29	7.38	1.13	3.2	0.96	0.15	0.15	0.043	425	15	259	168	53	169	181	22	21	11	24	5	3	99.93
L-682	217,330N; 278,716E	bio.-quartz-fonalitic gneiss	Yea	65.91	12.97	6.57	2.83	4.35	1.9	2.34	0.9	0.2	0.12	0.008	950	30	114	23	25	324	326	66	16	18	13	6	1.6	99.93
L-699	218,222N; 280,966E	bio.-horn.-quartz-dioritic gneiss	Yea	53.63	15.86	9.52	5.71	6.79	2.76	2.44	0.95	0.19	0.15	0.037	711	27	128	82	49	358	163	53	18	14	23	5	1.7	99.93
L-800	218,347N; 281,034E	tonalite	Pzt	71.32	15.24	2.2	0.46	2.13	5.64	1.75	0.19	0.08	0.04	0.001	371	5	43	5	5	707	101	13	5	5	2	5	0.9	100.00
L-853	220,231N; 270,562E	bio.-horn-fonalitic gneiss	Yea	52.31	13.45	12.48	6.65	6.69	1.5	2.77	1.32	0.19	0.19	0.037	589	27	163	159	58	243	118	45	24	21	23	6	2	99.92
L-854	218,130N; 272,913E	musc.-bio.-fonalitic gneiss	Yea	76.84	10.1	3.25	0.56	0.83	2.03	4.59	0.58	0.06	0.07	0.003	1071	5	44	5	18	189	409	61	22	18	4	5	0.8	99.93
L-855	215,124N; 271,932E	horn.-bio.-fonalitic gneiss	Yea	61.63	13.98	8.22	3.04	3.87	2.82	3.32	0.9	0.3	0.1	0.016	1157	35	140	44	34	317	498	49	16	17	15	5	1.6	100.08
L-858	215,434N; 276,564E	schistose metagraywacke	Zas	79.46	8.12	4.76	0.98	1.15	1.23	1.45	0.91	0.11	0.07	0.005	526	30	95	10	22	204	613	50	21	22	7	5	1.5	99.84
L-860	215,544N; 278,956E	schistose metagraywacke	Zas	63.77	14.38	7.28	2.93	2.4	2.21	3.11	1.05	0.29	0.08	0.008	571	66	173	14	28	232	627	61	22	23	18	5	2.2	99.92
L-861	215,336N; 280,039E	schistose metagraywacke	Zas	61.51	15.8	7.01	2.9	3.23	2.5	2.48	0.88	0.22	0.21	0.015	506	16	213	5	22	332	286	106	61	19	20	5	3	99.94
L-904	216,012N; 270,412E	schistose metagraywacke	Zas	55.53	20.12	9.55	2.26	1.96	2.31	3.35	0.96	0.32	0.13	0.01	745	56	247	36	52	215	299	146	61	26	19	6	3.2	99.92
L-1029	218,631N; 275,470E	calc-silicate granofels	cs	65.13	15.75	3.49	0.76	6.86	1.84	2.58	0.23	0.16	0.07	0.004	1671	9	148	21	5	275	150	138	38	9	6	5	2.9	100.06
L-1051	219,805N; 277,218E	amphibolite	Yea	51.81	13.42	11.89	4.64	9.07	2.65	2.53	1.58	0.5	0.18	0.013	989	41	223	56	62	324	196	80	49	17	31	6	1.4	99.92
L-1055	219,251N; 277,440E	calc-silicate granofels	cs	50.12	17.04	8.66	3.78	16.32	0.34	0.26	0.7	0.24	0.17	0.021	121	5	108	26	28	826	178	70	37	15	16	5	2.1	99.92
L-1067	216,753N; 279,453E	quartz diorite	Pzt	68.91	16	3.12	0.72	3.17	5.8	1.01	0.25	0.08	0.06	0.001	193	6	64	7	19	859	84	19	9	6	5	5	0.8	100.07

[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

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.

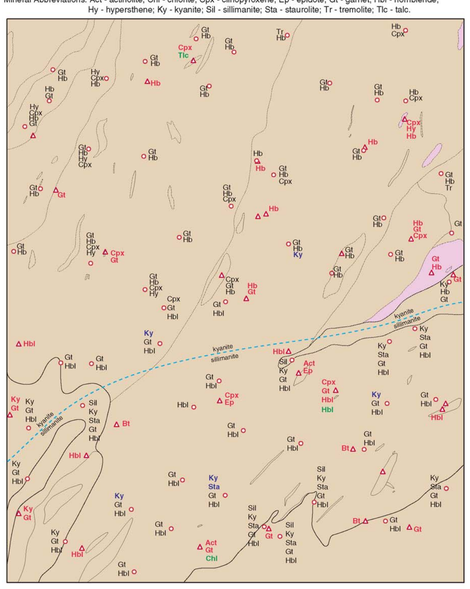
- Stream sediment heavy mineral sample site
- Thin section sample site
- Isograd indicates first appearance of sillimanite (kyanite → sillimanite)

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

- Areas of amphibolite facies metamorphism
- Areas of relict Grenville granulite facies metamorphism

Red - Prograde metamorphic minerals observed in thin sections;
Green - Retrograde metamorphic minerals observed in thin sections;
Blue - Aberrant metamorphic minerals observed in stream sediment heavy mineral samples (detrital grains or contamination?).
Black - Prograde metamorphic minerals observed in stream sediment heavy mineral samples (igneous or metamorphic origin of hornblende, pyroxenes, and garnet undetermined);

Mineral Abbreviations: Act - actinolite; Chl - chlorite; Cpx - clinopyroxene; Ep - epidote; Gt - garnet; Hbl - hornblende; Hy - hypersthene; Ky - kyanite; Sil - sillimanite; Sta - staurolite; Tr - tremolite; Tlc - talc.



MAP SHOWING CONTOURED SCINTILLATION READINGS

Gamma radiation readings recorded at ground level using a Eberline ESP-2 Scintillation Counter with a 2" x 0.5" sodium iodide crystal from November 2003 – January 2004. Gamma radiation results from the disintegration of Uranium^{238} in radioactive oxides and soluble radioactive salts, emanation of radon gas, and cosmic radiation. Values are not corrected for background cosmic radiation or radon gas emissions. Contouring by triangulation using RockWorks99 by RockWare.

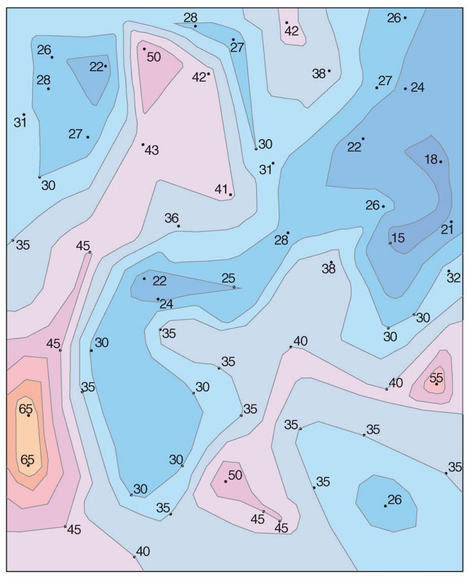
40 • Scintillation sample site and counts per second

Counts per second

Sample sites correspond with stream sample heavy mineral locations

Isometric interval = 5 count per second

15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65



STREAM SEDIMENT HEAVY MINERAL ANALYSIS

Stream sediment heavy mineral analysis was conducted from November 2003 through January 2004 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; Ep-epidote group minerals; Hb-hornblende; Zr-zircon; Ttn-titanite; Rt-rutile; Lx-leucoxene; Hem-hematite and other red opaque minerals; Il-ilmenite and other black opaque minerals; Unid-unidentified; Ens-enstatite; Mz-monazite; Tr-tremolite; Sta-staurolite; Hy-hypersthene; Sil-sillimanite; Ant-anthophyllite; Ky-kyanite.

SAMPLE[1]	NC COORDINATES (State Plane, NAD 83, in Meter)	MAP UNITS DRAINED[2]	%HM IN SAMPLE[3]	PERCENT HEAVY MINERALS IN SAMPLE[4] Mg	Gt	Ep	Hb	Zr	Ttn	Rt	Lx	Hem	Il	Unid	Ens	Mz	Tr	Sta	Hy	Sil	Ant	Ky
hm1	215,969N; 277,537E	Yea	0.10	10.53	0.89	5.37	2.68	29.97	2.68	0.45	4.03	8.05	32.21	0.00	0.00	0.00	0.00	1.79	0.00	0.00	0.00	1.34
hm2	215,428N; 276,267E	Zas, Yea	0.11	7.71	6.46	0.92	0.46	17.53	2.31	0.00	5.08	9.23	44.76	0.46	0.00	0.00	0.00	1.85	0.00	0.46	0.00	2.77
hm3	215,960N; 273,006E	Yea	0.27	4.47	0.48	10.99	16.24	5.25	0.96	0.00	6.21	1.91	51.59	0.00	0.00	0.48	0.00	0.00	0.48	0.00	0.00	0.96
hm4	215,235N; 271,342E	Yea, Zaa	2.67	1.06	0.49	19.29	54.91	3.96	1.48	0.00	0.00	0.00	17.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
hm5	216,633N; 274,293E	Yea	0.87	1.34	2.47	22.20	12.33	11.35	2.47	0.00	0.00	0.49	47.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hm6	215,448N; 273,956E	Yea	0.40	9.96	0.45	7.20	3.15	8.55	1.80	0.00	1.35	2.25	65.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
hm7	214,417N; 273,023E	Yea, cs	1.84	6.09	0.00	20.19	41.32	9.39	2.35	0.00	1.88	0.00	18.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.41
hm8	216,200N; 275,354E	Yea	0.27	9.71	0.00	3.16	0.00	6.77	0.46	0.45	0.90	3.61	74.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hm9	216,787N; 270,477E	Yea, Zas, Zaa	0.81	0.81	23.81	17.36	25.79	2.48	3.47	0.00	0.00	1.98	22.