NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENERGY, MINERAL, AND 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 2013-02

Landrum 7.5-minute Quadrangle, Open File Map 2013-02

MAP UNITS

MESOZOIC

- breccia

unnamed intrusive

- OCgg granitoid gneiss

ORDOVICIAN

Poor Mountain Formation

- Opmq quartzite
- Opm undivided

unnamed meta-igneous rocks

CAMBRIAN

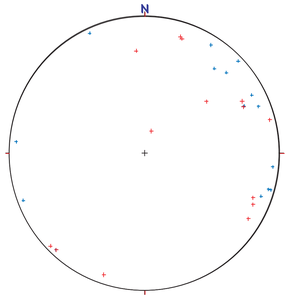
- €Zhqf hornblende quartzofeldspathic gneiss
- €Zhg hornblende gneiss
- €Za amphibolite
- €Zau altered ultramafic

Tallulah Falls Formation

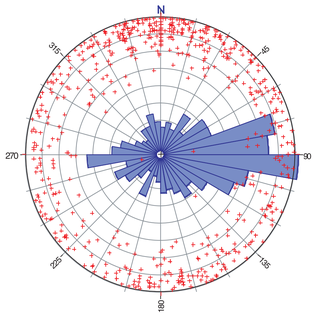
NEOPROTEROZOIC

- €Ztf undivided
- €Ztfb porphyroclastic biotite gneiss

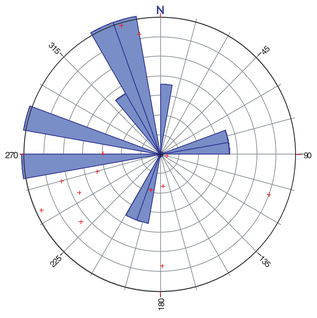
SCHMIDT EQUAL AREA STEREONET DATA



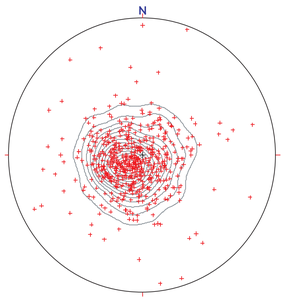
+ Trend and Plunge of minor fold axes. n = 14
+ Trend and plunge of mineral lineations. n = 15



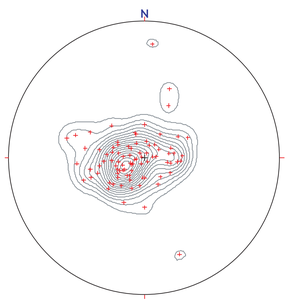
+ Poles to joints with unidirectional joint azimuth Rose diagram inset. n = 623



+ Poles to faults with unidirectional fault azimuth Rose diagram inset. n = 14



+ Poles to foliations. n = 571



+ Poles to mylonitic foliations. n = 86

ROCK DESCRIPTIONS

Breccia – Linear-trending cataclastic fault breccias form resistant outcrops and concentrations of characteristic quartz float. Breccia is typically: white to very light gray; massive to weakly foliated; fine- to medium-grained; quartz crystal growth locally present in void spaces; consists of 99% quartz, trace biotite and opaque minerals.

Granitoid gneiss (OCgg) – A felsic intrusive body consisting mainly of quartz, feldspar, and biotite. It is tentatively correlated with biotite granitoid gneiss of Ganhan, 2009. Granitoid gneiss may be neosomal migmatite derived from local melting of the surrounding Tallulah Falls Formation during regional high-grade metamorphism. Granitoid gneiss is typically: white to pinkish gray to light gray; weakly foliated to mylonitic; medium- to very coarse-grained; inequigranular; locally gradational with pegmatite; consists of plagioclase feldspar, potassium-feldspar, quartz, biotite, and minor garnet and muscovite.

Poor Mountain Formation

Undivided (Opm) – Heterogeneous unit of metagraywacke, schist, amphibolite, calc-silicate, quartzite, and metaarkose. Metagraywacke: medium light gray to medium dark gray; foliated; locally mylonitic; medium- to coarse-grained; equigranular to inequigranular; granoblastic to lepidoblastic; migmatitic; consists of 20-49% quartz, 20-44% plagioclase, 6-40% biotite, trace-20% muscovite, trace-1% garnet. Schist consists of muscovite, biotite, garnet, quartz, feldspar, and trace epidote, chlorite, and opaque minerals. Amphibolite consists of hornblende, plagioclase feldspar, epidote, biotite and trace amounts of opaque minerals. Calc-silicate consists of 65% quartz, 15% garnet, 15% biotite, 5% epidote, and trace chlorite.

Quartzite/meta-arkose (Opmq) – Very pale orange to grayish orange, dusky yellowish brown on weathered surfaces; foliated; medium-grained; equigranular; granoblastic; consists of 55-80% quartz, 25% potassium feldspar, trace-25% garnet, trace-15% biotite, trace-10% plagioclase feldspar, trace-10% muscovite, trace-5% epidote, and trace-3% opaque minerals.

Meta-igneous rocks

Hornblende and hornblende quartzo-feldspathic gneisses with minor mappable bodies of amphibolite and altered ultramafic rocks are interpreted to be intrusive into and stratigraphically lower than the Tallulah Falls Formation.

Hornblende quartzo-feldspathic gneiss (€Zhqf) – Very light gray to grayish black, commonly weathers dark yellowish orange; fine- to medium-grained; equigranular; foliated; well layered; consists of 5-50% quartz, 25-45% plagioclase, 10-30% potassium feldspar, trace-30% epidote, 1-25% biotite, trace-25% muscovite, 3-21% hornblende, trace-8% chlorite, trace-5% garnet, and trace apatite and opaque minerals; interlayered with amphibolite and hornblende gneiss

Hornblende gneiss (€Zhg) – Mottled white to greenish black on fresh surfaces; weathered surfaces are mottled white to dark reddish brown; medium- to coarse-grained; equigranular; foliated; massive to well layered; migmatitic; consists of 20-45% hornblende, trace-45% epidote, 30% plagioclase, 5-25% quartz, trace-20% biotite, trace-4% titanite, and minor opaque minerals.

Amphibolite (€Za) – Occurs as a minor rock type throughout other map units and as small mappable bodies within the hornblende quartzo-feldspathic gneiss: mottled white to dark green to black; fine- to coarse-grained; equigranular to nematoblastic; foliated; consists of 45-60% hornblende, trace-55% epidote group minerals, 25-37% plagioclase, trace-9% biotite, trace-8% quartz, trace-5% muscovite, and minor garnet, chlorite, pyroxene, titanite, and opaque minerals.

Altered ultramafic (€Zau) – Interpreted to be an altered pyroxenite: medium green; foliated; granoblastic to nematoblastic; equigranular; medium- to coarse-grained. Coarse-grained, bronze, poikilitic hypersthene with green amphibole inclusions locally preserve a relict porphyritic texture. Consists of 70-75% green amphibole, 15-20% hypersthene, 10-15% erstatite, 2-5% chlorite, and trace opaque minerals including magnetite. A banded quartz-magnetite rock occurs on the margins of the body and consists of 70% quartz and 30% opaque minerals including magnetite and hematite.

Tallulah Falls Formation

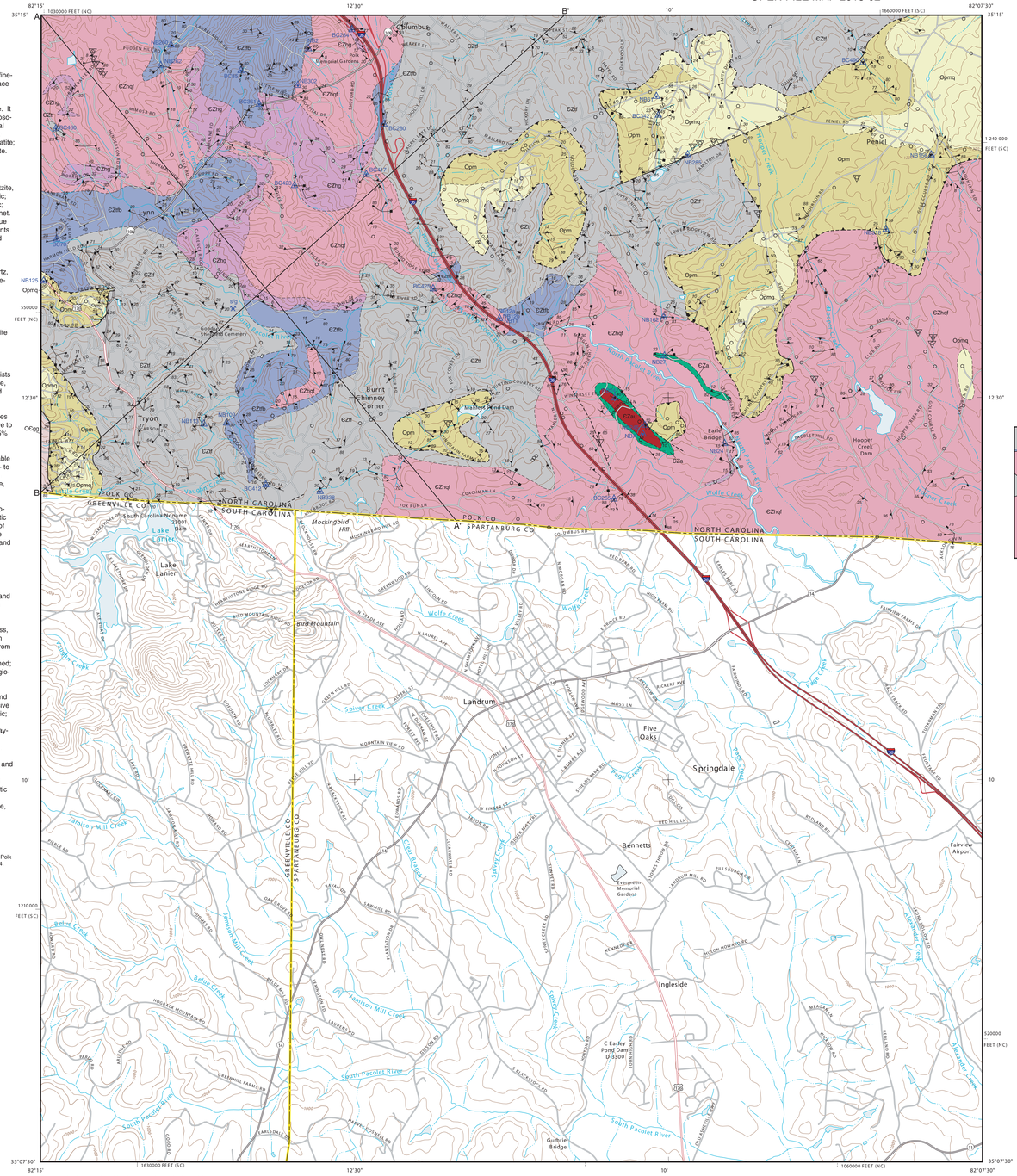
The Tallulah Falls Formation is a thick, heterogeneous sequence of metamorphosed sedimentary and volcanic rocks. Individual rock types within the Tallulah Falls Formation are interlayered with each other at all scales.

Biotite gneiss (€Ztfb) – Heterogeneous unit consisting of interlayered porphyroclastic biotite gneiss, metagraywacke, and schist with lesser amounts of hornblende quartzo-feldspathic gneiss. Tallulah Falls biotite gneiss locally separates metagrywackes and schists of the Tallulah Falls Formation from hornblende gneiss and hornblende quartzo-feldspathic gneiss. Biotite gneiss is typically: white to grayish black; well foliated; compositionally layered; locally protomylonitic; medium- to coarse-grained; inequigranular; porphyroclastic to lepidoblastic; migmatitic; consists of 25-40% quartz, 20-38% plagioclase, 10-20% biotite, 5-20% potassium feldspar, 3-15% muscovite, 2% garnet and 2% epidote.

Undivided (€Ztf) – Interlayered sequence of metagraywacke, schistose metagraywacke, schist, and amphibolite. **Metagraywacke**: medium light gray to medium dark gray; foliated (ranges from massive to gneissic); medium- to coarse-grained; equigranular to inequigranular; granoblastic to lepidoblastic; migmatitic; consists of quartz, plagioclase, biotite, muscovite, potassium feldspar, sillimanite, and minor opaques, epidote and apatite; thickness of layering ranges from decimeters to meters. Interlayered at all scales with garnet-mica schist, schistose metagraywacke, amphibolite, and minor calc-silicate. **Schistose metagraywacke**: medium-gray to dark-gray; foliated; fine- to medium-grained; equigranular to inequigranular; lepidoblastic to weakly granoblastic to porphyroblastic; migmatitic; consists of quartz, plagioclase, muscovite, biotite, potassium feldspar, sillimanite, epidote, chlorite, and trace opaque minerals; thickness of layering ranges from several millimeters to meters; commonly interlayered with metagraywacke, garnet-mica schist, amphibolite, and minor calc-silicate. **Garnet mica schist**: silvery gray to medium dark gray; fine- to medium-grained; inequigranular; lepidoblastic and porphyroblastic; migmatitic; consists of muscovite, biotite, garnet, quartz, feldspar, and trace epidote, chlorite, and opaque minerals; interlayered with metagraywacke, schistose metagraywacke, amphibolite, and rare calc-silicate granofels.

Mineral abundances are listed in decreasing order. Percentages, where given, are based upon visual estimates of sample thin-sections. Ranges of percentages are given where more than one sample of a particular rock type was analyzed.

Reference cited:
Ganhan, J.M., 2009, Geologic map of the Landrum quadrangle, Greenville and Spartanburg Counties, South Carolina, and Polk County, North Carolina: South Carolina Department of Natural Resources, Geological Survey, Geologic Quadrangle Map 44.



Topographic base produced by the United States Geological Survey.
Altered by the North Carolina Geological Survey for use with this map.
North American Datum of 1983 (NAD83).
World Geodetic System of 1984 (WGS84).
Projection: Universal Transverse Mercator, Zone 17S
10 000-foot ticks: North Carolina Coordinate System of 1983.
South Carolina Coordinate System of 1983.

Imagery.....NAIP, April 2009
Roads.....©2006-2010 Tele Atlas
Names.....GNIS, 2010
Hydrography.....National Hydrography Dataset, 2009
Contours.....National Elevation Dataset, 2011
Boundaries.....Census, IBWC, IBC, USGS, 1972 - 2010

UTM GRID AND 2011 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
LV
UT
Grid Zone Designation
17S

SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 MILES 1
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 FEET

CONTOUR INTERVAL 40 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with version 0.5.10 of the USGS US Topo Product Standard.
A metadata file associated with this product is draft version 0.5.16

QUADRANGLE LOCATION

NORTH CAROLINA

Cliffield Mountain	Mill Spring	Pea Ridge
Saluda	Landrum	Fingerville West
Tigerville	Campobello	Inman

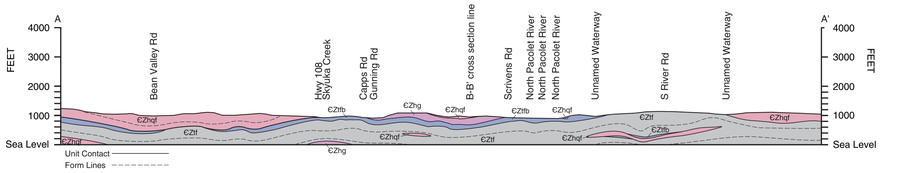
ADJOINING 7.5' QUADRANGLES

ROAD CLASSIFICATION

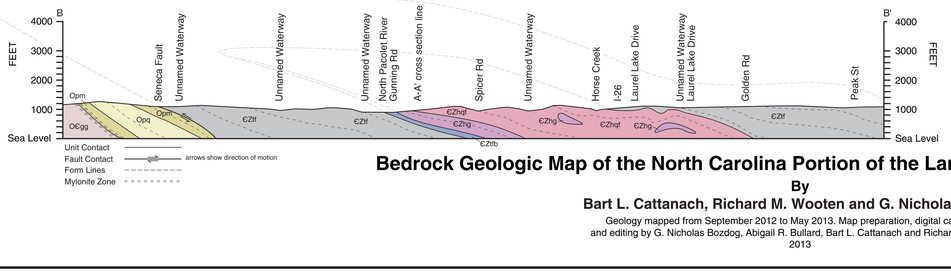
Interstate Route
US Route
Ramp
State Route
Local Road
4WD
Interstate Route
US Route
State Route

LANDRUM, SC-NC
2011

CROSS SECTION A-A'



CROSS SECTION B-B'



Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G12AC20308. This map and explanatory information is submitted for publication with the understanding that the United States Government is authorized to reproduce and distribute reprints for governmental use.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.

Bedrock Geologic Map of the North Carolina Portion of the Landrum 7.5-minute Quadrangle

By
Bart L. Cattanach, Richard M. Wooten and G. Nicholas Bozdog

Geology mapped from September 2012 to May 2013. Map preparation, digital cartography and editing by G. Nicholas Bozdog, Abigail R. Bullard, Bart L. Cattanach and Richard M. Wooten.
2013

STRUCTURAL FEATURES

CONTACTS

Solid line – located in field to within 100 meters
Short-dashed line – location inferred
Question marked line – identity or existence questionable
Fault teeth – on upper plate

Thrust Fault Contact
Fault Contact
Rotational or Scissor Fault Contact
Stratigraphic Contact

STRIKE AND DIP OF PLANAR FEATURES

Single observation at one locality (observation site at center of strike bar)
Foliation
Joint
Mylonitic Foliation
Vertical Joint

Multiple observations at one locality (observation site at junction of symbols)
Foliation
Joint
Mylonitic Foliation
Vertical Joint

BEARING AND PLUNGE OF LINEAR FEATURES

Mineral Lineation
Crenulation

NON-STRUCTURAL FEATURES

Float Location

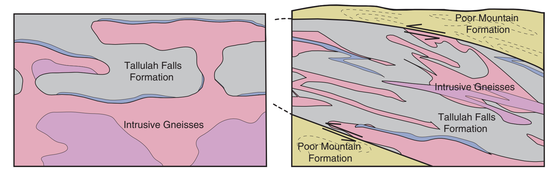
MINERAL RESOURCES

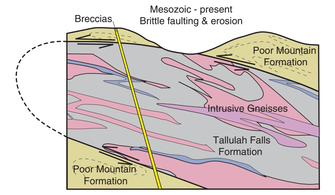
BC391 Thin section sample site.

COMMODITY LETTER SYMBOLS:
s/g Sand and gravel

Mine or quarry
Prospect

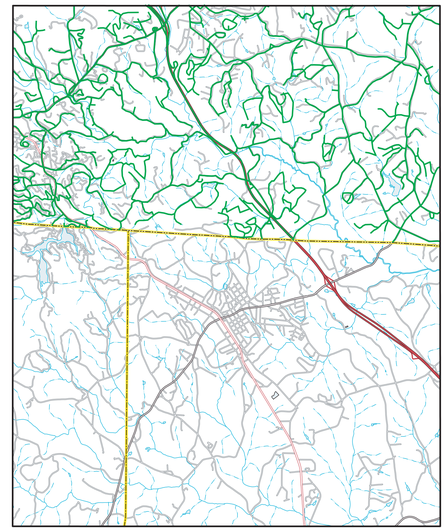
GENERALIZED STRATIGRAPHY AND SEQUENCE OF EVENTS IN CROSS-SECTIONAL VIEW





TRAVERSE MAP

Green lines show paths of field traverses.



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]
BC265	165,168N; 320,661E	felsic gneiss	€Zhqf	71.86	14.29	3.42	0.64	1.06	3.06	2.25	0.61	0.09	0.05	<0.002	<5	1874	24	<20	<20	357	274	161	8	<5	5	2.3	99.92
BC280	169,789N; 318,007E	migmatite	€Ztfb	66.68	16.08	4.58	1.54	2.57	2.17	2.68	0.51	0.31	0.07	<0.002	12	692	75	<20	<20	228	326	137	35	17	12	2.6	99.94
BC284	170,945N; 317,674E	hornblende gneiss	€Zhbn	64.11	13.75	5.67	4.35	5.94	2.19	0.59	0.17	0.03	0.14	0.066	<5	90	53	63	<20	161	40	<30	12	<5	28	2.9	99.94
BC342	169,792N; 321,346E	meta-arkose	Opmq	76.38	12.91	1.23	0.18	0.97	2.38	3.06	0.29	0.06	0.01	<0.002	11	1296	14	<20	<20	121	255	36	16	16	6	2.3	99.94
BC361	170,080N; 316,525E	altered amphibolite	€Ztfb	48.92	15.15	11.51	4.77	15.05	1.74	0.12	0.44	0.04	0.27	0.024	<5	<5	86	105	50	147	24	<30	21	<5	44	1.8	99.93
BC412	165,478N; 316,458E	calc-silicate	€Ztf	45.39	19.34	6.29	0.56	11.36	0.01	0.91	0.51	0.1	11.95	<0.002	<5	199	44	<20	<20	83	247	58	34	26	22	3.5	100
BC417	169,189N; 317,791E	hornblende gneiss	€Zhqf	51.27	15.63	11.75	3.66	6.92	3.38	2.72	2.5	0.69	0.21	<0.002	15	799	109	<20	<20	374	508	142	42	57	24	0.9	99.92
BC423	169,082N; 316,921E	felsic gneiss	€Zhqf	70.44	14.59	4.1	1.08	4.51	3.25	1	0.38	0.11	0.06	<0.002	7	231	30	<20	<20	284	226	<30	16	<5	14	0.3	99.94
BC425	167,781N; 318,556E	calc-silicate	€Zhqf	59.52	16.56	8.08	1.12	6.29	0.05	0.73	0.9	0.16	0.1	0.017	37	457	31	<20	<20	299	393	70	24	23	14	6.2	99.93
BC460	169,862N; 314,059E	meta-arkose	€Ztf	80.58	10.17	2.19	0.79	0.83	3.56	0.04	0.12	0.02	0.07	0.003	27	50	95	<20	<20	41	224	<30	27	<5	7	1.5	99.93
BC490	170,351N; 323,838E	metagraywacke	Opm	73.21	14.12	2.67	0.79	2.46	2.45	0.82	0.33	0.06	0.09	<0.002	27	338	24	<20	<20	260	183	<30	13	8	13	2.9	99.94
BC70	168,527N; 314,026E	biotite gneiss	€Ztfb	66.24	14.3	6.98	1.77	2.07	2.29	3.2	0.96	0.3	0.11	0.004	25	613	87	22	<20	198	284	55	28	17	11	1.6	99.95
BC85	170,495N; 316,317E	metagraywacke	€Ztfb	69.06	15.41	4.52	1.13	3.8	3.65	1.5	0.4	0.09	0.09	0.003	<5	303	49	<20	<20	152	161	46	19	10	14	0.2	99.94
NBX	165,937N; 321,037E	quartz magnetite rock	€Zau	62.51	0.78	29.62	<0.01	2.02	<0.01	<0.01	0.01	0.12	2.89	0.003	6	950	18	105	209	2	<5	<30	5	<5	6	1.8	99.94
NB109	166,239N; 316,006E	granitoid	€Ztf	69.26	17	1.41	0.29	1.08	2.64	4.44	0.12	0.03	0.02	<0.002	6	2107	16	<20	<20	393	97	51	7	<5	4	3.4	99.94
NB11	167,371N; 319,333E	felsic gneiss	€Zhqf	60.38	14.98	9.08	2.65	3.56	3.26	1.6	1.45	0.37	0.18	<0.002	65	303	99	<20	<20	122	279	32	59	<5	23	2.3	99.93
NB113	166,237N; 315,732E	granitic gneiss	€Ztf	71.02	16.09	1.24	0.18	0.85	4.48	4.56	0.08	0.03	0.01	<0.002	7	2092	10	<20	<20	497	90	41	5	<5	3	1.1	99.94
NB125	168,024N; 313,850E	garnet quartzite	Opmq	78.53	5.93	9.34	1.59	2.31	0.04	0.12	0.31	0.13	0.96	0.006	72	190	41	20	<20	23	64	57	22	5	8	0.6	99.93
NB12-A	167,382N; 319,322E	biotite gneiss	€Zhqf	57.44	14.54	10.95	3.34	4.78	2.62	2.75	1.43	0.48	0.15	0.003	15	283	116	<20	<20	258	284	35	62	6	24	1.3	99.94
NB12-B	167,382N; 319,322E	felsic gneiss	€Zhqf	73.94	13.57	2.52	0.45	1.76	4.08	2.55	0.17	0.03	0.03	<0.002	23	486	42	<20	<20	131	261	88	16	8	4	0.7	99.95
NB156	169,207N; 324,628E	mylonitic schist	Opm	50.86	23.79	12.37	1.28	0.07	0.08	2.44	1.34	0.11	0.15	0.022	111	363	140	35	<20	6	226	132	37	23	34	7.2	99.89
NB162	167,353N; 321,329E	felsic gneiss	€Zhqf	73.82	13.55	2.93	0.58	2.49	3.05	1.67	0.27	0.05	0.05	<0.002	52	397	33	<20	<20	134	134	<30	9	9	12	1.4	99.95
NB2	170,730N; 317,144E	granitoid gneiss	€Zhqf	73.97	14.4	1.62	0.27	2.94	3.02	1.83	0.1	0.02	0.03	<0.002	11	914	19	<20	<20	190	122	<30	<3	<5	3	1.6	99.96
NB241	166,393N; 320,709E	altered pyroxenite	€Zau	48.13	9.5	9.89	19.51	8.95	0.84	0.13	0.21	0.02	0.16	0.189	39	<5	59	425	70	28	14	<30	7	<5	34	2.3	99.91
NB24	165,802N; 322,019E	felsic gneiss	€Zhqf	74.9	13.97	3.57	1.2	2.91	2.19	0.89	0.27	0.13	0.06	0.004	27	64	47	23	<20	155	74	<30	15	<5	17	1.8	99.94
NB245	166,049N; 321,062E	altered pyroxenite	€Zau	47.62	8.59	10.39	20.41	8.27	0.32	0.08	0.14	<0.01	0.21	0.284	104	42	67	542	72	26	10	<30	8	<5	33	3.5	99.94
NB260	170,829N; 315,481E	amphibolite	€Ztfb	48.44	15.19	11.49	8.7	9.33	3.21	1.37	0.7	0.06	0.29	0.06	7	126	99	91	36	142	37	<30	31	<5	41	1	99.93
NB262	170,585N; 315,349E	granitoid gneiss	€Ztfb	66.02	15.84	4.22	1.66	3.62	3.46	3.38	0.4	0.27	0.08	0.004	20	1040	55	<20	<20	647	332	135	16	17	9	0.7	99.93
NB27	166,883N; 321,326E	amphibolite	€Za	52.75	10.44	9.92	10.13	13.43	0.99	0.56	0.22	0.04	0.21	0.079	25	86	73	105	40	111	25	<30	7	<5	39	1.1	99.93
NB285	169,306N; 321,682E	quartz breccia	Opmq	95.69	1.48	1.12	0.13	0.02	0.03	0.36	0.03	0.03	0.01	0.003	7	6	<5	<20	<20	<2	<5	<30	<3	<5	1	1.1	99.94
NB302	170,294N; 316,999E	altered amphibolite	€Zhqf	46.37	11.59	9.45	12.55	15.8	1.6	0.74	0.42	0.07	0.19	0.112	31	204	48	290	54	146	16	<30	9	<5	35	0.9	99.92
NB318	168,326N; 324,052E	calc-silicate	Opm	75.9	5.71	11.29	1.6	1.45	0.04	0.65	0.25	0.49	2.29	0.004	64	300	44	27	44	121	54	72	37	<5	8	0.2	99.96
NB338	165,422N; 317,093E	calc-silicate	€Ztf	52.59	18.3	7.64	1.6	15.85	0.08	0.09	0.85	0.11	0.14	0.009	6	37	109	20	<20	816	331	74	27	16	14	2.5	99.94
NB61	170,020N; 321,328E	meta-sandstone	Opmq	82.9	9.62	1.89	0.23	0.09	0.12	2.51	0.23	0.03	0.02	0.003	7	487	16	<20	<20	29	138	43	17	11	6	2.2	99.94

[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