# BEDROCK GEOLOGIC MAP OF THE SPRING CREEK 7.5-MINUTE QUADRANGLE, NORTH CAROLINA NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES NORTH CAROLINA GEOLOGICAL SURVEY **GEOLOGIC MAP SERIES - 12** DIVISION OF LAND RESOURCES This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

BART L. CATTANACH, MAP UNITS CARL E. MERSCHAT, MYLONITIC ROCKS **AND MARK W. CARTER** Pzmy Sericitic mylonite 2007 **METASEDIMENTARY SEQUENCE** Geology mapped from October 2002 to August 2003. Map preparation and editing by Bart Cattanach, Upper Unicoi Formation Mark Carter, Carl Merschat and Blair Tormey. Digital cartography by Bart Cattanach and Mark Carter. Lower Unicoi Formation Field review by Tyler Clark, Robert D. Hatcher Jr., Pete Lemiszki, and Leonard Wiener. STRUCTURAL FEATURES Sandsuck Formation CONTACTS

Roaring Fork Sandstone Longarm Quartzite Snowbird (undivided) Wading Branch Formation STRIKE AND DIP OF PLANAR FEATURES (Zswbp) phyllite (Zswbw) feldspathic Vertical bedding METAPLUTONIC ROCKS Overturned bedding Max Patch Granite Max Patch Protomylonitic granite Max Patch Mylonitic granite ✓ Vertical foliation

Max Patch Fine-grained leucocratic granite Amphibolite Xenolith Spring Creek Granitoid Gneiss Spring Creek Mylonitic Granitoid Gneiss Spring Creek Amphibolite Metagabbro Doggett Gap Coarse-grained Protomylonitic Granitoid Gneiss Doggett Gap Protomylonitic Granitoid Gneiss Doggett Gap Amphibolite

Sandymush Felsic Gneiss Sandymush Muscovite-bearing Felsic Gneiss Sandymush Amphibolite

Garnet-rich granulite gneiss

Granoblastic biotite granitic gneiss

\* Abandoned mine or quarry → Abandoned trench ( ) Inactive mining area site. Sample numbers correspond to stream sediment heavy

mineral analyses listed in table below. analyses listed in table below.

#### DESCRIPTION OF MAP UNITS<sup>1</sup>

MYLONITIC ROCKS SERICITIC MYLONITE (Pzmy) — Well developed Alleghenian mylonite characterized by the MAX PATCH MYLONITIC GRANITE (Ymmy) — Max Patch Granite that has undergone extensive development of sericite, epidote group minerals, and chlorite, and occurs as a linear, east-northeast striking unit. This unit encloses blocks of locally unmylonitized to progressively mylonitized rock. Mylonite - medium gray to dark gray; fine- to medium-grained; inequigranular; well foliated; lepidoblastic; mylonitic; thin-layered; consists of 29.6-37.0% quartz, 11.2-12.4%

ilmenite and other black opaque minerals. Mylonitic alteration minerals include 20.2-27.0% sericite and 6.6-8.6% epidote group minerals. METASEDIMENTARY SEQUENCE

UPPER UNICOI FORMATION (Ecuu) — Feldspathic quartzite - light gray to medium gray; medium-grained; moderately well sorted; bedding ranges from one decimeter to about one meter thick; locally cross bedded, locally vitreous; interbedded locally with light gray quartzite; consists of quartz, potassium feldspar, and plagioclase, with minor amounts of biotite, tourmaline, and zircon; matrix minerals consist of sericite, quartz, ilmenite, rutile and carbonate.

metaconglomerate. Metagraywacke - light gray to medium gray; medium- to coarse-grained; poorly sorted; bedding ranges from several decimeters to about one meter thick; locally sulfidic. Feldspathic quartzite - light gray to medium gray; fine- to medium-grained; poorly sorted; thin- to medium-bedded; grains consist of quartz, potassium feldspar, plagioclase feldspar, muscovite, apatite, and traces of zircon, rutile and tourmaline; matrix minerals consist of sericite, quartz, iron sulfides, ilmenite and carbonate. Granule metaconglomerate - light gray to pale yellowish brown; coarse-grained to locally very coarse-grained; poorly- to well-sorted; medium- to thick-bedded; graded bedding is common; consists of feldspar and quartz granules in a feldspathic matrix. WALDEN CREEK GROUP

SANDSUCK FORMATION (6Zws) - An interbedded sequence of metasiltstone, slate, and phyllite with few beds and lenses of metagraywacke. Metasiltstone - grayish olive green to medium gray, weathers light brown to moderate brown; fine-grained; thinly laminated to well-bedded to massive; thickness of bedding ranges from millimeters to about one centimeter. Slate - dusky yellowish brown to brownish black, weathers dark yellowish orange; faint laminae are locally present. Phyllite - greenish gray to medium gray; fine grained; lepidoblastic; mylonitic. Coarser beds and lenses of metagraywacke occur locally, and are similar to those in the lower Unicoi Formation.

ROARING FORK SANDSTONE (Zsrf) - Metagraywacke with minor interbeds of feldspathic quartzite, metasiltstone, and slate. Metagraywacke - medium dark gray to light brownish gray; medium- to coarse-grained; well-sorted; bedding ranges from several decimeters to about one meter thick; locally graded and cross-bedded; consists of 38-59.3% quartz, 22.4-35.8% potassium feldspar, 5.5-15.9% plagioclase, 1.2-9.1% sericite, trace to 8.2% carbonate, trace-5.8% biotite, and minor chlorite, epidote, opaques, apatite, zircon, and titanite.

LONGARM QUARTZITE (ZsI) - Dominantly meta-arkose and metasubgraywacke, with sub-ordinate metagraywacke, metasiltstone and slate. Meta-arkose and metasubgraywacke pinkish gray to grayish pink, mottled with white to very light gray quartz and grayish pink to grayish orange pink feldspar grains; coarse- to very coarse-grained, locally pebbly; thick-bedded; graded and cross-bedded; consists of 36.4-68.6% guartz, 8.2-25.3% potassium feldspar, 5.6-29.4% plagioclase, 1.0-8.3% sericite, trace-8.2% biotite, trace-8.1% epidote group minerals, and traces of zircon, titanite, chlorite, and opaque minerals. Interbedded throughout the sequence is dark greenish gray metagraywacke, grayish olive metasiltstone, and grayish black to

WADING BRANCH PHYLLITE (Zswbp) — Phyllite interbedded and gradational with feldspathic metagraywacke. Phyllite - olive gray to dark gray; fine grained; lepidoblastic; mylonitic; laminated to thin bedded; consists of sericite, quartz, plagioclase, biotite, opaques, and minor epidote, zircon, and spinel. Feldspathic metagraywacke - dark yellowish brown to olive gray; fine- to coarse-grained; angular to subrounded; poorly sorted; locally graded; consists of quartz,

WADING BRANCH FELDSPATHIC METAGRAYWACKE (Zswbw) - Feldspathic metagraywacke interbedded with granule conglomerate and phyllite. Feldspathic metagraywacke - light olive gray, mottled with moderate reddish orange to pinkish gray; mediumto coarse-grained; poorly sorted; angular to subrounded fragments; medium- to thick-bedded; locally graded; consists of 50.5-77.6% quartz, 6.7-15.4% potassium feldspar, 6.8-15.7% plagioclase, trace-14.5% biotite, trace-11.0% sericite, 0.2-1.4% opaques, and trace amounts of epidote, apatite, and zircon. Granule metaconglomerate - medium dark gray to dark gray; coarse-grained; angular to subrounded; poorly sorted, locally graded bedding; consists of quartz, potassium feldspar, sericite, plagioclase, chlorite, and minor epidote, opaques, and titanite. Phyllite - similar to that in the Wading Branch phyllite unit.

MYLONITIC SNOWBIRD GROUP, undivided (Zsmy) — Snowbird Group metasediments that have undergone extensive Alleghenian mylonitization. Interlayered clastic sequence of phyllite and meta-arkose. The unit is confined to thrust slices and could not be subdivided due to variable mylonitization and the interlayered nature of the rocks. Mylonitic phyllite - light olive gray; lepidoblastic; inequigranular; fine-grained; well foliated; consists of sericite, quartz, plagioclase, potassium feldspar, epidote, opaques, and very minor amounts of apatite, zircon, and garnet. Mylonitic meta-arkose - light gray to grayish olive green; lepidoblastic to granoblastic; inequigranular; fine- to medium grained; foliated; consists of about 45.4% quartz, 19.2% potassium feldspar, 11.0% plagioclase, 10% biotite, 9.8% sericite, 3.6% opaques, 1.0%

### METAPLUTONIC AND METAVOLCANIC ROCKS

MAX PATCH GRANITE (Ym) — (1050 Ma) Granite to alkali-feldspar granite is light gray, variably mottled with pale pink and pale green; coarse-grained; equigranular to slightly megacrystic granoblastic; weakly foliated to massive; the green coloration of the plagioclase is a result of saussuritization; granite typically consists of 23.3-38% quartz, 22.8-46.7% potassium feldspar, 19.3-29.7% plagioclase, 4.6-11.2% sericite, 0.2-4.6% biotite, trace-5.6% epidote group minerals, 0.2-2.5% opaque minerals, trace-2.4% hornblende, and traces of zircon, apatite, and carbonate; Thin zones of mylonitic rock occur throughout, and are characterized by increased sericite, epidote group minerals and chlorite. Amphibolite xenoliths occur locally.

MAX PATCH PROTOMYLONITIC GRANITE (Ymp) — Max Patch Granite that has undergone Alleghenian protomylonitization. Medium gray, mottled with pale pink to moderate red and pale green; medium- to coarse-grained; granoblastic to mylonitic; foliated; consists of plagioclase, potassium feldspar, quartz, biotite, epidote group minerals, and opaque minerals. Sericite

## MINERAL RESOURCES

BEARING AND PLUNGE OF LINEAR FEATURES

Slaty cleavage in metasedimentary rocks

Mineral lineation

Lithologic contact

Axial plane of small fold

Vertical mylonitic foliation

Plane of brecciation

✓ Mylonitic foliation

Vertical joint

Axis of small fold

COMMODITY LETTER Mine or quarry

ba-2: Mineral resource number, referred to in accompanying Mineral Resource Summary. Commodity indicated by letter O hm34: Stream sediment heavy mineral and scintillation sample

▲ scc323: Thin section and whole rock geochemistry sample site. Sample numbers correspond to whole rock geochemical

METAPLUTONIC AND METAVOLCANIC ROCKS (continued)

Alleghenian mylonitization. Light to medium gray with moderate orange pink megacrysts of potassium feldspar and moderate yellow green epidote alteration of plagioclase; inequigranular; medium- to coarse-grained; foliated; mylonitic; consists of quartz, potassium feldspar, plagioclase, biotite, and variable amounts of chlorite, apatite, titanite, carbonate, and opaque

MAX PATCH FINE-GRAINED LEUCOCRATIC GRANITE (Ymfl) — Light gray to white, mottled with pale pink to moderate red and pale green; fine-grained; massive to foliated; locally mylonitic; consists of plagioclase, potassium feldspar, quartz, epidote group minerals, and opaque AMPHIBOLITE XENOLITH (Yax) — Dark greenish gray to greenish black to brownish black; fine-

minerals. Mylonitic alteration minerals include abundant sericite and epidote. This unit also

contains blocks of unmylonitized Max Patch Granite and mylonitized amphibolite xenoliths.

primarily of hornblende, plagioclase, epidote-group minerals, and accessory opaque minerals. Where retrogressed, biotite replaces hornblende as the dominant mafic phase. Thin interlayers of biotite-rich gneiss and schist within the Spring Creek Granitoid Gneiss and Doggett Gap Protomylonitic Granitoid Gneiss most likely represent retrogressive equivalents of amphibolite. SPRING CREEK GRANITOID GNEISS (Ysc) — A heterogeneous metamorphosed igneous unit dominated by biotite granitic gneiss interlayered with biotite granodioritic gneiss, biotite tonalitic

gneiss, amphibolite, biotite gneiss, and biotite schist. Granitoid rock types are light gray, mottled

inequigranular; granoblastic to lepidoblastic, locally mylonitic; poorly foliated to foliated; massive

with pinkish gray to pale reddish brown; medium- to coarse-grained; equigranular to

to coarse-grained; nematoblastic to lepidoblastic; well foliated; thin- to medium-layered; consists

to medium-layered. Samples consist of 25.9-27.0% quartz, 0.4-36.7% potassium feldspar, 14.3-18.3% plagioclase, 5.8-39.1% biotite, 9.2-12.1% sericite, 4.0-7.2% epidote-group minerals, and trace opaque minerals, apatite, titanite, zircon, carbonate and garnet. SPRING CREEK MYLONITIC GRANITOID GNEISS (Yscmy) — Spring Creek Granitoid Gneiss that has undergone Alleghenian mylonitization. Light pinkish gray to light brownish gray; inequigranular; lepidoblastic; mylonitic; poorly layered to well layered; consists of plagioclase,

and trace chlorite and zircon. Locally interlayered with amphibolite and unmylonitized granoblastic granitoid gneiss. SPRING CREEK AMPHIBOLITE (Ysca) — Dark greenish gray to greenish black to brownish black; fine- to coarse-grained; nematoblastic to lepidoblastic; well foliated; thin- to medium-layered; consists primarily of hornblende, plagioclase, epidote-group minerals, and

quartz, potassium feldspar, epidote-group minerals, sericite, biotite, titanite, opaque minerals,

accessory opaque minerals. Where retrogressed, biotite replaces hornblende as the dominant mafic phase. Thin interlayers of biotite-rich gneiss and schist within the Spring Creek most likely represent retrogressive equivalents of amphibolite. METAGABBRO (Yg) - Typically brownish black to greenish black; sub-ophitic to blastophitic modified to nematoblastic, locally lepidoblastic to mylonitic; medium- to very coarse-grained; slightly foliated to massive; locally altered to amphibolite and biotite-chlorite schist; weathers

spheroidally; consists of 0.4-40.8% plagioclase, 1.4-5.8% opaques, 0.0-1.8% apatite, 0.0-27.4%

from centimeters to meters; consists of 14.9-35.2% plagioclase, 10.0-32.7% quartz, 10.1-28.8%

quartz, 0.0-0.8% potassium feldspar, 0.0-16.2% clinopyroxene, 0.0-41.6% hypersthene, and 0.0-10.2% olivine; metamorphic and mylonitic alteration minerals include 0.0-28.2% hornblende, 3.4-48.0% biotite, 0.0-19.0% actinolite/tremolite, 0.0-13.5% chlorite, 0.0-34.2% epidote, 0.0-5.2% sericite, and 0.0-2.2% titanite. Where porphyritic, the phenocrysts are plagioclase. DOGGETT GAP PROTOMYLONITIC GRANITOID GNEISS (Ydg) — Biotite tonalite to biotite granite consisting of medium-grained feldspar porphyroclasts within a biotite-rich matrix; light-gray to medium light gray to very pale-orange; medium- to coarse-grained; inequigranular; lepidoblastic; foliated; protomylonitic to mylonitic; poorly layered to layered; thicknesses range

biotite, 4-27.6% potassium feldspar, 3.3-17.0% muscovite, 3.0-11.9% epidote group minerals, trace-6% opaque minerals, trace-4.1% titanite, trace-1.4% apatite, and trace amounts of zircon DOGGETT GAP COARSE-GRAINED PROTOMYLONITIC GRANITOID GNEISS (Ydgc) biotite-rich matrix; light gray to medium light gray to very pale-orange; medium- to very coarse-grained; inequigranular; lepidoblastic; foliated; protomylonitic to mylonitic; poorly layered

to layered; thicknesses vary from centimeters to meters; composed of 15.4-38.1% potassium feldspar, 22.0-30.1% quartz, 17.9-22.8% plagioclase, 2.4-21.0% biotite, 1.2-13.0% epidote group minerals, trace-2.4% apatite, 1.2-2.2% muscovite, 0.2-1.6% titanite, trace-1.2% opaque minerals, and trace amounts of zircon and carbonate. DOGGETT GAP AMPHIBOLITE (Yda) — Dark greenish gray to greenish black to brownish

black; fine- to coarse-grained; nematoblastic to lepidoblastic; well foliated; thin- to medium-layered; consists primarily of hornblende, plagioclase, epidote-group minerals, and accessory opaque minerals. Where retrogressed, biotite replaces hornblende as the dominant mafic phase. Thin interlayers of biotite-rich gneiss and schist within the Doggett Gap most likely represent retrogressive equivalents of amphibolite.

SANDYMUSH FELSIC GNEISS (Ys) — Thick, monotonous, repetitive sequence of layered rocks dominated by biotite granitic gneiss to quartz dioritic gneiss. Interlayered with biotite schist and amphibolite; very light gray to pale orange to medium light gray; equigranular granoblastic to lepidoblastic; inequiganular where mylonitized; millimeter to meter thick layers; granitic and dioritic components consist of quartz, plagioclase, potassium feldspar, biotite, epidote group minerals, muscovite, opaques, garnet, titanite, apatite, and zircon.

SANDYMUSH MUSCOVITE-BEARING FELSIC GNEISS (Ysmu) — Pale reddish brown to dusky red in saprolite; fine-grained; lepidoblastic; well foliated; millimeter to centimeter thick layers; consists of muscovite, biotite, feldspar, and quartz; mapped in two small areas. SANDYMUSH AMPHIBOLITE (Ysa) — Interlayered with the Sandymush felsic gneiss. Dark

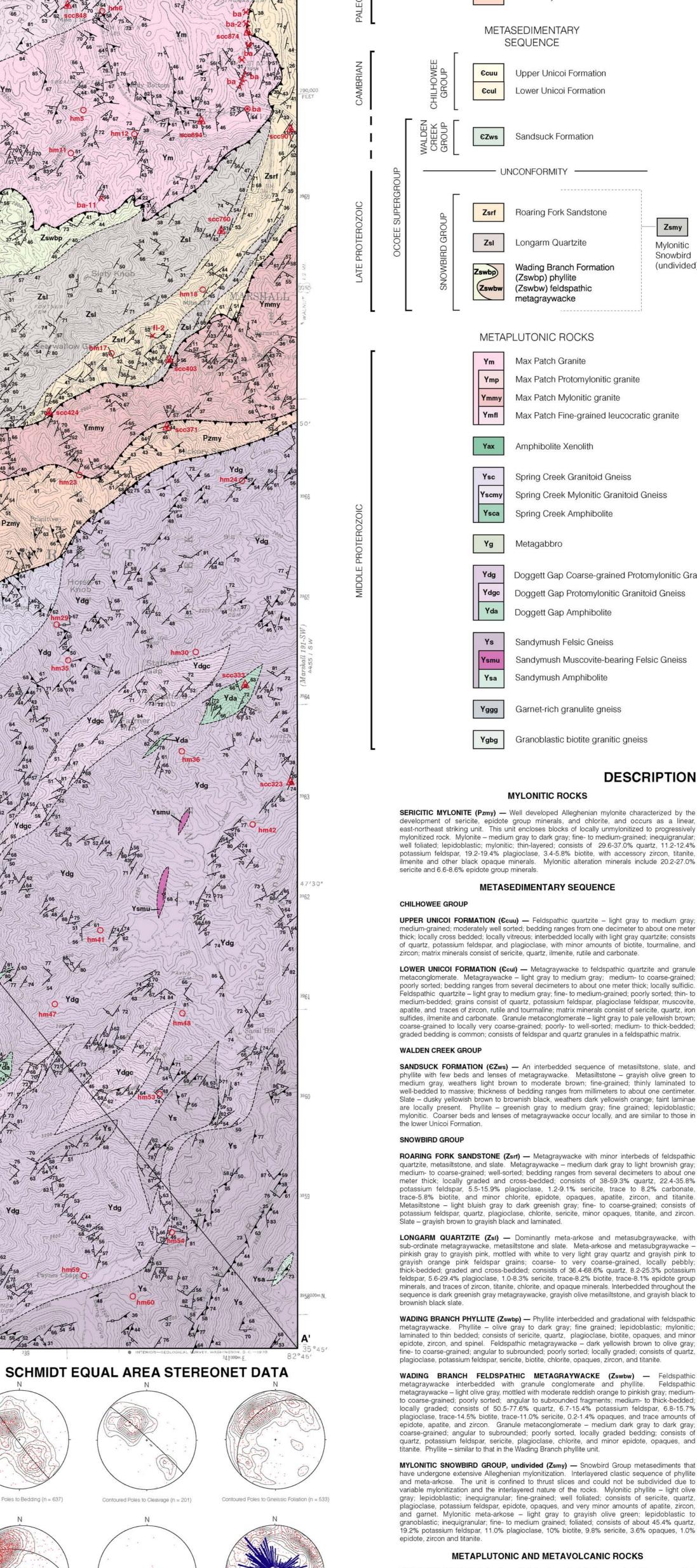
greenish gray to greenish black; equigranular; nematoblastic to lepidoblastic; medium- to coarse-grained; poorly foliated to well foliated; layering ranges from several centimeters to meters in thickness; composed of hornblende, plagioclase, biotite, quartz, epidote group minerals, potassium feldspar, opaques, garnet, titanite, and apatite.

GARNET-RICH GRANULITE GNEISS (Yggg) - Very light gray to light gray to yellowish gray, equigranular to inequigranular; granoblastic, locally mylonitic; weakly foliated to foliated; medium layered to massive; garnet is abundant and characteristic in most folia and is visually estimated to be present in amounts up to 15%; the quartzo-feldspathic component of the rock consists of 48.6% potassium feldspar, 30.6% quartz, 18.6% plagioclase, and 2.2% biotite. Interlayered with biotite granitoid gneiss, orthogranitic gneiss, amphibolite and granulitic biotite gneiss.

GRANOBLASTIC BIOTITE GRANITIC GNEISS (Ygbg) — Light gray to yellowish gray;

equigranular to inequigranular; granoblastic, locally mylonitic; massive to weakly foliated; medium- to coarse-grained; biotite and amphibole aggregates within the more felsic groundmass serve to define this unit; consists of 23.5-45.4% potassium feldspar; 18.2-36.4% plagioclase, 17.3-31.4% quartz, trace-11.7% muscovite, 1.6-5.6% biotite, 0.4-5.4% epidote group minerals, trace-2.4% hornblende, and trace amounts of zircon, chlorite, apatite and titanite. Interlayered with biotite granitoid gneiss, orthogranitic gneiss, amphibolite garnet rich granulite gneiss. <sup>1</sup>Mineral percentages are based on modal analyses of selected samples. A range of mineral

SAMPLE <sup>2</sup>	COORDINATES (State Plane, NAD 27ft)	ROCK TYPE	MAP UNIT	OXIDES IN PERCENT								ELEMENTS IN PPM <sup>3</sup>											
				SiO <sub>2</sub> Al <sub>2</sub> O <sub>3</sub> Fe	2O3 Mg	O CaO	Na <sub>2</sub> O I	K₂O T	102 P20	5 MnO	Cr <sub>2</sub> O <sub>3</sub>	Ba	Cu	Zn	Ni C	o Sr	Zr	Ce Y	N	lb S	c Ta	LOI <sup>4</sup>	SUM
scb-236	772,624N; 859,891E	ultramylonite	Pzmy		03 0.8	2.68	3.19	3.98	0.41 0.13	0.04	< .001	1176	< 20	41	< 20 < 3	20 438	143	76 13		10 6		1.5	100.01
scc-371	779,285N; 884,423E	mylonitic granitic gneiss	Pzmy	CARTES VOLUME OF	46 0.6		200		0.31 0.06	1 0000000	< .001	1136	< 20	1110795	< 20 < 2		240	133 22	1	10 4		0 000	99.99
scm-832	793,846N; 867,658E	quartzite	€cuu		15 0,1	31.7		-	0.16 < .0	-			< 20		< 20 < 2		-	31 12			2 < 20	W W CON. II	99.85
scm-584	792,003N; 867,448E	granule metagraywacke	€cul		34 1.0				0.87 < .0		0.004	_	< 20		< 20 < 3		335	38 20			7 < 20		100.05
scb-996	793,224N; 861,696E	metagraywacke	Zsrf		01 0.2	S. (1) SEC. (2) (4)		1000000	1.09 0.03	100,000	5,0705,274	1529	24-010-0	11/21/02/	< 20 < 3	2207 -7310	907	118 33	12	0 8	S 1000000	A 1	100.02
scb-797	784,400N; 854,262E	mylonitic silicified breccia	Zsrf		28 0.0				0.04 < .0	_	-	25	< 20		< 20 < 2						1 < 20		100.13
scb-860	789,701N; 862,643E	quartzite/metagraywacke	Zsrf		24 0.2	2 1			0.44 0.05		0.002	-	< 20		< 20 < 2		310	< 20 12			2 < 20		99.99
scb-909 scb-920	787,935N; 861,254E	quartzite/metagraywacke	Zsrf	TO A CONTRACT OF THE PROPERTY	.9 0.0	V/	1,100,00		0.55 0.07	1.100-1-01	0.003		< 20	100000	< 20 < 1		354 93	< 20 22		2.307	4 < 20	v	100.04
scb-920 scb-928	786,943N; 854,481E 788,582N; 860,937E	arkosic metasandstone	Zsrf Zsrf		77 0.0		2.7310		0.25 0.02	3.7.	< .001	1343			< 20 < 3		159	< 20 < 1	1000	10 1	1 < 20		100.04
scb-926	784,923N; 858,338E	arkosic metasandstone	Zsrf		.2 < .0	2014 - 1014 DECEMBER	10430020	7000	0.03 0.04		0.002	360391	20740700		30 < 1			1 Filthorn 1070	_		2 < 20	V	75.51
scc-424	779,886N; 880,560E	mylonitic barite mylonitic quartzite	Zsrt		06 0.1				0.21 0.03		< .001	-	< 20		< 20 < 1		134	47 < 1			1 < 20		99.9
cm-568	788,148N; 867,530E	metagraywacke	Zsrf	102450000 SECOVA 3	67 0.3	30,538.00	27514	1	0.53 0.03		0.006	-	< 20	Name of the last	< 20 < 1	1927 12.00	318	< 20 21	3000		2 < 20	1000000	99.98
cc-901	788,867N; 888,842E	metagraywacke	Zsrt		12 0.5				0.99 0.04		0.004		< 20	_	< 20 < 1		582	< 20 24	_		3 < 20		99.98
cc-1134A	778,166N; 871,476E	mylonitic metagraywacke	Zsl		.8 1.5				0.72 0.31		0.005	1361	36	175	29 <		153	184 16			0 < 20		99.98
cc-1134B	778,166N; 871,476E	mylonitic metasiltstone	Zsl	AMERICA MANAGEMENT	.4 0.6	) recen	tervise.ste		0.97 0.06		0.001	7555	< 20	14.5555	< 20 < 1	Check Assur	1 - 216	61 3	SSC. In	10 5	0/04 235047		100.19
cc-403	781,443N; 884,567E	quartzite	Zsl		01 0.2				0.51 0.08		< .001	_	< 20		< 20 < 1		349	64 24	_	10 3			100
cc-760	785,599N; 886,417E	feldspathic quartzite	Zsl	Notice to the second	24 0.3		2.2.1.250		0.57 0.02	1 1111 - 0.1	0.001		< 20		< 20 < 1		183	< 20 12			1 < 20		100.06
scm-500	782,817N; 867,348E	feldspathic quartzite	Zsl	Control of the second of the s	26 0.0	Mark Mark Control	504000 10	100000000000000000000000000000000000000	0.14 < .0	o sinatezani	0.002	801	< 20	3.777	< 20 < 2	COLOR WOOD	111	68 10		2.20	2 < 20	V. 15.000X	100.06
scb-763	777,274N; 861,783E	feldspathic sandstone	Zsl		98 0.0		55.53.33	1000	0.37 < .0		< .001	980	< 20		< 20 < 3	200	130	< 20 < 1			1 < 20	3 475214	100
scc-830	794,689N; 878,960E	feldspathic conglomerate/quartzite	Zswbw		98 0.0	Mark Name (Associa	10435400		0.05 0.07	/	0.002	498	< 20		< 20 < 1	APRIL CO. II	28	< 20 < 1		10 <	1 < 20		100.21
cm-455	790,164N; 873,401E	metagraywacke	Zswbw	The second secon	28 0.9		West Control		1.13 0.05		0.006	895	< 20		< 20 < 2		588	30 23		11.07	0 < 20		100.04
cm-496	781,162N; 869,396E	metagraywacke	Zswbw	78.61 9.53 3.	64 0.7	3 0.17	2.35	2.97	0.65 0.08	0.05	0.003	766	< 20		< 20 < 3		436	120 27	7 <	10 6	3 < 20	1.0	99.94
cb-743	774,605N; 857,818E	mylonitic arkose	Zsmy	81.64 7.94 2	18 0.3	7 0.11	0.6	4.69	0.65 0.04	0.03	< .001	999	< 20	74	< 20 < 2	20 102	401	< 20 12	2 1	6 3	3 < 20	1.6	100.04
cb-503	777,429N; 856,537E	metagabbro	Yg	45.71 14.69 16	6.86 3.7	6 6.55	4.06	1.1	3.42 1.78	0.19	< .001	597	< 20	206	< 20 42	458	277	87 42	2 3	5 1	5 < 20	1.7	100.03
cb-60	765,941N; 862,332E	metagabbro	Yg	49.73 20.91 8.	93 3.4	4 8.62	3.69	0.49	1.0 0.17	0.1	0.006	285	< 20	75	37 21	750	55	< 20 15	5 <	10 1	3 < 20	2.7	99.93
cb-66	766,457N; 862,276E	mylonitic metagabbro	Yg	52.19 9.69 20	0.3 9.5	9 0.33	0.02	0.03	1.76 0.27	0.24	0.03	59	< 20	145	103 70	11	115	< 20 14	4 <	10 3	2 < 20	5.5	100.02
cm-311	771,390N; 864,294E	metagabbro	Yg	49.51 11.76 18	3.32 7.8	9 7.15	2.37	1.03	1.67 0.39	0.23	0.013	869	< 20	175	83 59	361	133	42 29	> 6	10 2	5 < 20	< 0.1	100.34
cm-335	770,223N; 864,129E	metagabbro	Yg	47.16 15.99 14	1.86 4.0	4 7.56	3.59	1.04	4.66 0.42	0.17	0.005	514	< 20	124	34 45	609	133	59 27	7 3	1 2	4 < 20	0.6	100.28
cc 1043	773,786N; 866,950E	mylonitic metagabbro	Yg	45.83 9.88 19	9.9 8.7	1 6.85	1.25	0.88	2.81 0.38	0.26	0.013	320	< 20	194	92 77	125	110	41 28	3 <	10 2	9 < 20	3.0	99.85
cc-848	793,223N; 881,677E	amphibolite in leucocratic granite	Ymfl	46.53 13.96 12	2.37 4.2	9 7.17	2.35	3.81	2.86 0.35	0.34	0.007	3027	82	129	73 39	174	141	< 20 22	2 2	21 2	4 < 20	5.5	99.96
cb-681	781,182N; 858,137E	mylonitic metasediments	Zsmy	88.57 5.4 0.	85 0.0	6 0.06	0.15	3.59	0.11 0.04	0.01	< .001	668	89	36	< 20 < 2	20 39	81	< 20 < 1	0 <	10 <	1 < 20	1.1	100.04
cc-874	792,077N; 887,568E	mylonitic granite	Ym	61.59 19.65 3.	61 1.1	5 0.12	0.14	9.43	0.76 < .0	0.04	0.007	2132	< 20	31	< 20 < 3	20 108	267	30 21	1 <	10 13	3 < 20	3.2	100
cc-894	789,230N; 885,914E	mylonitic granite	Ym	76.15 12.51 1.	17 0.1	5 0.47	3.3	5.42	0.08 0.01	0.02	< .001	184	< 20	< 20	< 20 < 2	20 54	67	< 20 22	2 <	10 1	1 < 20	0.6	99.92
cm-412	784,915N; 873,029E	granite	Ym	69.89 14.22 3.	13 0.7	8 1.72	3.27	4.71	0.38 0.11	0.09	< .001	788	< 20	133	< 20 < 2	20 298	154	46 18	3 <	10 5	5 22	1.5	99.96
cm-418	783,912N; 870,357E	granite	Ym	68.73 14.36 4.	17 1.0	8 1.69	3.13	4.23	0.49 0.13	0.09	0.004	832	< 20	85	< 20 < 2	20 273	182	56 24	4 <	10 7	7 < 20	1.7	99.98
cm-424	785,272N; 870,203E	granite	Ym	76.51 11.72 1.	22 0.0	1 0.06	1.94	7.54	0.06 < .0	1 < .01	< .001	369	< 20	< 20	< 20 < 3	20 87	68	< 20 < 1	10 <	10 1	1 < 20	0.8	99.92
scb-137	750,427N; 859,403E	biotite granitic gneiss	Ydg	59.8 16.97 6.	97 2,6	7 2.69	4.33	3.77	0.87 0.45	0.08	< .001	1580	< 20	113	< 20 < 3	20 423	304	120 25	5 1	7 1	1 < 20	1.1	100
scc-1183	751,671N; 875,838E	protomylonitic granitic gneiss	Ydg	64.17 14.69 6.	67 1.1	3.59	2.67	4.12	1.06 0.48	0.09	0.001	1842	< 20	120	< 20 < 2	20 466	802	300 79	9 2	1 1	7 < 20	1.0	100.02
scc-323	767,442N; 888,036E	protomylonitic biotite granitic gneiss	Ydg		56 1.0	8 3.99	2.51	4.72	1.15 0.54	0.1	< .001	2786	< 20	116	< 20 < 2	20 579	899	199 57	7 9	9 1	7 < 20	1.6	100.01
scm-112	758,918N; 873,987E	granitic gneiss	Ydg	54.97 16.04 7.	65 2.4	7 5,1	2.8	5.15	2.32 1.24	0.09	< .001	3419	< 20		< 20 < 2			220 37	/ 1	0 1	3 < 20	1.4	99.88
scm-215	759,158N; 869,335E	granitic gneiss	Ydg	Little Control of the	45 1.9				0.89 0.36	11.01	0.005	1212		20021	< 20 < 3			172 18		<u> </u>	3 < 20	1000	100.28
scm-240	756,082N; 863,063E	biotitie granitic gneiss	Ydg		34 0.5	10 17 a 17 a 18 a	O 11 (0.11) (0.11)		0.31 0.05		< .001	0.10000000			< 20 < 3	A2010-1-10111111		101.00.00			1 < 20	0 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	99.88
scm-283	757,713N; 868,239E	biotite granitic gneiss	Ydg	L 111000 1 1 1 1 2 2 2 2 2	.5 0.8				0.4 0.15		< .001	_			< 20 < 2						5 < 20		99.91
scc-53	755,730N; 876,580E	protomylonitic granitic gneiss	Ydgc		72 1.0	William Division		Walter Co.	0.82 0.39		< .001	3712		2172	< 20 < 3		1015000	100000			7 < 20	0 15055	99.86
scc-65	753,837N; 875,230E	protomylonitic granitic gneiss	Ydgo		5000 VIVI	7 0.27			0.19 0.02		< .001	565		0.75	< 20 < 3		-	161 14	7-37	-	2 < 20	1771	100.03
scm-85	754,974N; 873,895E	layered biotite granitic gneiss	Ydgc		73 1.0				0.52 0.25		0.004	_			< 20 < 3						3 < 20		100.03
scm-15	749,968N; 866,371E	biotite granitic gneiss	Ydgc	CARLES ALL MANAGEMENT CO.	63 0.4			100	0.24 0.11		< .001	2069			< 20 < 2			52 < 1			2 29	1.0	99.99
scc-958	769,718N; 871,897E	granitic gneiss	Ysc		56 0.2				0.17 < .0		0.001	1514			< 20 < 3			32 < 1			2 < 20		100.05
scm 327	771,124N; 865,609E	granitic gneiss	Ysc		82 0.4				0.32 0.14		< .001	714			< 20 < 3			137 10			2 20	0.7	99.98
scm-141	763,244N; 869,814E	granitic gneiss	Ysc		81 0.3	W. J			0.34 0.04		< .001	2126			< 20 < 3						S 37.250.77	1.0	99.91
scb-337	760,560N; 857,980E	biotite granitic gneiss	Ysc		42 2.9				1.14 0.09		0.016	504		107		20 311					1 < 20		100
scc-333	770,711N; 886,668E	amphibolite	Yda		3.76 5.7 3.41 5.7	er i bullista i			2.44 0.4 2.58 0.33	0.16	0.003	-	< 20	107	40 37			52 29			0 < 20		99.99
				46.94 16.44 13	E 7	200	3.18	1157	2 5 K 0 33	0.16	0.006	1 212	< 20	119	50 46	550	128	42 29	1 1	10 20	0 < 20	1.4	99.93
scm-285	757,094N; 868,105E	metadiorite	Yda				0.000/1/0.11		201V-202-11-11-202-			_								2117			0000
scm-285 scb-173 scb-174	757,094N; 868,105E 769,815N; 860,809E 770,001N; 860,355E	granulitic biotite gneiss granulitic biotite gneiss	Ygbg Ygbg	63.94 15.93 5.	14 1.4		3.04	4.88	1.21 0.31 0.66 0.3		< .001	2049	< 20	64		20 383	945	394 13	3 1	7 5		2.0	99.99





Areas of relict Grenville

granulite facies

heavy mineral sample site

△ Thin section sample site

Stream sediment

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number 02HQAG0043. 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.

(Sandymush 183-NE)

MAP SHOWING MAJOR STRUCTURAL FEATURES

Syncline Plunging syncline Lithologic contact -----

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; II-ilmenite and other black opaque minerals; Tm-tourmaline; En-enstatite; Ap-apatite; Tr-tremolite; Hy-hypersthene; Ol-olivine; Bt-biotite; Ky-kyanite. PERCENT HEAVY MINERALS IN SAMPLE MAP UNITS DRAINED<sup>2</sup> Hb Zr Ttn Rt Lx Hem II Tm En Ap Tr Hy OI Bt K €cuu, €cul, €Zws coux, &cux, 789,732N: 882,063E 786,490N: 876,5988 785,116N; 855,462E 784,678N; 861,740E 783,569N: 862,2658 779,241N; 860,047E 78.004N: 881.476E 73,365N; 854,030E 72,656N: 874,2968 71,843N; 885,0658 769,479N: 854,966E 67.489N: 869.244E 764,205N; 865,700E 763,361N; 875,970E

Lineation Orientations (n = 44)

STREAM SEDIMENT HEAVY MINERAL ANALYSIS

Stream sediment heavy mineral analysis was conducted from October through November 2002 to aid geologic mapping, better define

conditions of metamorphism, and inventory minerals of potential economic significance. Procedure: In the field, approximately 13 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

Unidirectional Rose Diagram Ins (right-hand rule applied)

Contoured Poles to Bedding (n = 637)

Contoured Poles to Mylonitic Foliation (n = 1771)

of stream sediment heavy mineral analysis are tabulated below.

56.414N: 865.883E hm-52 hm-53 hm-54 hm-55 hm-56 hm-57 hm-58 hm-59 750,318N: 860,542E

ercentage of heavy minerals in 13.6 kg stream sediment sample

**CROSS SECTION A-A'** 4000 3000 2000

QUADRANGLE LOCATION

sections. Sample site localities also shown on geologic map.

Red - Prograde metamorphic minerals observed in thin sections

Purple - Mylonitic alteration minerals observed in thin sections

Blue - Primary igneous mafic mineral observed in thin section

Green - Retrograde metamorphic minerals observed in thin sections

origin of hornblende, hypersthene, and garnet undetermined)

Areas of Paleozoic

or contamination?)

Sea Level

greenschist facies

MAP SHOWING IGNEOUS AND METAMORPHIC CONDITIONS

Metamorphic and primary igneous mafic minerals observed in stream sediment heavy mineral samples and thin

Metamorphic Zones

Orange - Aberrant metamorphic minerals observed in stream sediment heavy mineral samples (detrital grains

Mineral Abbreviations: Act - actinolite; Bt - biotite; Chl - chlorite; Cpx - clinopyroxene; En - enstatite; Gt - garnet;

Areas of Paleozoic

amphibolite facies

Black - Prograde metamorphic minerals observed in stream sediment heavy mineral samples (igneous or metamorphic

Hbl - hornblende; Hy - hypersthene; Ky - kyanite; OI - olivine; Pyx - pyroxene; Ser - sericite

1000

<sup>3</sup>PPM = parts per million <sup>4</sup>LOI = loss on ignition in percent 5SUM = Sum total in percent

Sample numbers correspond to thin section and whole rock sample localities shown on geologic map

- 4000