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COMMISSION GÉOLOGIQUE DU CANADA

DESCRIPTIVE NOTES

The eastern Cobequid Highlands is part of the Avalon Composite Terrane of the Appalachian orogen and is underlain by Neoproterozoic to Early Carboniferous rocks (Donohoe and Wallace, 1982, 1985; Murphy et al., *in* press). The Highlands are bounded to the south by the Cobequid Fault; part of the Cobequid-Chedabucto (Minas) fault system that separates the Highlands from the Meguma terrane. To the north the Highlands are unconformably overlain by middle to late Carboniferous rocks. The Rockland Brook Fault, which parallels the Cobequid Fault, divides the Highlands into two blocks that have contrasting pre-Namurian stratigraphy.

In the southern block, Neoproterozoic rocks include granitoid gneisses and amphibolites of the Mount Thom Complex (unit 1), whose age and tectonic significance remain uncertain, gneissic, supracrustal and plutonic rocks of the Bass River Complex and granitoid plutons. The Bass River Complex (units 2 to 5) comprises of the Gamble Brook Formation, Economy River Gneiss, Folly River Formation and the Great Village River Gneiss. The Gamble Brook Formation is dominated by medium to low-grade metasediments and is divided into two units, unit 2a which is dominated by quartzites, and unit 2b which predominantly consists of pelitic schists and phyillites. These units are thought to represent a platformal environment (Nance and Murphy, 1990). The 734±2 Ma Economy River Gneiss (unit 3) is a sheared granitoid body with an arc geochemical signature (Doig et al., 1993). Its metamorphic grade is uncertain. The gneiss provides a minimum age for Gamble Brook Formation rocks that it intrudes. The Folly River Formation (unit 4c) consists of greenschist to sub-greenschist grade continental tholeiitic basalts and coeval locally sheeted mafic dykes. These rocks are coeval with arc-related rocks elsewhere in the Cobequid Highlands (e.g. Pe-Piper and Piper, 1987) and are interpreted to represent rifting within a volcanic arc (Pe-Piper and Murphy, 1989). The contact between the Folly River and Gamble Brook formations is interpreted as an unconformity (Murphy et al., 1988, 1989). The isolated and little-deformed rocks of the Dalhousie Mountain Formation (unit 4d) consist of felsic to mafic volcanics and interbedded greywackes and shales (Murphy et al., 1992). This unit is lithologically and geochemically similar to the Jeffers Group (unit 4a) with which it is correlated. The ca. 580-610 Ma Great Village River Gneiss (unit 5a, Doig et al., 1991) predominantly consists of moderately to intensely sheared greenschist grade gabbroic to granitoid rocks. The rocks of this unit are interpreted as coeval with respect to granite gneissic bodies (unit 5b) that are dated at ca. 600 Ma (Doig et al., 1991) and occur along the shear zone contact between the Great Village River Gneiss and the structurally overlying Gamble Brook Formation. The granite gneiss bodies are interpreted to be synkinematic with respect to ductile motion along the shear zone (Nance and Murphy, 1990). The Great Village River Gneiss is also temporally equivalent to less deformed plutons (units 5c and 5d; e.g. Frog Lake and Debert River plutons, Keppie et al., 1990) and greenschist to sub-greenschist grade arc-supracrustals including the Folly River Formation and the Dalhousie Mountain Formation. The Great Village River Gneiss is also correlated with the Jeffers Group, (unit 4a) and Warwick Mountain Formation (unit, 4b) to the north of the Rockland Brook Fault.

In the northern block, the Neoproterozoic Jeffers Group and Warwick Mountain Formation (units 4a, 4b) consist of mafic to felsic volcanic rocks with arc geochemical signatures (Pe-Piper and Piper, 1987, 1989; Pe-Piper and Turner, 1988) and interbedded greywackes. They correlate in age, lithology, geochemistry and tectonic setting with the Dalhousie Mountain and Folly River formations and equivalent-aged rocks in the Antigonish Highlands in eastern mainland Nova Scotia (Murphy et al., 1992).

In general, Neoproterozoic rocks contain Neoproterozoic fabrics, except adjacent to Paleozoic faults where local overprinting occurs (Murphy et al., *in* press). The shear zone contact between the Great Village River Gneiss and the Gamble Brook Formation is typically about 1 km in width and is characterized by penetrative fabrics in gneisses, syntectonic granites, and volcano-sedimentary successions. Fabrics within ca. 600 Ma sheared granite gneisses are interpreted to reflect synkinematic crystallization within active ductile shear zones associated with sinistral intra-arc transtension and basin development that heralded the deposition of the Folly River volcanic and sedimentary rocks. Fabrics in the volcanic-sedimentary successions reflect deformation and closure of the transtensional basin soon after its formation (Nance and Murphy, 1990). These fabrics are truncated by ca. 600 Ma plutonic rocks (units 5c, 5d), indicating their Neoproterozoic age.

Early Paleozoic rocks predominantly occur to the north of the Rockland Brook Fault. They consist of Late Ordovician to Late Silurian sub-greenschist to unmetamorphosed rocks that are dominated by shallow marine fossiliferous siliciclastic sedimentary and minor volcanic rocks of the Wilson Brook Formation (unit 7). Although the original stratigraphy is disrupted by structural complexities, the lithologies and faunal assemblages are broadly similar to the Arisaig Group to the northeast of the map area. The rocks are unconformably overlain by Early to middle Devonian thick clastic sequences of the Portapique River and Murphy Brook Formations (unit 8). Silurian to middle Devonian rocks are folded into tight to overturned ENE to NE trending en echelon folds, that are truncated by late Devonian strata, suggesting an episode of folding between the middle and Late Devonian. South of the Rockland Brook Fault, rocks of similar age are poorly exposed in fault slices, and their relationship to other coeval strata is not understood. Our mapping indicates that much of the area previously mapped as the Tournaisean Nuttby Formation appears to be older

Late Devonian-Carboniferous rocks north of the Rockland Brook Fault comprise continental sediments and intracontinental bimodal volcanic rocks of the Fountain Lake Group (unit 9). Bimodal (mafic and felsic) plutonic complexes (unit 10; emplacement age ca.360 Ma, Doig et al., 1996) occur on both sides of the fault may be co-genetic with the volcanic sequences (Pe-Piper 1991). In contrast to Neoproterozoic igneous rocks, ca. 360 Ma volcanic and plutonic rocks display within-plate characteristics (Pe-Piper et al., 1989) and are thought to be related to rifting that occurred in transtensional regimes adjecent to major transcurrent faults. In areas of poor exposure, these contrasting geochemical characteristics may be important in distinguishing between Neoproterozoic and Late Devonian-Carboniferous igneous rocks. Plutonic rocks typically display abundant field evidence of magma mixing and hybridization and have narrow contact aureoles. To the south of the Rockland Brook Fault, Devonian-Carboniferous rocks predominantly consist of Early Tournaisean coarse to fine-grained clastic rocks of the Nuttby Formation, which is thought to be a local representative of the regionally extensive Horton Group in Maritime Canada.

Heterogeneous, locally intense, episodic dextral deformation related to movement along the Rockland Brook and Cobequid faults occurred at various times in the Late Devonian and Carboniferous. Early faults are associated with ca. 360 Ma magmatism (Piper et al., 1993; Piper, 1994) and some plutons (e.g. Pleasant Hills pluton) stitch the fault. Later faults transect and offset these plutons and affect Tournaisean strata. Regional constraints (Murphy et al., *in* press) suggest deformation was related to reactivation of the Rockland Brook Fault, occurred before Westphalian times, and produced positive flower structures, local isoclinal folds (Miller et al., 1995). Episodic dextral motion in the Devonian and Carboniferous may be related to movement on the Cobequid-Chedabucto (Minas) Fault Zone during dextral transpression along the Avalon-Meguma terrane boundary.

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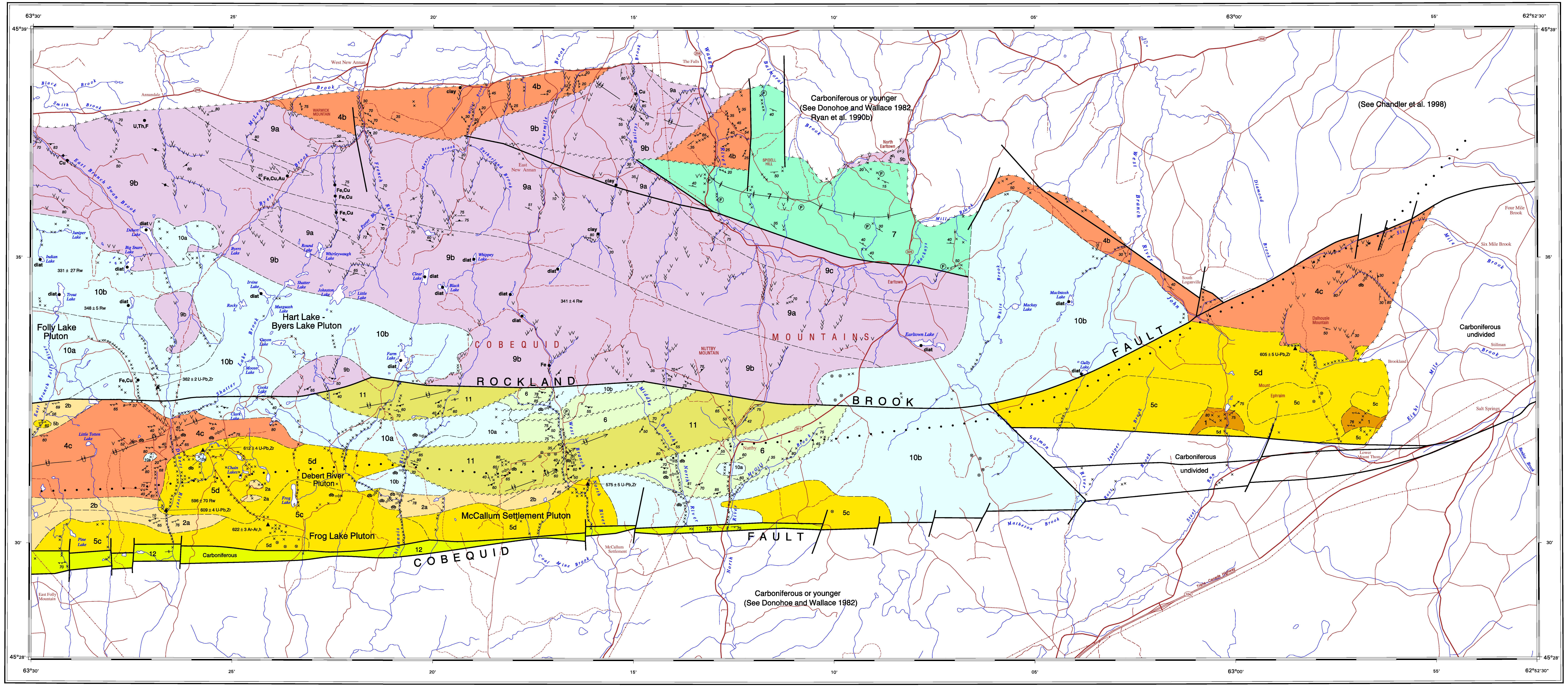
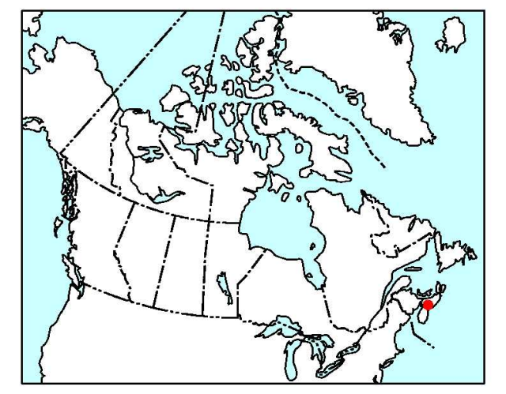
1990b: Cumberland Basin Geology Map 90-14, NTS sheet 11E/11, Nova Scotia Department of Natural Resources, scale 1:50,000




LOCATION MAP

Geology by J.B. Murphy, G. Pe-Piper, R.D. Nance, D. Turner, and D.J.W. Piper

We wish to acknowledge the mapping of Howard Donohoe and Peter Wallace in this area (1982), without which, this study could not have been accomplished

Digital cartography by L. Renaud and J.A.Y. Pratt, Earth Sciences Sector Information Division (ESS Info)

COOPERATION

COOPERATION AGREEMENT ON MINERAL DEVELOPMENT

ENTENTE DE COOPÉRATION SUR L'EXPLOITATION MINÉRALE

Contribution to Canada-New Brunswick Cooperation Agreement on Mineral Development (1990-1995), a subsidiary agreement under the Economic and Regional Development Agreement.

Contribution à l'Entente de coopération Canada - Nouveau-Brunswick sur l'exploitation minérale (1990-1995), entente auxiliaire négociée en vertu de l'Entente Canada/Nouveau-Brunswick de développement économique et régional.

Canada

New Nouveau Brunswick

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GEOLOGY

EASTERN COBEQUID HIGHLANDS

NOVA SCOTIA

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilomètres

Universal Transverse Mercator Projection
North American Datum 1983

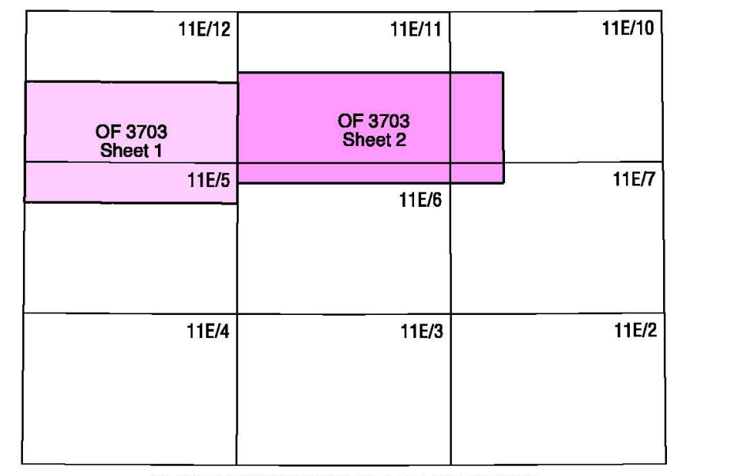
Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Digital base map from data compiled by Geomatics Canada, modified by ESS Info and Pole Star Geoscience Inc

Some geographical names subject to revision

Mean magnetic declination 2000, 20° 28' W, decreasing 4.0' annually. Readings vary from 20° 20' W in the SW corner to 20° 35' W in the NE corner of the map



NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

LEGEND

This legend is common to open files 3703 sheet 1 and 3703 sheet 2.
Not all map units and symbols shown in the legend necessarily appear on this sheet.

CARBONIFEROUS	
☐	
12	*LONDONDERRY FORMATION: grey, grey-green felspathic sandstone, siltstone, maroon silstone and shale*
11	*NUTTBY FORMATION: grey, grey-green quartz sandstone, feldspathic sandstone, polymictic conglomerate, siltstone; maroon silstone and shale*
LATE DEVONIAN	
10	*a) Gabbro: darkgrey medium grained augite-hornblende-plagioclase gabbro Diorite: heterogeneous mixture of gabbroic and granite components* *b) Granite: red, orange and pale grey coarse to medium grained quartz-rich, locally graphic, alkali-feldspar leucogranite*
FOUNTAIN LAKE GROUP	
9	*a) DIAMOND BROOK FORMATION: dark green to dark grey basalt, commonly amydaloidal, maroon to red sandstone and siltstone, minor rhyolite* *b) BYERS BROOK FORMATION: felsic flow-banded ignimbrite, tuff, minor agglomerate, volcaniclastic sandstone, siltstone and basalt*
EARLY-MID DEVONIAN	
8	*PORTAPIQUE RIVER and MURPHY BROOK FORMATIONS: maroon to red conglomerate, red, dark grey and green sandstone, siltstone, minor shale, contains Emsian-Eifelian plant fossils*
LATE ORDOVICIAN-SILURIAN	
7	*WILSON BROOK FORMATION: sparsely fossiliferous green, grey and black micaceous siltstones and wackes; minor tuffs, thin coquina beds*
6	*UNDIVIDED: sandstone, siltstone, sparsely fossiliferous*
NEOPROTEROZOIC III	
NEOPROTEROZOIC PLUTONS	
5	*a) GREAT VILLAGE GNEISS: sheared, locally mylonite massive to layered quartz-plagioclase, hornblende amphibolite, hornblende-bearing granitoid orthogneisses biotite±garnet-rich, psammitic paragneiss* *b) GRANITIC GNEISS: sheared, strong mylonitic foliation and linear fabric, porphyroclasts of orthoclase, plagioclase and quartz±biotite and muscovite* *c) APPINITIC GABBRO, DIORITE: dark medium to coarse grained, locally pegmatitic, hornblende-plagioclase bearing gabbro and diorite* *d) GRANITE, DIORITE: orange to grey medium to coarse equigranular quartzfeldspathic granite with minor biotite, with subhedral granitic texture*
JEFFERS GROUP	
4	*a) green to grey basalt, hyaloclastite and tuff, volcanogenic and chlorite sedimentary rocks, minor jasperitic ironstones, chloritic metasedimentary rocks and abundant co-genetic mafic dykes* *b) WARWICK MOUNTAIN FORMATION: felsic and volcanic rocks, cleaved turbiditic mudstones, lithic arkoses* *c) FOLLY RIVER FORMATION: green to grey basalt, hyaloclastite and tuff, volcanogenic and chloritic sedimentary rocks, minor jasperitic ironstones, chloritic metasedimentary rocks and abundant co-genetic mafic dykes* *d) DALHOUSIE MOUNTAIN FORMATION: massive felsic ignimbrites, felsic to intermediate tuffs, mafic flows, some with plagioclase phenocrysts, thin, interlayered fine-grained, pale to dark green turbiditic mudstones displaying plane-lamination, grading and cross-bedding*
3	*ECONOMY RIVER GNEISS: sheared, mylonitic quartz, plagioclase and hornblende bearing granitoid with strong linear and planar fabrics*
2	*a) GAMBLE BROOK FORMATION: tan to white locally sheared and transposed orthoquartzite, arkosic quartzite, minor biotite-muscovite-garnet psammatic schist, carbonate beds and lenses* *b) biotite-muscovite and biotite-garnet schist and phyllite, orthoquartzite and psammitic schist*
MOUNT THOM COMPLEX	
1	*quartzofeldspathic biotite-muscovite orthogneiss, garnet-bearing paragneiss, minor amphibolite*

Geological boundary (defined, approximate, inferred)
Unconformities (defined, approximate, inferred)
Exposures (in place, volcanic rocks, float) × V ⊗
Bedding, top known (inclined, overturned) 30 75
Bedding, top unknown (inclined, vertical) 35
Flow layering in volcanic rocks (inclined, vertical) 55
Fault (brittle, ductile, thrust)
Schistosity, gneissosity (Precambrian) 20
Cleavage (non-penetrative)(Precambrian) 30
Cleavage (Carboniferous) 40
Mineral lineation 20
Regional fold (anticline, syncline, overturned syncline)
Minor folds (S-sense, Z-sense, intrafolial) 20 20 20
Diabase dyke (age unknown) db
Gravity anomaly ● ● ●
Radiometric age determination in million of years
R=Rb/Sr system date; w=whole rock; m=mineral;
mu=muscovite; b=biotite; h=hornblende;
U-Pb, Zr=Zircon analysis 341±4Rw ▲
Fossil localities Ⓕ
Spore localities Ⓢ
Mineral occurrence Au●
Commodities (clay, diatomite) diat●

Minerals

Copper	**Cu**	*Uranium*	**U**
Diatomite	**diat**	*Lead*	**Pb**
Thorium	**Th**	*Clay*	**Clay**
Zinc	**Zn**	*Fluorine*	**F**
Arsenic	**As**	*Lanthanum*	**La**
Gold	**Au**	*Vanadium*	**V**
Iron	**Fe**	*Silver*	**Ag**
Rip rap, road metal	**Rock**		
Ankerite	**Ank**		

OPEN FILE
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3703
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OTTAWA
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SHEET 2 OF 2
FEUILLET 2 DE 2

Sheet 2 of 2, Geology

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