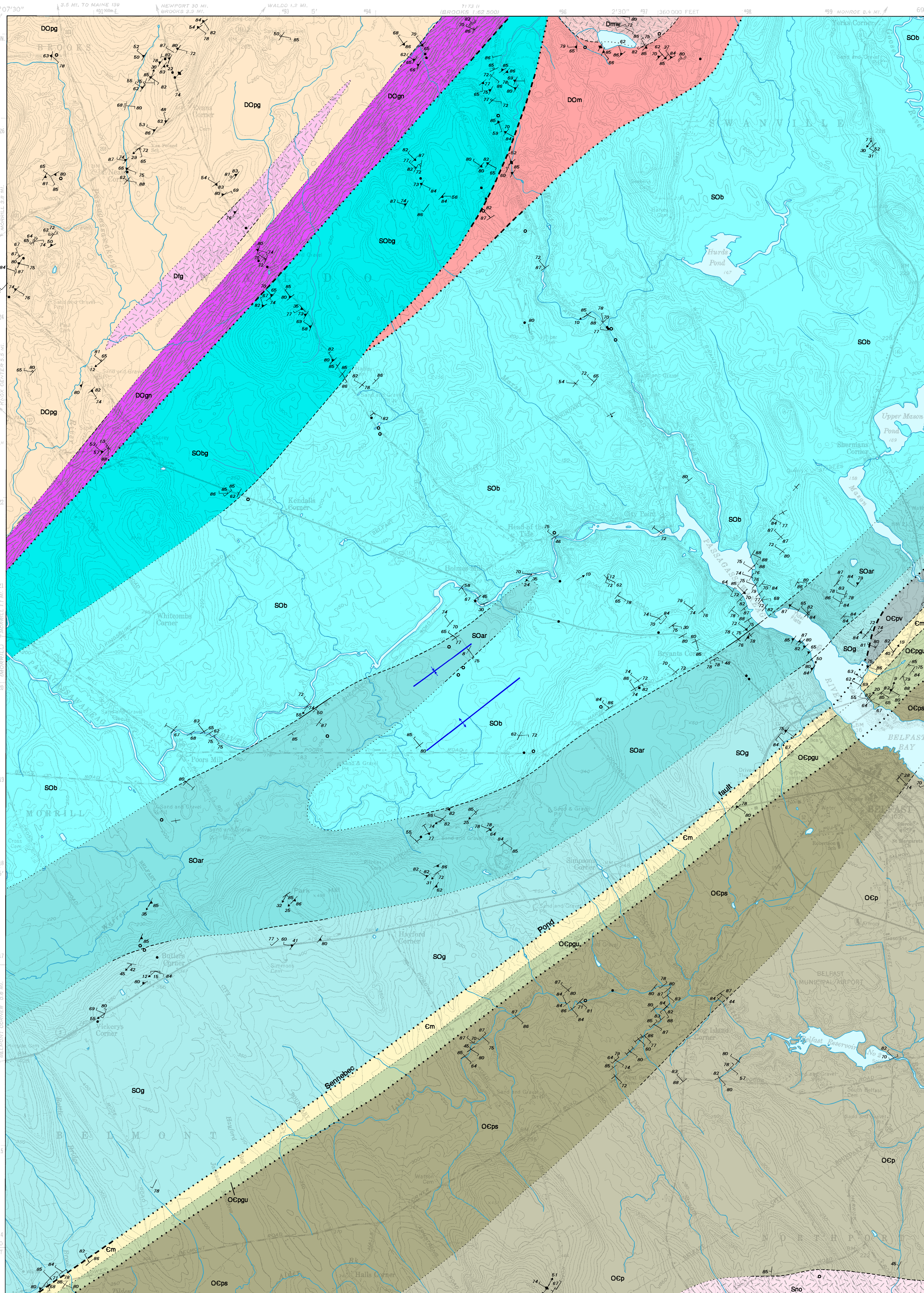

EXPLANATION OF SYMBOLS

Note: Structural symbols are drawn parallel to strike or trend of measured structural feature. Barb or tick indicates direction of dip, if known. Annotation gives dip or plunge angle. For most planar features, symbol is centered at observation point; for joints, observation point is at end of strike line opposite dip tick. For linear features, tail of symbol is at observation point. Multiple measurements at a site are represented by combined symbols.

- Outcrop of mapped unit. Generally, a small pavement exposure less than 2 square meters covered with lichen or moss, and from which no structural and limited lithologic information can be gathered.
- Occurrence of float blocks suggesting frost-heaved outcrop in the shallow subsurface.
- 20 Bedding, tops unknown or uncertain. *In rocks of greenschist or lower amphibolite facies:* Prominent sedimentary layering. *In rocks of middle amphibolite facies:* Well defined compositional layers, commonly alternating granofels and metapelite. (inclined, vertical)
- 20 20 Bedding, tops known through textural grading or sedimentary structures. (vertical, tops toward ball; inclined, overturned)
- 20 Compositional layering. Layers or planes not suggestive of bedding, such as alternating granofels and schist. Suggesting overall gneissic quality or migmatitic layering. (inclined)
- 20 Early schistosity or cleavage, which is cross-cut by dominant foliation or schistosity. Not to be confused with elements of composite S-C fabrics. (inclined)
- 20 Dominant schistosity or foliation in the outcrop, controlled by phyllosilicate minerals. Also may be S-surfaces in S-C fabrics in which the C-surface is weakly developed. (inclined, vertical)
- 20 Rock cleavage in slates, phyllites, and metasandstones. May be pressure-solution cleavage in metasandstones. Coarser-grained phyllites are considered to have a cleavage rather than a true micaceous schistosity. (inclined, vertical)
- 20 Late cleavage, usually a crenulation cleavage, which cuts across the dominant rock cleavage, foliation, or schistosity. (inclined)
- 20 Mylonitic foliation. A planar foliation commonly associated with quartz ribbons or porphryoclasts in finer-grained matrix. (inclined)
- 20 C-surface cleavage in an S-C shear band consisting of S (schistosity) planes transected by distinct C (cleavage) planes. (inclined)
- 20 C-prime (C') cleavage in shear band. This is a specific type of shear band cleavage which is oblique to shear zone boundaries and to the older schistosity (Passchier and Trouw, 2005). Shear bands are usually short and anastomosing or wavy. Uncommon in mylonitic mica-rich schists. (inclined)
- 20 Fold axis. (plunging)
- 20 Dominant joint set at the outcrop. Dominance varies with map unit and outcrop size. May represent a single measurable joint or the average of multiple measurable joints. (inclined, vertical)

EXPLANATION OF UNITS

INTRUSIVE ROCKS

Devonian (?)

Dmw — **Mount Waldo Granite.** Medium gray, fine-grained to very fine-grained biotite ± amphibole granite. The rocks are free of enclaves, schlieren, or compositional variation. The south edge of the Mount Waldo pluton is exposed at the north edge of the Belfast quadrangle, in the vicinity of Nicols Pond.

Dfg — **Fine-grained granite.** Gray, non-foliated and unsheared, very fine-grained to fine-grained biotite granite. In addition to the mapped body, this rock is commonly present as small, concordant bodies within other map units. Moderately common in the northern third of the Belfast quadrangle.

Silurian

Sno — **Northport Granite.** White, medium-grained to coarse-grained, muscovite-biotite granite. Contains large, dark red garnets up to 1 cm across, especially in dikes and near the pluton margin. Magmatic foliation commonly present. Exposed in the Belfast quadrangle only in float. Contact projected from the neighboring Lincolnville and Searsport quadrangles.

MIGMATITIC ROCKS

Devonian-Ordovician(?)

DOm — **Migmatite.** Texturally heterogeneous, stromatic metatexite migmatite. Thin to medium (8 to 30 cm) compositional layers of fine-grained biotite-quartz ± garnet ± plagioclase ± sillimanite granofels. Augen of quartz or alkali feldspar within the granofels range from approximately 0.5 to 2 cm. Thin layers of very fine-grained amphibolite are present locally. Granite, present as pods, boudins, lenses, stroma and/or dikes, exhibits a variety of textures, which range from fine-grained through medium-grained to very coarse-grained granite; tourmaline granite pegmatite is present locally.

Overall, these rocks lack dextral shear fabrics; granite boudins or pods are commonly biconvex. This contrasts with the ubiquitous dextral shear fabrics and asymmetric boudins of the Passagassawakeag Gneiss (**DOpg**) to the west. This migmatite also differs from the migmatites to the west in containing garnet as a minor accessory, and having lesser quantities of feldspar. Striped gneiss and mylonite are present very locally.

STRATIFIED ROCKS

Fredericton Belt

Silurian-Ordovician(?)

SOg — **Ghent Phyllite.** In the southwest part of the map area, this unit is a medium dark gray to grayish black claystone phyllite. Locally, thick laminae and very thin beds of quartz-rich metasiltstone or very fine-grained quartzite are common. Thin beds (1 to 3 cm) commonly exhibit well defined sharp bases and tops. The rock exhibits very closely spaced cleavage planes. Quartz laminae are locally transposed parallel to the regional cleavage. X-ray diffraction of this phyllite indicates a mineralogy of chlorite, muscovite, biotite, and quartz. Metamorphic grade increases to the northeast. In the vicinity of Park Hill and Simpsons Corner, the Ghent is a dark gray to grayish black, very coarse-grained garnet-bearing phyllite to very fine-grained muscovite-biotite-garnet-quartz schist. Garnet porphyroblasts in this area are typically less than 1 mm in size. Exposures northeastward of Simpsons Corner exhibit increased grain size to that of a very fine-grained to fine-grained muscovite-biotite-garnet ± andalusite ± staurolite schist. Garnet porphyroblasts are 2 mm or less, and andalusite and staurolite porphyroblasts approach 1 cm in length.

SOar — **Appleton Ridge Formation.** Slightly rusty-weathering to rusty-weathering, medium-grained to coarse-grained quartz-plagioclase-muscovite-biotite-garnet ± staurolite ± andalusite schist, interbedded with fine-grained quartz-plagioclase-biotite-muscovite granofels. Bedding ranges in thickness from approximately 10 to 30 cm. The proportion of granofels to schist is variable. Most localities are dominantly schist with 10% or less granofels. In some places, however, sequences of granofels beds are dominant and granofels beds range from 10 to 30 cm in thickness. Granofels beds exhibit sharp bases without noticeable textural variation or grading. Garnet porphyroblasts are generally less than 1 mm. Staurolite is commonly present as untwinned porphyroblasts up to 1 cm. Andalusite is present in two forms, either as dark chiasolite porphyroblasts up to 1 cm, or as 1 to 3 cm grains of anhedral, pink andalusite in quartz veins, pods and boudins.

SOb — **Bucksport Formation.** Biotite granofels interlayered with calc-silicate granofels. The biotite granofels is brownish black to very dusky purple biotite granofels and biotite quartzite. The calc-silicate granofels is very pale green to light greenish gray. Grain size varies between very fine-grained and fine-grained. Compositional layers are well developed and pronounced. The biotite granofels layers and beds range from 5 cm to more than 1 m in thickness, and are generally consistent within an outcrop. Sections may consist entirely of thin (< 15 cm), medium (15 to 50 cm), or thick (> 50 cm) beds. The calc-silicate rock is very fine-grained and non-calcareous. Calc-silicate layers are common, but their proportion varies considerably; at some localities, calc-silicate rock may comprise 60% of the rock. In sections with medium to thick beds of biotite granofels, the calc-silicate granofels layers are commonly less than 3 cm in thickness. Where calc-silicate is most common, the calc-silicate layers may exceed 4 cm in thickness, while the interlayered biotite granofels layers are less than 1 cm.

SObg — **Granofels and schist member.** Very fine-grained to fine-grained feldspar-quartz-biotite granofels and very fine-grained feldspar-quartz-biotite schist. Thin bedding is prominent and ranges in thickness from approximately 5 to 15 cm. Schistose beds are thinner, ranging from 5 to 8 cm. The granofels beds are the most volumetrically significant. Minor thin and discontinuous laminae or bands of calc-silicate rock are uncommon to rare and are commonly less than 1 cm in thickness. The calc-silicate rock consists primarily of plagioclase, quartz, amphibole, and epidote with minor garnet. Thin dikes, boudins, and lenses of grayish, very fine-grained biotite granite are common in the westernmost outcrop areas. Granite can be fairly common in the outcrops near the striped gneiss unit, which abuts this unit to the west.

St. Croix Belt

Ordovician-Cambrian

O€p — **Penobscot Formation.** Thinly interbedded metapelite and metasandstone. Bedding ranges from approximately 10 to 30 cm in thickness for both metapelite and metasandstone. Metasandstone to metapelite ratios are approximately 1:1. Sequences of metapelite beds, however, may be several meters in thickness. Varying degrees of rusty weathering characterize the metapelite. The metapelite ranges from a fine-grained to very fine-grained biotite-muscovite-quartz-garnet-andalusite schist in the southwest to very fine-grained biotite-rich schist and coarse-grained phyllite in the northeast. Metasandstone beds are characteristically very fine-grained to fine-grained quartz meta-arenite. Sedimentary structures are lacking or not preserved.

O€pv — **Metavolcanic member.** Limited exposure of layered metavolcanic rocks at the east edge of the map, east of the Passagassawakeag River. These rocks may correlate with the lithologically similar Gushee member, but are structurally isolated from it by faults.

O€pgu — **Gushee member.** Lithologically heterogeneous, generally sulfide-rich rocks with moderately well developed compositional layering. The unit includes: (a) fine-grained plagioclase-epidote-amphibole granofels; (b) greenish gray fine-grained to medium-grained plagioclase-quartz granofels. This rock contains small (<1 mm) quartz phenocrysts together with small (<4 mm) lithic grains, suggesting a tuffaceous protolith; (c) greenish gray, very fine-grained, feldspathic metawacke; (d) very fine-grained amphibole-rich granofels; (e) fine-grained quartz-sulfide-garnet-graphite granofels; and (f) minor amphibolite. This unit is interpreted to be a fine-grained, intermediate to felsic metatuff.

O€ps — **Thick-bedded metasandstone member.** This member consists of medium and thick beds of medium dark gray to dark gray, well sorted, fine-grained and very fine-grained quartz meta-arenite. Slate and phyllite which consists of metasiltstone is a minor lithology. Beds of quartz meta-arenite are most commonly between 30 and 45 cm in thickness, and range from 5 cm to approximately 1 m. Beds overall lack sedimentary structures such as textural grading and sole markings. Rock cleavage is absent at most locales. Slate and phyllite beds are commonly less than 4 cm thick between the meta-arenite beds. Slate and phyllite commonly are mildly rusty-weathering. The metapelite gradually changes from siltstone slate in the southwest to siltstone phyllite in the northeast. In the northeastern outcrops, biotite or chlorite pseudomorphs are present. The shape of the pseudomorphs suggests that garnet may have been the original mineral.

Cambrian(?)

€m — **Quartz-rich metasiltstone (Megunticook Formation ?).** A lithologically heterogeneous unit. The predominant lithology consists of medium to light gray quartz-rich metasiltstone with well developed rock cleavage. While the rock appears to be a cleaved metasiltstone, the nature of the rock cleavage locally resembles a mylonitic foliation. This unit also includes minor fine-grained quartz-muscovite-garnet-biotite schist; very fine-grained quartz-feldspar-biotite-garnet granofels; rusty-weathering and yellow-weathering quartz-rich granofels; medium dark gray, very fine-grained quartz-rich granofels; very fine-grained quartz-rich metasandstone, and minor phyllite similar to rocks of the Ghent Phyllite.

EXPLANATION OF LINES

Stratigraphic or intrusive contact (well located, approximately located, poorly located).

Fault or sheared contact (approximately located, poorly located).

Axial trace of fold, inferred from map pattern (anticline, syncline).

Bedrock Geology of the Belfast Quadrangle, Maine

Bedrock geologic mapping by
Stephen G. Pollock

Digital cartography by
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Robert D. Tucker

Geologic editing by
Henry N. Berry IV

Cartographic design and editing by
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State Geologist

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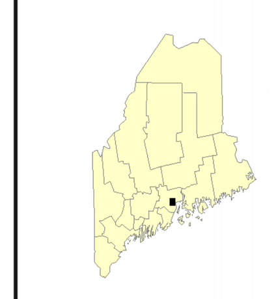
Open-File Map 12-37
2012
This map supersedes Open-File Map 11-27.



Quadrangle Location

TRUE NORTH

SCALE 1 : 24,000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

SOURCES OF INFORMATION

Stephen G. Pollock, field mapping, 2010-2011. Two outcrops near Northport pluton from maps of Bickel, 1971.

Topographic base from U.S. Geological Survey Belfast quadrangle, scale 1:24,000 using standard U.S. Geological Survey topographic map symbols. Magnetic declination 17° west of North.

The use of industry, firm, or local government names on this map is for location purposes only and does not impute responsibility for any present or potential effects on the natural resources.

HIGHLY DEFORMED ROCKS

Devonian-Ordovician(?)

DOpg — **Passagassawakeag Gneiss.** Compositional layering varies from absent to locally prominent. The compositional layering is not interpreted as relict bedding. Individual compositional layers range in thickness from approximately 2 to 15 cm. The lithologies are: (1) thin compositional layers of fine-grained plagioclase-biotite-quartz-sillimanite granofels; (2) thin to medium compositional layers of fine-grained plagioclase-biotite-quartz ± sillimanite gneiss; (3) fine-grained to medium-grained biotite-plagioclase-quartz ± sillimanite schist; (4) very fine-grained to fine-grained amphibolite; (5) very fine-grained to fine-grained calc-silicate gneiss, locally with diopside. Garnet is rare in all lithologies. Porphyroclasts of granite or feldspar are common in the granofels and schists. Granite porphyroclasts range from approximately 1 x 4 cm to approximately 3 x 10 cm and larger. Feldspar porphyroclasts are rarely larger than 1 cm. Quartz boudins, veins, and segregations are present, but do not strongly characterize the unit.

Boudins of medium-grained to coarse-grained muscovite ± biotite ± tourmaline granite are ubiquitous. They range in size from approximately 5 x 15 cm to 0.4 x 15 m. Most boudins have asymmetric or sigmoidal shapes suggesting dextral shear. Other boudins have been folded in a ductile manner. The margins of many boudins lack any fabric. Boudin margins are typically holocrystalline igneous textures in sharp contact with the surrounding schist or granofels. Uncommonly, boudins exhibit a reduction in grain size at the margin, or feldspars appear to have been broken away from the granite boudin. These grains are interpreted as porphyroclastic grains. Boudin margins with a reduced grain size may exhibit a weak foliation which is broadly coincident with the foliation of the adjacent schist. Dikes of this granite are uncommon to rare. Where seen, the dikes are of variable width ranging from 10 cm to approximately 1 m. Pinch-and-swell structure as well as boudinage are locally present, but most commonly remnants of the dikes are present as symmetrical or non-sigmoidal boudins ranging in size from 1 cm x 10 cm to 40 cm x 1 m. Grain size reduction in some dikes and boudins appears to be due to cataclasis.

Zones or outcrops where extensive dextral shear is absent are consistent with stromatic metatexite migmatites. These metatexite migmatites consist of two parts, leucosome and melanosome. The leucosome occurs as felsic veins, dikelets or thin dikes and stroma of fine-grained to very coarse-grained granite, locally containing pyroxene or amphibole or both. The melanosome is primarily a fine-grained biotite-plagioclase-quartz ± amphibole granofels. Possible paloesome consists of light to medium gray biotite-feldspar-quartz gneiss. Melanocratic selvages along the margins of the leucosome consist predominantly of biotite-sillimanite-alkali feldspar-quartz schist.

DOgn — **Unnamed gneiss.** Alternating layers of fine-grained to coarse-grained granite, fine-grained quartz-feldspar-biotite granofels, and fine-grained quartz-feldspar-biotite ± garnet ± sillimanite schist. The rock is strongly foliated with steeply dipping mylonitic foliations. Lineations on foliation surfaces plunge to the north less than 20 degrees. Sillimanite, where present, is observed as a lineation on foliation surfaces. Sillimanite may also be present as radial sprays. Boudins of coarse-grained granite are present. In these boudins, the granite is commonly finer-grained at the margin and coarser-grained in the interior. Locally, adjacent to the boudin margin, porphyroclastic feldspar grains or composite porphyroclasts of quartz and feldspar are present. Granite boudins within this unit are biconvex, which differs from the asymmetric and sigmoidal shapes of granite boudins in the Passagassawakeag Gneiss (**DOpg**).

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GEOLOGIC TIME SCALE

Geologic Age		Absolute Age*
Cenozoic Era		0-65
Mesozoic Era	Cretaceous Period	65-142
	Jurassic Period	142-200
	Triassic Period	200-253
Paleozoic Era	Permian Period	253-300
	Carboniferous Period	300-360
	Devonian Period	360-418
	Silurian Period	418-443
	Ordovician Period	443-489
	Cambrian Period	489-542
Precambrian time		Older than 542

* In millions of years before present. (Okulitch, A. V., 2004, Geological time chart, 2004: Geological Survey of Canada, Open File 3040 (National Earth Science Series, Geological Atlas) - REVISION.)