Preliminary Bedrock, Surficial, and Stuctural Data Maps of the Southbridge quadrangle, Massachusetts and Connecticut

by George E. Moore, Jr.

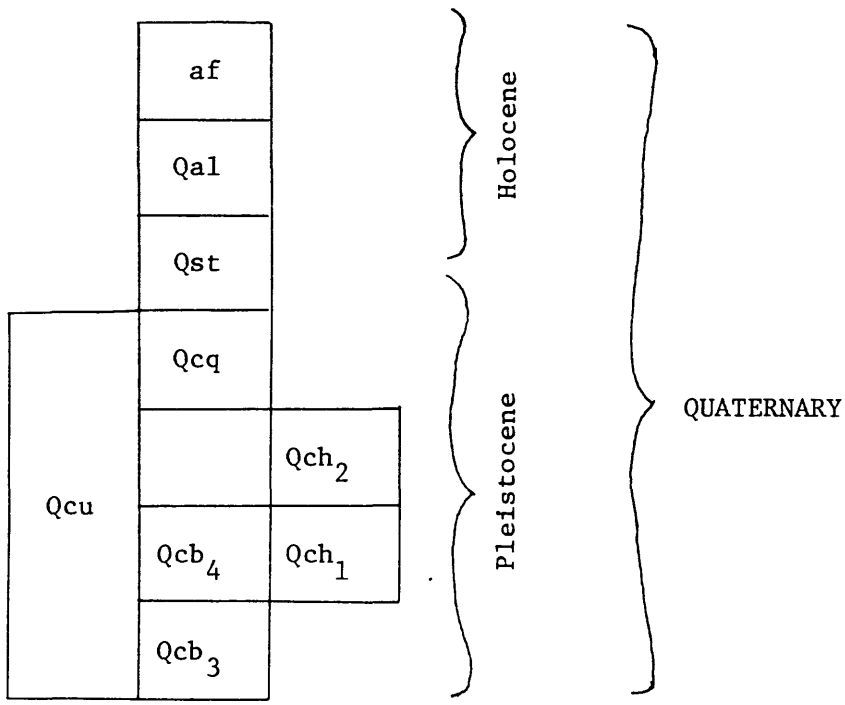
U.S. Geological Survey Open File Report 78-220

Prepared in cooperation with the Massachusetts Department of Public Works and with the State of Connecticut Geological and Natural History Survey

1978

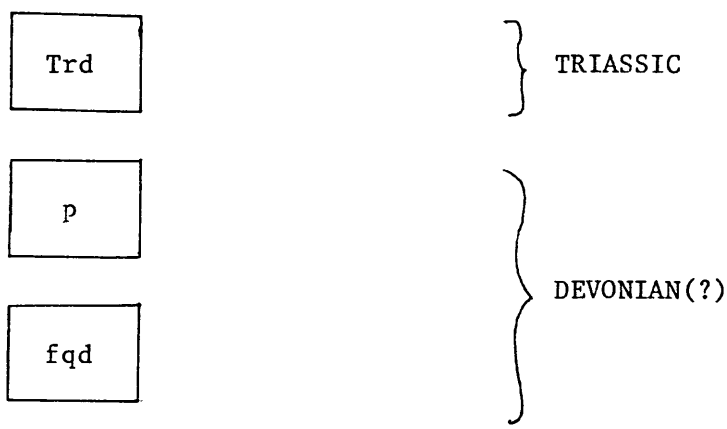
CORRELATION OF MAP UNITS

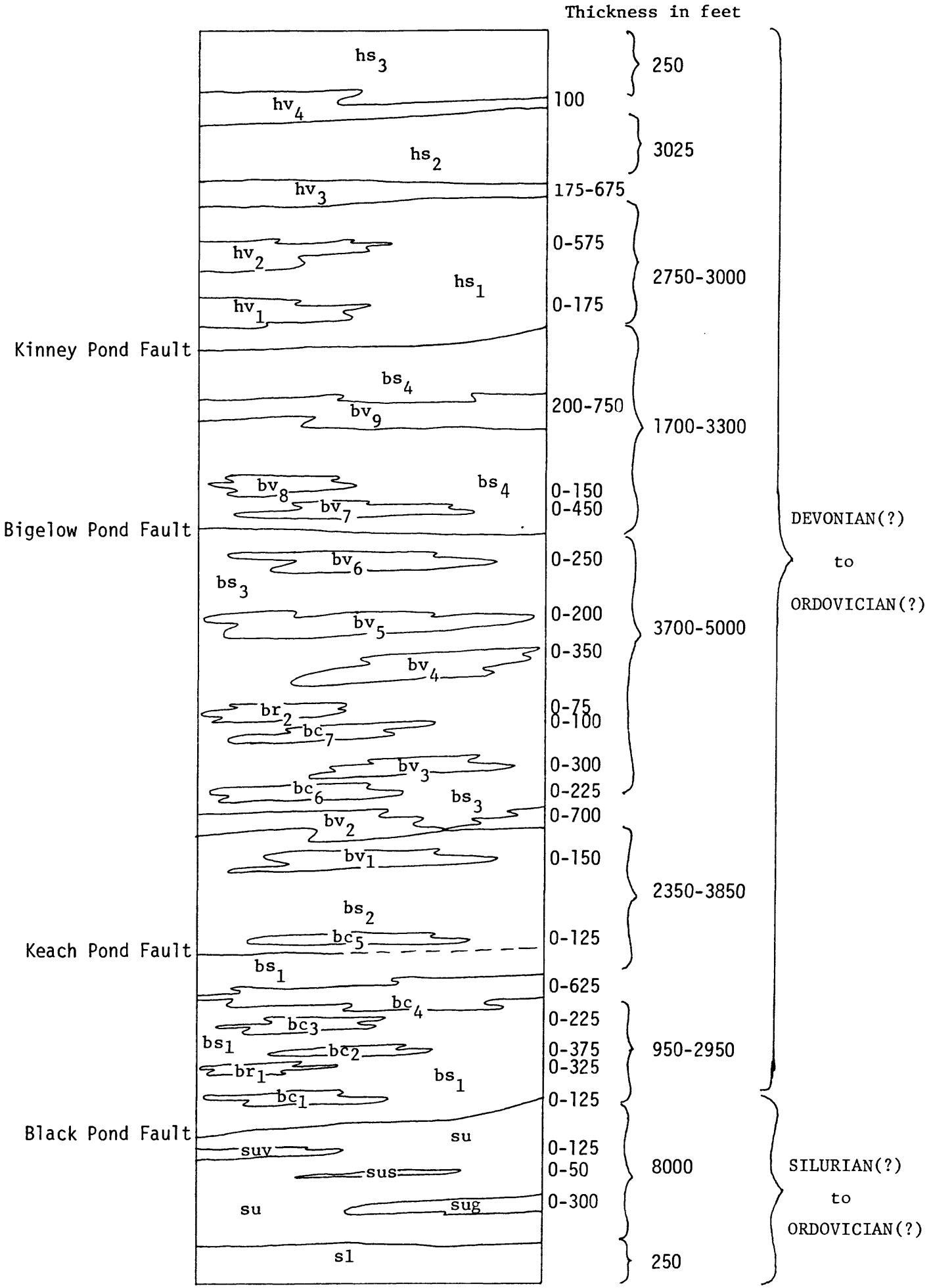
Surficial Deposits



Unconformity

Intrusive Rocks[1]




Thickness in feet
hs3
hv4
hs2
hv3
hv2
hs1
hv1
Kinney Pond Fault
bs4
bv9
bv8
bs4
bv7
Bigelow Pond Fault
bv6
bs3
bv5
bv4
br2
bc7
bv3
bc6
bs3
bv2
bv1
bs2
bc5
Keach Pond Fault
bs1
bc4
bc3
bs1
bc2
br1
bs1
bc1
Black Pond Fault
su
suv
sus
su
sug
sl
100
250
3025
175-675
0-575
2750-3000
0-175
200-750
1700-3300
0-150
0-450
0-250
0-200
3700-5000
0-350
0-75
0-100
0-300
0-225
0-700
0-150
2350-3850
0-125
0-625
0-225
0-375
950-2950
0-325
0-125
0-125
8000
0-50
0-300
250
DEVONIAN(?)
to
ORDOVICIAN(?)
SILURIAN(?)
to
ORDOVICIAN(?)

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS (QUATERNARY)

A thin layer of windblown silt and fine-grained sand, and an underlying thicker glacial till, are the surface deposits in most areas not covered by alluvium nor shown as bedrock exposures. The till is a poorly sorted mixture of silt, sand, and clay, most of which contains many pebbles, cobbles, and boulders; locally it contains small isolated lenses of sand and gravel that require systematic trenching for detection and delineation.

af ARTIFICIAL FILL

Qal ALLUVIUM (HOLOCENE) - Silt, sand, and gravel mixed with organic debris on flood plains of modern streams; includes swamp deposits, which can be distinguished on the map by symbols.

Qst STREAM-TERRACE-DEPOSITS (HOLOCENE AND PLEISTOCENE) - Sand, silt, and gravel; forms terraces 3-6 m above modern flood plains.

GLACIAL-STREAM OR LAKE DEPOSITS (PLEISTOCENE: WISCONSIN) - Sand, silt, and gravel, poorly to well bedded and sorted, deposited partly in contact with stagnating ice blocks by glacial melt water as kames (t) kame terraces, ice-channel fillings, and deltas (d). Pitted to hummocky topography is characteristic.

Qcq Quinebaug River area stratified drift sequence.

Qch_2 Hamant Brook stratified drift sequence.

Qch_1

Qcb_4 Bigelow Brook stratified drift sequence.

Qcb_3

Qcu Uncorrelated stratified drift

INTRUSIVE ROCKS[1]

[1]The age prefix has been omitted from the letter symbols for igneous rocks (except for the Triassic diabase) and for metasedimentary and metavolcanic rocks in order to keep the symbols as short as possible.

Trd DIABASE (TRIASSIC) - Medium-grained dark-gray to black diabase of plagioclase and clinopyroxene in a dike with chilled margins of very fine-grained dark diabase that contains scattered phenocrysts of plagioclase and clinopyroxene. Weak primary foliation parallel to dike walls. Minimum width of dike about 60 feet.

p PEGMATITE (DEVONIAN?) - Medium-to very coarse-grained light gray to white strongly foliated pegmatite in sills and concordant lenses as much as a few tens of feet thick and a few hundred feet long. Consists mostly of elongate grains of microcline, sodic plagioclase, and quartz; major accessory minerals are biotite, garnet, sillimanite, tourmaline, and cordierite. Most of minerals grains highly fractured and granulated, but some microcline, mostly 4 to 10 cm long but some 25 cm long, is neither granulated nor cracked. Locally aplitic. Some small bodies of pegmatite of similar composition are cross-cutting and not foliated.

fdq Medium-grained medium- to light-gray strongly foliated quartz monzonite to quartz diorite.

METASEDIMENTARY AND METAVOLCANIC ROCKS

In the rock names given below, hyphenated mineral names are used as adjectives in the rock name. Minerals are listed in the most commonly observed order of decreasing abundance. Minerals shown in parentheses are not present in every sample of a given rock type.

BRIMFIELD GROUP

HAMILTON RESERVOIR FORMATION (DEVONIAN(?) TO ORDOVICIAN(?))

hs_3 Medium-grained medium-gray quartz-feldspar-biotite schist and gneiss, some with abundant garnet and/or sillimanite, and light-gray granular gneiss,

locally well-bedded. Some thin beds of metavolcanic rocks like those in hv_4.

hv_4 Fine- to medium-grained medium-gray quartz-feldspar-biotite-hornblende gneiss; medium-grained dark-gray heavy feldspar-pyroxene gneiss and quartz-feldspar-biotite-hornblende-pyroxene gneiss, and medium-grained black hornblende-feldspar gneiss and amphibolite.

hs_2 Medium-grained medium-gray rusty-weathering quartz-feldspar-biotite-garnet-graphite-sillimanite schist and gneiss; fine- to medium-grained light- to medium- gray granular quartz-feldspar-biotite gneiss, some with as much as 20 percent rose garnet as much as 3 mm in diameter; fine-grained blue-gray tough feldspathic garnet-biotite quartzite and quartz-feldspar-biotite-garnet-graphite gneiss, and interbeds of calc-silicate granulite and gneiss and metavolcanic gneisses like those in hv_3. Bedding not as prominent as in hs_1.

hv_3 - Mostly fine- to medium-grained medium- to light-gray well foliated and thinly bedded metavolcanic quartz-feldspar-biotite gneiss; medium-grained medium-gray more massive quartz-feldspar-biotite-(hornblende) gneiss; and medium- to coarse-grained dark-gray to black hornblende-feldspar (biotite) gneiss, schist, and amphibolite, locally with coarse metacrysts of hornblende. Interbeds of well-bedded quartz-feldspar-biotite-garnet gneiss as much as 20 feet thick, much gray-green quartz-diopside calc-silicate granulite, and other meta-sedimentary rocks, most abundant near base of unit.

hs_1 - Mostly fine-grained and medium-grained light-gray, medium-gray, and blue-gray quartz-feldspar-biotite (graphite, garnet, hornblende, pyroxene) gneiss and schistose gneiss, and medium-grained medium-gray quartz-feldspar-biotite-graphite-garnet-sillimanite schist and schistose gneiss, much of which weathers rusty; these are well-bedded in most places and are locally thin-bedded. Other interbeds are rusty-weathering quartz-feldspar-biotite-graphite (pyrite) schist; fine-grained light-gray granular quartz-feldspar-biotite (garnet) gneiss and schistose gneiss; light-gray feldspathic quartzite in beds as much as a few inches thick; fine- to medium-grained salt-and-pepper colored gneiss; and beds of gray-green quartz-diopside calc-silicate granulite and medium to dark-gray metavolcanic quartz-feldspar-biotite-(hornblende) gneiss in beds as much as a few tens of feet thick.

hv_2 Mostly medium-grained medium-gray metavolacnic quartz-feldspar-biotite (garnet) gneiss, but ranges from fine to coarse and light- to dark-gray, and fine- to coarse-grained dark-gray to black (quartz)-feldspar-biotite-hornblende schist and gneiss. Well-bedded in most places. Interbeds of black feldspar-hornblende amphibolite, and metasedimentary rocks like those in hs_1.

hv_1 Mostly medium- to coarse-grained medium- to dark-gray metavolcanic quartz-feldspar-biotite-(hornblende)-(pyroxene)-(garnet) granular to schistose gneiss and dark-gray hornblende-biotite-feldspar gneiss; thin interbeds of medium-grained light- to medium-gray quartz-feldspar-biotite gneiss, gray-green quartz-diopside calc-silicate granulite, and other metasedimentary rocks like those in hs_1.

BIGELOW BROOK FORMATION (DEVONIAN(?) TO ORDOVICIAN(?)

bs_4

Mostly medium- to fine-grained medium- to light-gray and blue-gray well-bedded tough granular quartz-feldspar-biotite-(garnet)-(graphite)-(pyrite) gneiss, in part very quartzose, and some with a trace of pyroxene. Medium-grained medium- to light-gray quartz-feldspar-biotite-garnet-(graphite)-sillimanite schist and schistose gneiss occur throughout the unit but are most abundant in the southern part of the area; some of these, in new excavations, are rusty-weathering and sulfurous-smelling, and some very schistose quartz-biotite-garnet-graphite-pyrite-sillimanite schist rapidly develops an efflorescent yellow coating. Thin beds of blue-green to gray-green granular quartz-diopside-(pyrite) calc-silicate granulite, blue-gray tough quartz-feldspar-actinolite-hornblende granulite, fine grained purple-gray quartz-biotite-feldspar-garnet gneiss, fine-grained blue-gray and light-gray

impure garnet quartzite, and medium-grained medium- to dark-gray metavolcanics like those mapped separately are locally abundant.

bv_9 - Mostly medium- to coarse-grained medium- to very dark-gray, or locally light-gray, metavolcanic quartz-feldspar-biotite (hornblende) gneiss containing 15 to 20 percent biotite in most places and locally as much as 5 percent garnet, foliation well-developed, rock tends to be uniform at any one locality and to form large rounded surfaces on weathering. Thin beds of fine-grained dark biotite-rich schistose metavolcanic rock occur locally; and intercalated beds of metasedimentary rocks like those in bs_3 are locally numerous, most are thin, but some are several tens of feet thick. Some of the dark gneiss may be foliated quartz diorite intrusives or metamorphosed basic lava flows; the unit was mapped as foliated quartz diorite in the Wales Quadrangle.

bv_8 - Medium-grained dark-gray metavolcanic gneiss like that in bv_7.

bv_7 - Medium- to fine-grained medium- to dark-gray metavolcanic quartz-feldspar-biotite (hornblende) gneiss containing 15 to 25% biotite and scattered metacrysts of feldspar as much as 6 mm long. Foliation moderately to strongly developed. Some layers with much biotite tend to be schistose. Some interbedded metasedimentary rocks like those in bs_3.

bs_3 Mostly medium- to fine-grained medium-gray, light-gray, and blue-gray granular to slightly schistose quartz-feldspar-biotite-(garnet)-(graphite) gneiss, some with plagioclase metacrysts as much as 5 mm long; medium-grained light- to medium-gray quartz-feldspar-biotite-garnet-sillimanite-(graphite)-(pyrite) schis and schistose gneiss that locally weathers rusty; and fine-grained light-gray granular salt-and-pepper quartz-feldspar-biotite (garnet) gneiss. Unit is in part thinly and evenly bedded, with gneiss and schist described above alternatin with many beds typically 1 to 6 inches thick of fine- to medium-grained light-gray to blue-gray feldspathic (garnet) (pyrite) quartzite and quartzose gneiss, some with garnet; fine- to medium-grained purplish-gray and greenish-gra quartz-feldspar-biotite gneiss with some calc-silicate minerals, and greenish-gray quartz-diopside-(calcite) calc-silicate granulite. Locally beds of medium-grained light- to medium-gray metavolcanic gneiss.

bv_6 Medium- to coarse-grained light- to medium gray metavolcanic quartz-feldspar-biotite gneiss containing 4 to 8 percent biotite, scattered feldspar metacrysts to 5 mm long, and as much as 2 percent light-pink garnet as much as 5 mm in diameter. Unit is thick bedded and has moderate foliation. Contains minor interbedded metasedimentary rocks like those of bs_3.

bv_5 - Medium- to fine-grained or locally coarse-grained light- to medium-gray metavolcanic quartz-feldspar-biotite gneiss with 2 to 6 percent biotite, scattered feldspar metacrysts as much as 6 by 12 mm in dimensions, and accessory garnet. Very fine-grained dark-gray or purplish-gray quartz-feldspar biotite schist with 2 to 3 percent feldspar metacrysts as much as 10 mm long occurs locally along the west side of the unit.

bv_4 - Medium- to coarse-grained medium- to dark-gray or locally light-gray metavolcanic quartz feldspar-biotite gneiss with 12 to 25 percent biotite and locally with as much as 2 percent garnet; moderate to strong foliation; and interbeds of metasedimentary rocks, like those of bs_3, as much as 10 feet thick.

br_2 - Medium-grained light-gray rusty-weathering quartz-biotite-graphite-pyrite schist with abundant coarse sillimanite; minor amounts of other metapellitic sedimentary rocks.

bc_7 - Mostly medium-grained gray-green evenly-bedded quartz-diopside calc-silicate granulite; minor beds of quartzose and pellitic metasedimentary rocks.

bv_3 - Medium- to coarse-grained, or locally fine-grained, medium- to dark-gray metavolcanic quartz-feldspar-biotite-(hornblende) gneiss, with some interbedded pellitic metasedimentary rocks.

bv_1 - Medium-grained medium- to dark gray quartz-plagioclase-biotite hornblende metavolcanic gneiss, locally somewhat schistose; locally thin interbeds of metasedimentary gneiss and schist like that in bs_2.

bc_5 - Medium-grained gray-green quartz-diopside-calcite calc-silicate granulite; fine- to medium-grained dark gray to greenish-gray quartz-plagioclase-biotite-hornblende-actinolite gneiss, fine-grained purplish-gray quartzose quartz-feldspar-biotite gneiss, and thin beds of gneiss and schist like those in bs_2.

bs_1 - Fine- to medium-grained light- to medium-gray granoblastic to schistose quartz-feldspar-biotite gneiss, some of which contains 5 to 10 percent dark green to black pyroxene or amphibole and much of which contains scattered plagioclase metacrysts as much as 10 mm long; and medium-grained gray quartz-feldspar-biotite schist and schistose gneiss commonly with garnet, sillimanite, muscovite, graphite, and pyrite, the sillimanite more abundant toward the top of the unit, locally this unit weathers rusty. Less numerous are thin beds and concretions of fine- to medium-grained gray-green quartz-diopside calc-silicate granulite and well-bedded medium-grained blue-gray to green-gray quartz-diopside-plagioclase-graphite-pyrite calc-silicate granulite; thin-bedded fine-grained tough blue-gray to purple-gray granoblastic quartz-feldspar-biotite gneiss, and beds of medium-grained medium-gray salt and pepper quartz-feldspar-biotite granoblastic gneiss.

bc_6 - Mostly thin-bedded medium-grained gray-green granular quartz-diopside calc-silicate granulite, medium-grained greenish-black amphibolite, and dark blue-gray quartzose quartz-feldspar-biotite gneiss; some interbedded pellitic metasedimentary rocks.

bv_2 - Chiefly medium- to coarse-grained dark- to medium-gray, or locally light gray, metavolcanic quartz-plagioclase-biotite-hornblende gneiss locally with rose garnet and metacrysts of feldspar as much as 10 mm long, and with biotite content ranging from 10 to 25 percent; foliation is moderately to strongly developed, this rock tends to develop rounded "elephant-backs" as much as 30 feet across on weathering. Layering shown by differences in grain-size, color, and mineral composition, as well as interbeds of quartzose and pellitic metasediments, indicate that most of the unit is pyroclastic in origin; some may be flows or intrusives. (Mapped in the adjacent quadrangle as intrusive quartz diorite to gabbro).

bs_2 - Most abundant is interbedded fine- to medium-grained light-gray, medium-gray, and blue-gray quartz-feldspar-biotite granular gneiss, schistose gneiss, and schist, some of which contains garnet, sillimanite, graphite, and weathers rusty, or scattered metacrysts of feldspar as much as 0.5 inches long, or 5 to 10 percent pyroxene and amphibole. Intercalated with these are evenly-bedded fine- to medium-grained blue-gray to purple-gray hard tough granular quartzose quartz-feldspar-biotite gneiss; fine-grained light-gray quartzite in beds to 2 inches thick; fine-grained light-gray salt and pepper granular quartz-feldspar-biotite gneiss; and calc-silicate rocks like those in bc_4.

bc_4 - Calc-silicate granulite and interbedded gneiss and schist. Medium-grained light gray-green to dark gray-green thin-bedded quartz-plagioclase-diopside calc-silicate granulite is the typical lithology, but much fine-to medium-grained light- to medium gray or greenish-gray quartz-feldspar-biotite schist and gneiss, commonly with garnet, sillimanite, or pyroxene. Also medium-grained greenish-gray quartz-feldspar-biotite actinolite gneiss, fine-grained medium-gray, blue-gray, and purplish-gray quartzose quartz-feldspar-biotite gneiss; light gray feldspathic quartzite, and fine-grained light-gray salt and pepper granular gneiss. Most of these rocks are graphitic.

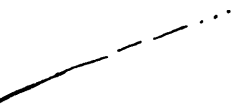
bc_3 - Well-bedded thin-bedded interlayered calc-silicate rocks like those in bc_1 and bc_2; minor amounts of other beds like those in bs_1.

bc_2 - Well-bedded medium-grained and fine-grained gray-green to light-green quartz-feldspar-diopside-(garnet-graphite) calc-silicate granulite and fine-grained quartz-rich granular quartz-plagioclase-diopside-biotite-(graphite) gneiss; medium-grained dark-gray and black quartz-feldspar-hornblende calc-silicate gneiss; and minor amounts of other beds like those in bs_1.

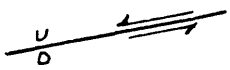
br_1 - Light-gray quartz-muscovite-sillimanite-feldspar-graphite-pyrite schist and schistose gneiss that weathers rusty yellow to orange.

MAP SYMBOLS

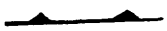
BEDROCK OUTCROPS - Includes closely spaced outcrops examined in the field. Very small outcrops shown only by structure symbol.



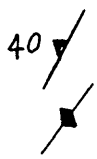
CONTACT - Dashed where only approximately located, dotted when concealed by surficial deposits.



STEEPLY DIPPING FAULT - Dashed where only approximately located, dotted where concealed by surficial deposits. Arrows show relative horizontal movement. U, upthrown side; D. downthrown side.



THRUST FAULT - Dashed where only approximately located, dotted where concealed. Sawteeth on upper plate.



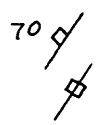
STRIKE AND DIP OF FOLIATION

Inclined

Vertical

STRIKE AND DIP OF FOLIATION PARALLEL TO BEDDING - Dots indicate top of beds determined from primary sedimentary structure; one dot, graded bedding; two dots, corss-bedding.

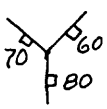
Inclined



STIKE AND DIP OF JOINTS

Inclined, one set

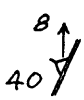
Vertical, one set



Inclined, three sets, measurement made at point of intersection of symbols.

BEARING AND PLUNGE OF LINEAR FEATURES - Lineation expressed by sillimanite, S, by the hinges of minor folds, F.

STRIKE AND DIP OF AXIAL PLANE AND BEARING AND PLUNGE OF HINGE OF MINOR FOLD, AND MAP PATTERN OF FOLD.



STRIKE AND DIP OF AXIAL PLANE AND BEARING AND PLUNGE OF HINGE OF MINOR FOLD WITH AXIAL PLANE CLEAVAGE

PIT OR CUT IN SURFICIAL MATERIAL - Hachures show boundary of larger pits.

bc_1 Thin- and even-bedded fine-grained greenish-gray quartz-diopside calc-silicate granulite and blue-gray to greenish-gray tough dense quartz-rich calc-silicate granulite; minor amounts of other beds like those in bs_1.

SOUTHBRIDGE FORMATION (SILURIAN(?) TO ORDOVICIAN(?))

UPPER MEMBER

su Mostly fine- to medium-grained light to medium-gray well-foliated granular to slightly schistose quartz-plagioclase-biotite (garnet) gneiss, much of which contains accessory medium- to dark-green diopside or actinolite-hornblende; biotite content commonly 10 to 20 percent. Locally the gneiss contains more biotite, is coarser-grained and dark-gray, and grades into schist. Typical gray gneiss contains discontinuous beds a few mm thick of fine-grained light gray quartz-plagioclase-biotite gneiss that contain only a few percent biotite and constitute about ten percent of the unit. Throughout the unit, but most abundant in the middle and upper parts are lenses and beds of gray-green or bluish-gray quartz-diopside (feldspar, biotite) calc-silicate granulite as much as several meters thick.

suv Medium- to coarse-grained dark-gray well-foliated to nearly massive metavolcanic quartz-feldspar-biotite-hornblende gneiss.

sus Medium-grained rusty-weathering quartz-feldspar-biotite-garnet-sillimanite schist.

sug Medium-grained medium-gray quartz-plagioclase biotite gneiss like most of that in su, but with as much as 2 percent garnet.

LOWER MEMBER

sl Gray gneiss, one outcrop in this quadrangle.