Dolostone member—Massive beds of white to buff dolostone

interfingered with sandy dolostone containing dolostone clasts

Ordovician, Cambrian, and Neoproterozoic cover rocks

Bolton (Ratcliffe and others, 1999; Thompson and others, 2002)

uncertain.) Mapped only in the area west of Granville

massive and specular hematite near top at Sheldon

biotite-albite-amphibole amphibolite

Hazens Notch Formation (Cambrian and Neoproterozoic)

graphite and rocks identical to Fayston Formation

Fayston Formation (Lower Cambrian and Neoproterozoic)

biotite, magnetite, and sphene

grained quartz-albite-biotite gneiss

mite)-laminated schist

and sandstone clasts in a calcareous sandy matrix

orange dolostone in a black arenaceous matrix

north of the Lincoln Mountain massif

West Bridgewater Formation (Middle Ordovician)

Sandstone member—Thin- to thick-bedded calcareous coarse-grained sandstone

Conglomerate member—Conglomerate with dolostone and sandstone clasts

Calcareous sandy conglomerate member—Conglomerate with dolostone

Sandy dolostone member—Sandy dolostone containing limestone clasts,

Dark conglomerate member—Conglomerate consisting of round clasts of

Black to dark-gray, sulfidic to nonsulfidic, carbonaceous, fine-grained, well-foliated

otite-muscovite-quartz phyllite; contains pods and thin beds of medium-dark-gra

d gray-and-white-mottled dolostone, thin beds of ankeritic quartzite, and,

per part, rhythmically layered gray quartzite, limestone breccia and lamina cic phyllite. Dolostone contains Middle Ordovician conodonts (Ibexian

-Whiterockian at West Bridgewater and Whiterockian at Buels Gore and Wes

Dark-gray and green phyllite member—Interbedded dark-gray and grayish

-----unconformity-----

Fairfield Pond Formation (Cambrian and Neoproterozoic)—Light-gray to

White Brook Formation (Cambrian and Neoproterozoic)—Buff to cream-

Underhill Formation (Cambrian and Neoproterozoic)—Silvery-green quartz-

muscovite-chlorite schist and phyllite, commonly with albite and magnetite; locally

contains dolomite. Local lenses of white to pale-gray quartzite, quartz-albite

granotels, quartz-granule chlorite (±biotite) metawacke (€Zunw), and garnet schist

Greenstone and amphibolite member—Thinly bedded carbonate-albite

Quartz-laminated schist member—Light-gray to tan and rusty-weathering,

ine-grained, well-foliated mylonitic albite-chlorite-muscovite-quartz (±dolo-

Hazens Notch Formation, undivided—Schist, gneiss, and quartzite;

lark-rusty-brown graphitic biotite-muscovite-chlorite-quartz (±garnet) schist and

foliated quartzite are common. Unit includes rusty-weathering schist without

schist to massive greenstone containing varying amou

gneiss; black albite porphyroblasts, large euhedral pyrite, and beds of dark-gray

Greenstone and amphibolite member—Dark-green, pitted-weathering,

chlorite, albite, carbonate, epidote, amphibole, and sphene; and amphibolite

Schist member—Rusty-weathering, non-graphitic, sulfidic chlorite-muscovite-

containing varying amounts of hornblende, actinolite, albite, chlorite, epidote,

Albite schist member—Silvery-green to grayish-green, medium-grained

porphyroblasts; resembles albitic schists of the Tyson Formation (£Ztab) and

green albitic granofels of the Hoosac Formation (£Zhgab). Locally contains

unmapped light-gray, thin quartzites; salt-and-pepper-colored, medium to

coarse-grained pyrite-magnetite-biotite-albite-quartz schist and gneiss; and

ted with rocks of the Tyson Formation and with the schists of the Pinney

silvery-dark-gray to rusty-weathering, medium-grained chlorite-tourmali

bite-muscovite-quartz schist. The Fayston south of Mount Abraham is inte

Greenstone member—Dark-green, pitted-weathering, foliated carbonate-

Foliated metawacke member—Salt-and-pepper-colored, medium- to coarse-

albite-chlorite (±magnetite±epidote) greenstone or amphibolite

albite-chlorite-muscovite-quartz (±garnet±magnetite) schist with white albite

te greenstone and massive magnetite-albite-amphibole-biotite-ep

albite-amphibole schist; dark-green, coarse-grained, weakly foliated epidote-

light-green, quartz-sericite-chlorite (±magnetite±biotite) phyllite and foliated quartzite

ored massive dolomite and dolomitic sandstone, containing prominent zone of

een chlorite-muscovite-quartz-knotted albitic phyllite, containing pods of

bluish-gray dolostone. (Correlation with West Bridgewater Formation

BEDROCK GEOLOGIC MAP OF VERMONT

Nicholas M. Ratcliffe, Rolfe S. Stanley, Marjorie H. Gale, Peter J. Thompson, and Gregory J. Walsh Norman L. Hatch, Jr., 1* Douglas W. Rankin, Barry L. Doolan, Jonathan Kim, Charlotte J. Mehrtens, John N. Aleinikoff, and J. Gregory McHone ¹U.S. Geological Survey, ²University of Vermont, ³Vermont Geological Survey, ⁴Wesleyan University, *Deceased. Cartography by Linda M. Masonic¹

The Vermont Geological Survey would like to thank former State Geologists Charles Ratté for initiating State support and Diane Conrad for continued world

contains garnet, sillimanite-andalusite and cordierite; intrudes rocks of the

and others, 1992) at Bellows Falls

bole, epidote, chlorite, and calcite

ley Formation in New Hampshire. U-Pb zircon age of 407±5 Ma, no. 43 (Kohn

Kinsman Quartz Monzonite of Billings (1955) (Early Devonian)—Medium- to

parse-grained, potassium-feldspar-megacrystic, biotite granodiorite gneiss of th

Ashuelot pluton. U-Pb zircon age of 403±2 Ma (R.D. Tucker, USGS, written

Fairlee Quartz Monzonite (Early Devonian)—Greenish-gray, pink-tinged,

Moulton Diorite (Early Devonian)—Dark-gray, medium-grained metadiorite

Dikes and sills of porphyritic and nonporphyritic metarhyolite of Hunt Mour

tain intrusive into the Albee Formation (Early Devonian)-Some cont

xenoliths of dikes of the Comertord Intrusive Complex (Scd). U-Pb zircon ages

Biotite-quartz diorite gneiss of Vernon dome (Late Ordovician)—Light-gray,

Lost Nation granite—Foliated biotite and (or) hornblende granite; locally diorit

Highlandcroft Granodiorite of Billings (1935, 1937)—Medium-greenish-gray to

dark-greenish-gray, medium-grained, foliated metamorphosed granite, granodio-

rite, and tonalite containing quartz, microcline, saussuritized plagioclase,

Nonconformably overlain by the Clough Quartzite and Fitch Formation. U-Pb

Joslin Turn Tonalite—Greenish-gray to light-brownish-gray, medium-grained,

veakly foliated metamorphosed tonalite. Primary minerals include quartz, plagic

clase, biotite, magnetite, pyrite, and apatite; secondary minerals include chlorite,

Granodioritic to quartz dioritic gneissic border phase of Oobg, perhaps in part

interlayered with light-gray, fine-grained micaceous quartzite; in southeastern Vermont near the Vernon dome DI is equated with DSwb and may be older than

Metarhyolite—White-weathering, medium to dark-gray, foliated and

laminated, aphanitic to very fine grained granofels to schist or metatuff, welded

tuff, and lithic tuff commonly with a few percent millimeter-size quartz and

Fitch Formation (Lower Devonian and Upper Silurian)—Metamorphosed

ate and polymict conglomerate with calcareous matrix. Locally equivalent t

Sawyer Mountain Formation (Devonian and Silurian)—Greenish-gray

Madrid and Smalls Falls Formations in Chesterfield, N.H., area

nestone, calcareous sandstone, siltstone, and pelite. Some limestone conglom

gray, pyritic, locally calcareous phyllite and light-gray, locally pyritic

lcareous, fine- to medium-grained, feldspar-rich metasandstone; some be

punky weathering. Graded grit and conglomerate beds (having cobble-size clasts of

quartz and felsite) toward base. Interpreted as transitional between Connecticut

Felsic metavolcanic rocks-Includes volcanic debris flow, laminated tuff, and

Valley and Bronson Hill sequences and correlative with Frontenac Formation

Clough Quartzite (Lower Silurian)—Quartzite and quartz-cobble metaconglom

Skitchewaug Mountain, upper quartzite (Scq) and lower conglomerat

rusty-weathering sulfidic slate and phyllite interlayered with felsic volcanic rocks

hyolite tuff, lapilli tuff, tuff breccia, and lava. Generally porphyritic with $5\ {
m to}\ 2$

percent plagioclase and, in some places, quartz phenocrysts and minor

Ammonoosuc Volcanics of Billings (1935) (Upper and Middle Ordovician)

Ammonoosuc Volcanics, undivided—A heterogeneous unit of interlavered

nd interfingering metamorphosed volcanic, volcaniclastic, and sedimentar

ominate (tuff to tuff breccia), but include sparse mafic pillow lava and fels

Greenish-gray, light-bluish-gray, or medium-bluish-gray metarhyolite tuff, lapilli

tuff, tuff breccia, and lava. Generally porphyritic with 5 to 20 percent plagio-

ark-greenish-gray to medium-bluish-gray metamorphosed andesitic an

basaltic tuff, crystal tuff, and tuff breccia; minor pillow lava. Commonly

clase and, in some places, quartz phenocrysts. Generally strongly foliated with

lava. Sedimentary protoliths include dark-gray sulfidic shale, ironstone

siltstone, graywacke, volcanic conglomerate, and rare limestone

contains plagioclase and (or) altered mafic phenocrysts

Metarhyolite—Greenish-gray, light-bluish-gray, or medium-bluish-gray me

abundant dark-gray phyllite matrix that resembles phyllite of the Littleton Formation

Partridge Formation (Upper Ordovician)—Dark-gray to grayish-black,

microcline phenocrysts. U-Pb zircon age of 407.5±3.9 Ma, no. 44 (Rankin

Stratified rocks of the Bronson Hill arch and Sawyer Mountain belt

epidote, sericite, and calcite. Granophyric intergrowths of guartz and plagioclass

U-Pb zircon age of 469±1.5 Ma, no. 27 (Moench and Aleinikoff, 2003)

Hornblende metagabbro—Dark-green, coarse-grained, well-foliated horn-

Oobg Biotite granite—Pink, medium-grained muscovite-biotite-microcline-perthite

granite and gneissic granite, and aplite of the Lebanon dome

Littleton Formation (Lower Devonian)—Medium-dark- to dark-gray slinterlayered with light-gray fine-grained micaceous quartzite: in southeaste

Metamorphosed mafic volcanic rocks

strongly foliated felsite

and tuffs, and amphibolite (Opa)

waxy sheen on foliation surfaces

and lesser amounts of gabbro. Where present, potassium feldspar is microcline. Contact aureole is in the Albee Formation. U-Pb zircon ages of 442 ± 4 Ma, no. 30 (Moench and Aleinikoff, 2003), and 444.1 ± 2.1 Ma, no. 29 (Rankin and

acker, 2009); and U-Pb sphene age of 443±3 Ma, no. 31 (Moench and

Highlandcroft Plutonic Suite (Early Silurian to Middle Ordovician

Epizonal to mesozonal, foliated and metamorphosed (greenschist facies)

plutons exposed northwest of the Ammonoosuc fault. Compositions

gneiss; forms sills in overlying Ammonoosuc Volcanics

range from granite to diorite to lesser amounts of gabbro

zircon age of 450±5 Ma, no. 28 (Lyons and others, 1986)

Oliverian Plutonic Suite (Late Ordovician)

blende-andesine metagabbro

vell-foliated subporphyritic biotite (±hornblende)-quartz diorite and trondhjemite

114±4 Ma, no. 40, and 412±2 Ma, no. 41 (Lyons and others, 1997; Moench and

composed mainly of secondary minerals such as saussuritized plagioclase, amphi-

J-Pb zircon age of 410±5 Ma, no. 42 (Moench and Aleinikoff, 2003)

veakly foliated, coarse-grained to porphyritic biotite granite of the Fairlee pluton.

Schist and phyllite member—Predominantly fine-grained, lustrous.

vell-foliated, silvery-green, grayish-green, and bright-green, quartz-ribbed and

€Zsgt) at higher grades; areas rich in metadiabase dikes shown by overprin

Carbonaceous phyllite member—Interlayered grayish-green and

Large-garnet schist member—Silvery-green to grayish-green, garnet (large)

plagioclase-biotite (chlorite)-quartz-muscovite schist. Comparable to garnet

Amphibolite and greenstone member—Dark-green hornblende-rich biotite-

nphibolite, and light-grayish-green, rusty-weathering, carbonate-pitted

agioclase (±garnet) amphibolite, epidote-hornblende-plagioclase-quartz

nterbedded feldspathic quartzite (£Zsg). Locally a mafic basaltic metawacke

Kyanite schist member—Silvery-blue, medium- to coarse-grained chlorite-

Amphibolite member-Dark-green to black, massive, medium- to coarse-

grained, layered albite-epidote-hornblende amphibolite; possibly is a meta-intrusive. Exposed in the Worcester Mountains

Schist member—Light-grayish-green, fine-grained, chlorite-muscovite-quartz

Mount Abraham Formation (Cambrian and Neoproterozoic)—Lustrous, silvery-

reen to bluish-gray, fine- to medium-grained, white mica-chloritoid-quartz-chlori

schist and phyllite, locally with minor garnet and magnetite porphyroblasts (£Zap)

Distinctive chlorite streaks and 1-cm rusty needles of altered kyanite are common

Mapped in southern Vermont where the uppermost part is continuous with

amphibolites, schists, and feldspathic schists of the Rowe Schist of Massachusetts

hese upper units are continuous with rocks of the Stowe Formation to the nort

Units in the middle and lowermost structural positions (above the Hoosac Forma

Hollow Formations, although structural continuity and correlations with the

Ottauquechee and Pinney Hollow Formations are uncertain owing to extensive

Amphibolite and greenstone member—Predominantly very dark green to

greenish-gray, chlorite-plagioclase-ankerite greenstone and interlayered gra

have transitional basalt to MORB compositions; greenstones have MORB

orite-muscovite-quartz phyllite and schist, highly tectonically laminated n

larger ultramafic bodies (EZu). Unit typical of lustrous chloritic schists of the

Garnet schist member-Mainly yellowish-green, lustrous, biotite-chlorite-

coarse cross-biotite. Typical of rocks within the Stowe Formation elsewhere

Biotite-plagioclase schist and gneiss member—Gray and light-gray-weath-

gneiss, commonly flecked with large cross-biotite. Locally contains coarse garne

slabby, well-foliated, quartz-rich muscovite-biotite-plagioclase-quartz schist,

Cooper Hill Member—Dark-gray or green, dull-gray- and rusty-weathering

garnet schist, and splintery chlorite-chloritoid-muscovite-plagioclase

(±garnet)-quartz schist, with minor feldspathic biotite gneiss. Unit noncarbona-

ceous and atypical of the Ottauquechee Formation except for minor layers of

containing thin beds of dark-bluish-gray vitreous quartzite. Restricted to

occurrence in £Zrch, along the base of the major amphibolite above £Zi

Ottauquechee Formation but at a different structural or stratigraphic level

Chlorite schist member—Rusty-gray- to yellowish-brown-weathering, lustrous

and within amphibolite at a structurally high position within the Rowe Sch

near the Massachusetts State line. Closely resembles rocks typical of the

non-carbonaceous, well-foliated chlorite-quartz-muscovite (±plagioclase) schist

Garnet-biotite feldspathic schist member—Dark-grayish-brown-weathering,

EARLY TO LATE TACONIAN ACCRETED TERRANE OF THE

Tillotson Peak Structural Complex (Cambrian)—Mafic schist and amphiboli

Dark-bluish-gray, fine- to medium-grained, massive to foliated bluesch

mposed ot amphibole (glaucophane, barroisite, and actinolite), epidote, garnet

Pelitic schist—Silvery-gray, medium-grained schist composed of white mica,

Albite gneiss—White, light-gray- and green-banded, medium-grained,

well-layered epidote-white mica-quartz-albite (±garnet±magnetite) gneiss with

plagioclase and polycrystalline quartz porphyroblasts. Green, chloritic layers 2 to

10 cm thick also contain chlorite pseudomorphs after garnet. Gneiss is similar to

quartz, chlorite (±garnet±albite±glaucophane±chloritoid); local centimeter-thick

chlorite with minor magnetite, pyrite, and apatite. Quartz and garnet coticule occu

locally. Eclogite occurs locally, delimited by green, medium-grained layers and pod

of garnet, omphacite, glaucophane, epidote, quartz, albite, and white mica

gneiss at the base of the Belvidere Mountain Structural Complex

Eastern allochthonous sequence, oceanic and accretionary realm,

ultramafic inclusions, volcanic-arc intrusives, and volcanic rocks

coarse-grained garnet-biotite-plagioclase-quartz schist

ROWE-HAWLEY ZONE

muscovite-plagioclase-quartz-garnet schist, distinguished by large garnets and

biotitic feldspathic volcaniclastic rock and feldspathic quartzite. Amphibolite

Chlorite phyllite member—Pale-green to dark-green, lustrous, magnetite-

k, tinely toliated biotite-plagioclase amphibolite to dark-green to light

tion) are in a similar structural position as rocks of the Ottauquechee and Pinner

phyllite or schist and quartzite; white quartzofeldspathic layers alternate with

muscovite-quartz schist (±garnet±kyanite±chloritoid); contains characteristic

spangly muscovite and elongated knots of quartz and layers of pinkish coticule,

schist member of the Rowe Schist in southern Vermont and around the

sty-weathering black quartzose phyllite, similar to dark carbonaceous phyllites

Sericite schist member—Quartz-sericite phyllite and schist

of the Ottauquechee Formation (€o)

Chester and Athens domes (€Zrgs)

nd interbedded amphibolite

exposed in the Worcester Mountains

Jay Peak Formation (Cambrian and Neoproterozoic)

green chloritic phyllitic layers; locally albitic

Rowe Schist (Cambrian and Neoproterozoic?)

structural duplication by thrust faulting and folding

Stowe Formation farther north

compositions

tted, magnetite-chlorite (biotite)-albite (plagioclase)-sericite (musco

Quartzite member—Tan, yellowish-gray-weathering garnet-muscovite quartz-

Garnetiferous quartzite and quartz schist member-Lustrous muscovite-

Calc-silicate gneiss and marble member—Dark-green, massive, diopside-

Okemo Quartzite (Middle Mesoproterozoic)—Light-tan to whitish-gray, massive

trograde phyllite. Occurs as a thick unit on Ludlow Mountain, in Okemo

Forest. U-Pb ages of detrital zircons range from $1,359\pm32$ Ma to $1,261\pm62$ Ma, no. 10 (Aleinikoff and others, 2011), and suggest derivation from trondhjemitic

Quartzite, undifferentiated (Middle to Early Mesoproterozoic)—Tan to

biotite-quartz-plagioclase paragneiss. Unit probably occurs at various stratigraphic

coarse-grained dolomite-phlogopite-scapolite marble; pyritiferous varieties

Sherburne Center, Weston, and in the Pine Hill slice; is commonly associated with

weather salmon pink to beige. Unit occurs on West Mountain in Chittenden, i

Calcite marble (Middle Mesoproterozoic)—Light-bluish-gray and white, coarse-

beds or pods less than $5\ m$ thick, interbedded with or passing laterally into other

dark-green hornblende-diopside rock or pale-green diopside rock; hornblende

Amphibolite (Middle Mesoproterozoic)—Dark-grayish-green, fine-grained

includes both meta-igneous and metasedimentary rocks intercalated throughout

Hornblende-plagioclase gneiss (Middle Mesoproterozoic)—Medium to

Garnet-biotite gneiss (Middle Mesoproterozoic)—Dark-gray- to rusty-grayish-

Biotite-quartz-plagioclase gneiss (Middle and Early Mesoproterozoic)—A

widespread, heterogeneous unit of well-layered, predominantly biotite-quartz

plagioclase gneisses containing variable amounts of magnetite, hornblende, an

garnet, and little potash feldspar. Plagioclase-rich lavers contain epidote-crowded

olcanics and volcaniclastic rocks. Unit varies from very dark gray biotitic gneiss

ight-gray more plagioclase- and quartz-rich gneiss, contains quartz-rich laye

ninor amphibolites, rusty-weathering garnetiferous quartzites, and calc-silic

volcaniclastic and clastic sediments. Areas of Y^{1,2}bg associated with 1,400-t

1,350-Ma intrusive rocks range down into the Early Mesoproterozoic, whereas the

upper parts may be Middle Mesoproterozoic. Rocks mapped as Y^{1,2}bg may not all

Biotite-epidote-quartz gneiss and epidotic quartzite (Middle and Early

Quartz schist (Early Mesoproterozoic)—Rusty-weathering sulfidic schist and

Five structural slices of the Taconic allochthon in Vermont (Zen, 1961, 1972;

Potter, 1972) contain rocks ranging in age from Neoproterozoic to Ordovician. The

Mountain and Dorset Mountain slices are inferred to contain largely Cambrian and

lowermost slices, the Sunset Lake, Giddings Brook, and North Petersburg slices,

contain the complete stratigraphic range whereas the higher and more easterly Bir

Neoproterozoic rocks and to exhibit different facies from those of the lower slices

imbricate thrust faults, thus complicating both the inferred stacking sequence a

the identification of primary emplacement relations. For example, the bound

uncertain and is not shown on this map; there may be no distinction. Although the

structural stacking sequence and boundaries are indefinite, the names are useful for

describing geographic areas and stratigraphic distinctions and are retained here for

gray to yellowish-gray slate, quartz wacke, and limestone; interpreted by Zen

Vesicular basalt breccia at East Hoosick (Upper Ordovician)—In the Walloomsac

Whipstock Breccia in the Walloomsac Formation (Upper Ordovician)—Largely

Wildflysch-like conglomerates within the Hortonville, Ira, and Walloomsac Forma

tions occur as local areas of black slate rich in inclusions of quartzite, greenish-gra

tary breccias, deposited in front of the advancing Taconic allochthon (Upper

Ordovician) (Zen, 1961; Potter, 1972; Fisher, 1985). Exposed near the western

and northern margin of the allochthon and in the Bennington area at the type

Whipstock. Here and at many localities the Forbes Hill and Whipstock breccias ar

tectonic breccias formed in situ by disruption of thin to thick beds, laminae, an

compositional layering. Units are retained although interpretation as sedimentar

rbonate-quartz-sulfide veins rather than clastic sedimentary rocks. T

and related folding commonly is a late strain-slip cleavage characterized by a down-plunge lineation parallel to reclined hingelines of minor folds of foliati

slate, wacke, and punky-weathering bluish-gray limestone, interpreted as sedin

tructural boundaries among the slices are commonly late post-e

and distinction between the Bird Mountain and Giddings Brook slices is particu

(Upper Ordovician)—Black slate containing angular to irregular chips of green

Ofh Forbes Hill conglomerate and breccia in the Ira and Hortonville Formations

a tectonic breccia formed in situ; contains abundant pseudo-pebbles

Mesoproterozoic)—Light-pale-yellowish-green to gray quartzite gneiss co

minor amphibolite older than part of the South Londonderry Igneous Suite

and marbles which locally are mappable. Association suggests an accumulati

plagioclase and isolated igneous quartz grains and probably are metadacitic

the Early and Middle Mesoproterozoic-age rocks of the Mount Holly Complex

and as lenses within biotite-quartz-plagioclase paragneiss. Unit prob

lende-plagioclase amphibolite, locally garnetiferous, and mediur

calcite-diopside knotted rock; and rusty-weathering, beige scapolite-quartz-

Y²cs Calc-silicate rock (Middle Mesoproterozoic)—Heterogeneous unit consists of

plagioclase gneiss, tremolite-phlogopite schist, and diopside quartzite

nd medium-grained calcite-diopside marble and calcite-diopside-talc marble in

associated with aluminous schists and calc-silicate rocks or interbedded withi

Dolomite marble (Middle Mesoproterozoic)—Light-gray to yellowish-gray,

rusty-brown or gray, thinly layered garnet-biotite quartzite and schistose quartzite

brown garnet-muscovitic quartzite and aluminous sericite-muscovite-tourme

vitreous quartzite in beds several meters thick, interlayered with rusty-grayish-

chlorite-chloritoid or muscovite-chlorite-biotite-clinozoisite retrograde schistose

ablende rock, lenses of bluish-gray to gray, medium- to coarse-grained

calcite marble and calcite-diopside marble and dolomitic talc-phlogopite-

Dolomite marble member—Beige-weathering to whitish-gray, fine-grained

quartzite and large-garnet schist. Resembles a retrograde variety of the Hague

ite and feldspathic retrograde-garnet quartz gneiss

Gneiss (of Alling, 1918) (Y2hgn) near Whitehall, N.Y.

gneiss of the South Londonderry Igneous Suite

levels; may be Early Mesoproterozoic in part (Y1q)

tremolite-talc marble and tremolite-talc schist

coarse-grained hornblende dioritic-appearing gneiss

be correlative

ated with diopside-bearing quartzite

THE TACONIC ALLOCHTHON

descriptive purposes (see Zen, 1961, 1964, 1967).

(1961) as sedimentary wildflysch

wildflysch deposits is in part questionable

Formation; perhaps intrusive

Contains thin belts of amphibolite and calc-silicate gneiss

U-Pb zircon upper-intercept ages of 945±7 Ma, no. 17, and 955±5 Ma, no. 18 (Karabinos and Aleinikoff, 1990)

Pegmatite (Mesoproterozoic)—Light-gray to pinkish-gray, biotite-muscovite

es. Albitic garnet-muscovite pegmatite common in metapelitic rocks

lount Holly Complex, and especially prominent in the northern and east-cen

Albitic biotite granite and pegmatite at Baker Brook (Mesoproterozoic)-

(Aleinikoff and others, 2011). Undated light-gray biotite granite gneiss (Y

containing abundant rose-colored zircon also is confined to the Pine Hill slice

Granulose albitic gneiss (Mesoproterozoic?)—Massive to poorly layered, highly

magnetite-biotite (chlorite)-muscovite-albite-quartz gneiss, veined with magnetite

lineated, light-tannish-gray to grayish-green, medium-grained, granulose, epidote

pots of ankerite and clots of chlorite after original amphibole, pyroxene, or

re common. Highly altered rock is perhaps metasomatic and related to 1,1

albitic micropegmatite, to nonlayered albitic granulose white gneiss. Occu

central Green Mountain massif from Plymouth to Shrewsbury, on Robinson H

contact that crosscuts paragneiss units. Unit also in Lincoln Mountain massit and

coarse-grained biotite-microcline megacrystic granite and monzogranitic gneiss;

passes locally into more equigranular granitic gneiss (Y^{3A}g) and locally into

extensive areas of biotite pegmatoid granitic gneiss (Y^{3A}pg), locally muscovite

FPb zircon ages of $1,119\pm3.3$ Ma (no. 15) and $1,121\pm1.4$ Ma (no. 1

Microcline-magnetite augen gneiss at Brandon Gap—Pinkish-gray to medium-

SHRIMP age of 1 149+8 Ma no 13 (Aleinikoff and others 2011). Unit is associ

d with minor exposures of metadiorite to tonalitic gneisses; crosscuts a gne

Granitic gneiss of Chittenden Intrusive Suite (?)—Light-gray, coarse-grained,

with 1,149- to 1,120-Ma augen gneisses, in the northern part of the Green Moun-

Mountain Intrusive Suite of the central and southern Green Mountains

Stratton Mountain Intrusive Suite (Middle Mesoproterozoic)

gg or as thin dikes or sills in paragneiss units

Migmatitic and mylonitic rocks of uncertain origin

Hill slice near South Wallingford is mapped as Yur

1,309±6 Ma, no. 9 (Aleinikoff and others, 2011)

(1,393±9 Ma to 1,309±6 Ma)

augen as much as 4 cm in length

(1,244±8 Ma to 1,221±4 Ma)

Londonderry Igneous Suite

Microcline augen gneiss of Lincoln Mountain massif—Light- to medium-gra

tain massif. Not distinguishable with certainty from older granitoids of the Stratton

medium-grained, biotite-quartz-plagioclase-microcline gneiss; contains microcline

Biotite-granitic gneiss—A heterogeneous unit consisting of granitic and grano

zircon TIMS age of 1,221±4 Ma, no. 12 (Ratcliffe and others, 1991; Aleinikoff

and others, 2011) obtained from Londonderry. Unit intrudes rocks of South

Aplitic gneiss—Light-gray to white, fine-grained aplitic granite gneiss as border of

College Hill Granite Gneiss—Light-gray to medium-dark-gray, porphyri

lineated, and saturated with less deformed later pegmatite; grades outward into

Forms a single large intrusive mass on College Hill in Jamaica and west of Stratto

Granitic gneiss of Lincoln Mountain massif (Middle Mesoproterozoic)—Hetero-

Interpreted as intrusive granitic rock older than Y^3 rocks of Chittenden Intrusive

Migmatitic gneiss (Middle Mesoproterozoic)—Light-gray and pinkish-gray to

bg, but also locally appears to be intrusive. A mixed rock of uncertain or

suggests affinity with metamorphic and igneous events associated with the Mido

Mesoproterozoic Ludlow Mountain and Proctor Hill granodiorite gneisses of the

Mylonitic gneiss (age uncertain)—Highly schistose, biotite-muscovite (±chlorite)

Ludlow Mountain granodiorite gneiss (Middle Mesoproterozoic)—Light-gray,

edium- to fine-grained garnet-biotite-microcline-perthite granodiorit

¹rs), and calc-silicate rocks on Ludlow Mountain. U-Pb zircon SHRIMP age o

magnetite-studded white aplite, and kyanite-tourmaline pegmatite. Conta

pathic mylonite and mylonitic gneiss mapped near Brandon Gap; in the Pine

South Londonderry Igneous Suite. Age of migmatization is younger than 1,326 Ma

U-Pb zircon SHRIMP age of 1,326±4 Ma, no. 8 (Aleinikoff and others,

South Londonderry Igneous Suite (Middle and Early Mesoproterozoic)

wish-gray, massive, medium-grained plagioclase granitic gneiss, and mi

ester dome, and in Weston where it appears to form an integral part

nit consisting of medium-grained biotite-microcline-plagioclase gneis

Mountain; truncates structure in older gneisses. U-Pb zircon TIMS age of 1,244±

Ma, no. 11 (Ratcliffe and others, 1991; Aleinikoff and others, 2011)

migmatitic border exhibiting decreasing concentration of microcline megacry

biotite-microcline megacrystic to even-grained granite gneiss closely associated

ay, biotite-magnetite-microcline-plagioclase augen gneiss. U-Pb zircon

in country rocks and may extend northward along eastern limb of Lincoln

determined on samples near Sherburne Center and on Telegraph Hill east of

biotite-quartz-plagioclase gneiss having centimeter-thick veins of garnet-

and along the eastern margin of the Green Mountain massif east of Rutland

hittenden Intrusive Suite (Late Mesoproterozoic)

at Brandon Gap; similar rock mapped in the Adirondacks

Chittenden Reservoir by Karabinos and Aleinikoff (1990)

(1,149±8 Ma to 1,119±3 Ma)

,120-Ma period of granitic intrusions. Unit shows all gradations from pinkish

highly interpretive based on crosscutting of gneissosity and weakly deformed

parts of the Green Mountain massif. Assignment of individual pegmatites to '

Mount Holly Complex intrusive rocks (Mesoproterozoic)

Quartz schist member-Bluish-black, rusty-weathering, fine-grained albite-

"Pinstriped" granofels member—Light-gray to pale-green, whitish-gray-

Carbonaceous and sulfidic schist member—Rusty-weathering, dark-gray

splintery-fractured, biotitic sulfidic quartz schist. Contains layers of

nent zone that extends from the north end of the Chester dome and near

Proctorsville southward to near Townshend contains abundant ultramafic rocks

uch as 10 m thick but commonly less than 1 m thick. Resembles quartzites

z granofels and schist containing abundant fine layers of pinkish-gray

Feldspathic quartzite member—Light-grayish-brown- to tan-weathering

Chlorite schist member—Pale-greenish-gray, lustrous and nonlustrous

Garnet schist member—Greenish-gray feldspathic garnet schist; grades into

Hornblende fascicule schist and granofels member—Light-gray to grayish-

Carbonaceous schist member-Dark-gray, fine-grained carbonaceous bi

ite-muscovite-quartz (±garnet) phyllite and schist. Occurs west of Montpelier

Amphibolite and greenstone member—Includes light-pale-green chloritic

ankeritic greenstone; black, fine-grained hornblende-plagioclase

Mariposite-bearing metarodingite member—Bright-green and white, fine-

Felsic metavolcanic member—Gray, purplish-gray, and light-gray dacitic to

Phyllite facies—Predominantly medium-dark-gray to lustrous-tan, fine-grained

Black sulfidic carbonaceous schist facies—Dark-gray, sooty- and

dark-gray quartzite, coticule, and ironstone, locally mapped separately

Coticule and quartzite facies—Dark-gray to light-gray, vitreous magnetite

garnet-biotite-muscovite phyllite and carbonaceous phyllite; contains layers of

rusty-weathering, sulfidic biotite-muscovite-plagioclase-quartz schist and

granofels; is a lateral variant of Omwh. Contains layers of rusty-weathering

Metavolcanic facies—Pale-tannish-gray- to purplish-gray-weathering, phyllitic

Metasiltstone facies—Pale-greenish-gray, finely laminated, magnetite-

Gile Mountain Formation, undivided—Shown in cross section only

Quartzite and metapelite member—Gray to light-gray, fine-grained

Meetinghouse Slate Member—Dark-gray slate and phyllite containing sparse

Felsic metavolcanic member—Very light gray, fine-grained porphyritic

netafelsite schist or granofels near Maidstone Lake. Groundmass recrystallize

to an aggregate of quartz, microcline, plagioclase, biotite, muscovite, and

microcline (some in granophyric intergrowths with quartz), and saussuritized

plagioclase. U-Pb zircon age of 407.0±3.3 Ma, no. 45 (Rankin and Tucker,

Grit—Lenticular masses of metamorphosed quartzose volcaniclastic grit and

vith sandstone, pelite, and porphyritic rhyolite (Dgmr). Conglomerate contains

rounded clasts of rhyolite, fine-grained granitoid, and angular clasts of

Quartz-pebble metaconglomerate member—Thin lens of metadiamictite

Rhythmically graded member—Light- to medium-gray, fine-grained

or schist in beds 10 to 25 cm thick; and dark-gray micaceous phyllite or schist

containing beds of micaceous quartzite: locally thickly bedded. Detrital volcanic

zircons yield a U-Pb age of 409±5 Ma, no. 51 (McWilliams and others, 2010)

Thick-bedded micaceous feldspathic quartzite member—Brown to gra

Amphibolite member—Hornblende amphibolite and hornblende-plagioclase-

quartz granofels; interpreted as metabasaltic and volcaniclastic rocks

micaceous quartzite to dark-gray muscovite-quartz-biotite carbonaceous phyllite

dark-gray slate. Correlative with Halls Stream Grit Member of the Ironbound

glomerate, commonly having abundant dark-gray pelitic matrix interlayered

apatite: grain size about 0.05 mm. Relict phenocrysts of embayed quartz.

micaceous quartzite a few centimeters to tens of centimeters thick, interbedded

o moderately abundant beds of light-gray, fine-grained metasandstone and

metadacitic volcanic breccia, agglomerate, and grayish-green fragmental

orite-biotite feldspathic metasiltstone and pale-greenish-yellow-weathering

andesitic metavolcanic and metavolcaniclastic rocks, similar to Omwhv

Whetstone Hill Member of the Moretown Formation

meta-andesitic breccia; may occur at several levels

o medium-grained, variably foliated calcite-quartz-albite-mariposite-actinolite-

tremolite-epidote-zoisite granotels to gneiss. Associated with greenstone and

n chlorite-muscovite-biotite-plagioclase-quartz schist, conspicuous sprays

chlorite-muscovite feldspathic schist and schistose granofels. Local richly

Granofels and coticule member—Gravish-green, chlorite-biotite-plagioclase

rusty-weathering amphibolite, coticule, and vitreous quartzite (Ombq). A pro

Quartzite member—Dark-gray to steel-bluish-gray vitreous quartzite in beds

viotite-muscovite feldspathic quartzite and muscovitic quartz schist

viotite-muscovite-quartz (±garnet) schist, carbonaceous schist, and gray,

eathering, chlorite-biotite-plagioclase-quartz granofels and tectonically

sericite-chlorite-quartz schist with pyrite

of the Ottauquechee Formation (€obq)

garnetiferous variant (Omgt)

ultramafic rocks in Roxbury

amphibolite and dark-gray quartzite

muscovite-chlorite-quartz phyllite

CONNECTICUT VALLEY TROUGH

Gile Mountain Formation (Lower Devonian)

with dark-gray graphitic slate, phyllite, or schist

Mountain Formation (of Myers, 1964) to the north

decrease in thickness of quartzite beds

of the Meetinghouse Slate Member (Dgm), south of Bradford

"pinstriped" granofels and feldspathic biotite quartzite

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DESCRIPTION OF MAP UNITS

[Minerals are listed in order of increasing and approximate abundance

Minerals that are variably present are shown in parentheses with ±. No

Brandon Lignite (lower Miocene)—Organic silt, sand and gravel and slumped

kaolin, residual hematite, and ochre deposits near Brandon. Lignite was let down

between the Dunham Dolostone on the west and the Cheshire Quartzite on the

east. Deposit largely concealed but known from historic underground workings fo

Cuttingsville stock (Early Cretaceous)—Composite stock and intrusive breccia

dikes consisting of augite and hastingsite syenite, nepheline and sodalite syenite

essexite, and monzodiorite. Associated dikes of monchiquite, camptonite, boston-

ite, and spessartite. Average of five K-Ar ages 101 Ma; ages range between 103 ± 4 and 99 ± 2 Ma (Armstrong and Stump, 1971)

Andesite breccia containing xenoliths of Mesoproterozoic gneiss and

Ascutney Mountain igneous complex (Early Cretaceous)—Consists of two

Medium- to coarse-grained biotite-microperthite-orthoclase-albite granite

Syenite-porphyrite to sericite-perthite-hornblende-biotite syenite; contains

Trachytic to rhyolitic tuffs, and breccias containing fragments of volcanic rocks

Hornfels—Dense, compact hornfels consisting of recognizable but altered

in structural continuity with rocks outside the contact aureole. Loc

quartz-wollastonite, plagioclase, grossular garnet, and scapolite

gabbro infiltrated by hornblende and biotite diorite

aluminous rocks of the Waits River Formation contain andalusite, sillimanite,

A composite gabbro-diorite stock having two (eastern and western) intrusive

abundant, poorly defined areas of diorite. Includes two areas of syenite (Kas)

centers defined by weakly developed igneous foliation. Gabbro is intruded by

Gabbro and diorite—Medium- to coarse-grained augite-hornblende-biotite

Paisanite dike—Fine-grained syenitic dike similar to spherulitic dikes found

well outside the Ascutney Mountain stocks in the saddle between the Chester

small, 0.5-km-long, northwest-trending stock consisting of a coarse-grained alkali

Composite stock of quartz syenite, syenite granite, and essexite. K-Ar age of 175±4

Quartz syenite—Greenish-gray to pink hornblende-biotite quartz syenite

Granite—Hornblende-biotite-microperthite granite, gradational into quartz syenite

Essexite—Pyroxene-biotite-hornblende andesine gabbroic rock grading into

Dikes associated with Monadnock Mountain pluton—Granite, syenite, quartz

Dikes of White Mountain Igneous Suite—Largely Early Cretaceous, but some may

K-Ar biotite age of 114±2 Ma (Armstrong and Stump, 1971) and Rb/Sr whole-rock isochron on trachyte dikes of 125±5 Ma (McHone and Corneille, 1980)

hin the plutons and in the adjacent country rocks. One paisanite dike occur

hists of the country rock. Shown only around main Ascutney Mountain stocl

cordierite, pleonaste, and corundum; calcareous pelites contain diopside,

minor fayalite, augite, and quartz; occurs as a partial ring dike in the Little

ring trachytic flow structure and layering. Interpreted as volcanic rocks of

Hornblende granite occurring as small intrusive masses in Kas

plutons, a partial ring dike, and screens of volcanic rocks. K-Ar ages of 122 to 120

White Mountain Igneous Suite (Early Cretaceous and Jurassic)

Nepheline and sodalite syenite, hornblende syenite

autoclasts of felsic alkalic and fine-grained mafic rocks

kaolin, hematite ochre, and lignite

Quartz syenite

Essexite (alkali gabbro)

Ascutney Mountain stock

Little Ascutney stock

and Athens domes

Ma (Foland and Faul, 1977)

quartz syenite

be Middle Jurassic (McHone, 1992)

Barber Hill stock (Early Cretaceous)

Monadnock Mountain pluton (Middle Jurassic)

bostonite, camptonite, aplite, and pegmatite

into kaolin perhaps by karst collapse along a concealed west-dipping normal fault

and dismembered lignite occurring as elongate disrupted deposits in underlying

51 refer to uranium-lead (U-Pb) zircon age samples listed in table 1 on the

back of this sheet and shown on the geologic maps]

U.S. GEOLOGICAL SURVEY

Predominantly mafic and intermediate dikes of diabase, <1 m to 3 m thick, consisting

monchiquite and granitic, rhyolite, trachyte and foidal felsic dikes; and spherulitic

sewhere, felsic dikes are not shown separately. Orientation gives strike of dike

of olivine-augite diabase, lamprophyre, calcite amygdaloidal mafic dikes; alkali basalt,

trachyte dikes. Only felsic dikes near intrusive centers are distinguished as K

neasured; spot locations from literature without strikes are not shown. Distribu

uneven owing to nonuniform reporting; however, three general areas contain dike

associated with Monadnock Mountain pluton; (2) Early Cretaceous swarms associated

lamprophyre at western margin of Connecticut Valley trough; and (3) a southern

ly Cretaceous swarm of foidal felsic, mafic, and lamprophyre dikes associated with

tons at Mount Ascutney and Cuttingsville and extending westward into the Tacon

Commonly dikes are nondeformed and chilled, but locally they are offse

inor faults that are either northeast-trending normal or strike-slip. Notable faulted

Mountain, along U.S. Route 4 southwest of Proctor, and immediately west of the

(four general designators are used: Dbg, binary and biotite granite and granodic

small dikes. Only Dbg and Dg are shown in the Description of Map Units)

Binary and biotite granite and granodiorite, undifferentiated—Includes small

Igneous rocks of the Northeast Kingdom batholith of Ayuso and Arth

Derby pluton—Light-gray, medium- to coarse-grained, massive, epidote-biotite-

muscovite porphyritic granodiorite and minor tonalite (Ddbg), with a rim zone of

granodiorite (Ddrz). Rb/Sr whole-rock isochron age of 370±17 Ma (Ayuso and

Echo Pond pluton—Light-gray to pink, medium- to coarse-grained, massive,

Nulhegan pluton—Light-gray to dark-gray, medium- to coarse-grained, massive,

nite (Dnqm). Rb/Sr whole-rock age of 390±14 Ma (Ayuso and Arth, 1992)

Willoughby pluton—Light-gray to pink, medium- to very coarse grained, massive,

Averill pluton—Gray to pink, medium- to coarse-grained garnet-muscovite-biotite

Victory pluton—A western zone of medium- to fine-grained biotite-muscovite

granite and minor hornblende-biotite tonalite and an eastern, more melanocratic

zone of biotite-hornblende quartz monzonite like that in the Nulhegan pluton, as

ained hypidiomorphic, granular, biotite-muscovite-microcline-plagioclase

Overprint pattern—Shows areas of intricately mixed country rock, hornfels, and

abundant dikes and sills of granite. Underlying color and symbol identify country

nuscovite granite. Has distinctly more potassium feldspar and is lighter gray than

otite granodiorite. U-Pb zircon Sensitive High Resolution Ion Microprobe

quartz monzonite, locally orbicular; commercially known as "Bethel white"

and similar to the predominantly lighter-colored granitic rocks of southern Vermont

Stiles Pond pluton—Gray, medium-grained, nonfoliated biotite-muscovite tonalite

Porphyritic, light-gray, hypabyssal biotite granite and tonalite in sill-like

odies—Contains phenocrysts of euhedral and embayed quartz, euhedral micro-

Newark pluton—Pinkish-gray to cream-colored, medium- to coarse-grained

Maidstone pluton—Almost-white to dark-gray, locally pink, medium- to coarse-

granite; accessories include apatite, sphene, pyrite, and magnetite

Knox Mountain pluton—Light-gray, medium-grained, quartz-rich biotite-

East Barre plutons—Gray, homogeneous, fine- to medium-grained muscovite-

(SHRIMP) age of 368±4 Ma, no. 47 (Aleinikoff and others, 2011)

East Bethel plutons—Very light-bluish-gray to white, medium-grained, muscovite-

Other plutons of the New Hampshire Plutonic Suite

granite and pegmatite, undifferentiated

well as biotite granodiorite

rocks of the East Barre plutons

rock unit

magnetite-microcline-perthite-biotite granite

miarolitic garnet-muscovite peraluminous leucogranite. Varies from a pegmatitic

main zone (Dwmz) to biotitic granodioritic western zone (Dwwz), to inner

hydrothermally altered zone (Dwhz). Rb/Sr whole-rock age of 376±9 Ma (Ayuso

biotite-clotted, hornblende-quartz monzodiorite, minor granodiorite, and granite

divided into a western zone (Dnwz), inner zone (Dniz), and core of quartz monzo-

gabbro and quartz diorite (Dedg), and inner zone of granite (Degr)

West Charleston pluton—Dark-gray, medium to coarse-grained, massive,

quartz-biotite-hornblende (±pyroxene) gabbro and diorite

riate to porphyritic granodiorite and granite (Debg) and outer zone of quartz

rite, undifferentiated; Dqm, quartz monzonite; Ddg, diorite and gabbro; and Dg,

New Hampshire Plutonic Suite

Devonian intrusive rocks

(1992)—Plutons identified on map

with Barber Hill stock near Lake Champlain and extending eastward to swarm of

swarms: (1) probable Middle Jurassic dikes of syenite diabase, and lamprophyre

cline with Carlsbad twinning (in granite), plagioclase, and euhedral biotite

Black Mountain pluton of the Guilford dome—Weakly foliated, light-gray to

Granite and trondhjemite dikes of Chester and Athens domes and west of

the Connecticut Valley trough—Light-gray to white, garnet-muscovite-bioti

hitish-gray, garnet-biotite-muscovite granite, minor pegmatite, and aplite dikes

(Dg). Rb/Sr muscovite age of 383±7 Ma (Naylor, 1971) and a U-Pb zircon upper-

46 (Aleinikott and others, 2011), from rims on Proterozoic-age cores (J.

Aleinikoff, USGS, written commun., 2002); and whitish-gray muscovite-rich

rosscutting nonfoliated dikes within the core of the domes and as folded and

mall stocks of very light gray to white, muscovite-rich, locally garnet-bearing, fine-

ular, that intrude cover rocks east of the Green Mountain massif from Jama

orthfield, including the Liberty Hill locality and the granodiorite stock eas

 $\frac{1}{2}$ HRIMP age of about 380 to 390 Ma (Aleinikoff and others, 2011); a similar dike

south of Plymouth has a U-Pb zircon SHRIMP age of 365±5 Ma, no. 49

(Aleinikoff and others, 2011). These closely resemble undated white granodiorites

dikes of granite, trondhjemite, and quartz monzonite largely west of the Connecti-

Hathaway Formation (Upper Ordovician)—Clasts of limestone, dolostone,

Iberville Formation (Upper Ordovician)—Dark-gray shale with thin discontinu-

Stony Point Formation (Upper Ordovician)—Dark-gray calcareous shale with

Cumberland Head Formation (Upper Ordovician)—Interbedded graded

Glens Falls Limestone (Upper Ordovician)—Dark-bluish-gray-weathering, thinly

Black River Group, undivided (Upper Ordovician)—Thin-bedded to massive

dolostone, sandy dolostone, and light-gray limestone; vertical burrows in basal

Orwell Limestone (Upper Ordovician)—Dove-gray-weathering, black to dark-

Chazy Group, undivided (Upper and Middle Ordovician)—Dark- to light-gray,

Valcour Formation (Upper Ordovician)—Dark- to light-gray fossiliferous limestone

Crown Point Formation (Middle Ordovician)—Gray, massively bedded fossilifer-

Providence Island Dolostone (Middle and Lower Ordovician)—Light-buff-tan-

"beeswax-scored" surfaces: contains thin layers of fossiliferous bluish-gray

weathering, massive to thick-bedded, fine-grained dark-gray dolostone: has

mestone (largely equivalent to the Bridport Member of the Chipman Formation,

Fort Cassin Formation (Middle and Lower Ordovician)—Shown locally from

Root Pond Quartzite Member (Middle and Lower Ordovician)—Light-gray to

tannish-white, well-bedded and vitreous steel-gray quartzite interbedded with

orangey-tan- and beige-weathering dolostone and thin beds of fossiliferous

mestone. Named for occurrences near Root Pond in the Benson quadrangle

herein extended to include thin lenses of quartzite that occur interbedded

upper Ibexian conodonts southwest of Root Pond (J.E. Repetski, USGS, written

Whitehall, N.Y., to Orwell, Vt. Laterally equivalent to Providence Island Dolostone

massively bedded fossiliferous limestone and calcareous sandstone

Odp Day Point Formation (Middle Ordovician)—Gray, thin-bedded to massive

Beekmantown Group (Middle Ordovician to Upper Cambrian)

Obku

Beekmantown Group, undivided (Middle Ordovician to Upper Cambrian)—Gray

mestones, fossiliferous limestones, and dolostones

weathering shaly limestone beds rich in fragments of the trilobite Cryptolithus

ed dark-gray to black granular limestone; locally grades upward into sooty-

bioclastic limestone, bluish-gray calcareous shale, and laminated shale

of the Bethel area and dikes in the Chester and Athens domes: also resemble sma

ROCKS OF THE LAURENTIAN MARGIN

(west of the Orwell and Champlain thrusts)

Adirondack lowlands and Lake Champlain lowlands

sandstone, and chert within beds of black shale and chert

ous beds of crossbedded and graded dolomitic siltstone

beds; upper beds fossiliferous with black chert

gray, fine-grained poorly fossiliferous limestone

Chazy Group (Upper and Middle Ordovician)

sandstone and fossiliferous limestone

th. The latter contains inherited zircon with rims having an imprecise

o medium-grained biotite-muscovite guartz monzonite and granodiorite. loca

vell-foliated dikes on the east and west flanks of the domes; also granite dikes and

quartz monzonite and granodiorite, granite pegmatite, and aplite which occur as

Biotite metadiorite in unit Dgq northeast of St. Johnsbury—Medium-light-

intercept age of 364±4 Ma, no. 48 (Aleinikoff and others, 2011)

bluish-gray, fine-grained, foliated and lineated

Devonian granitic rocks of southern Vermont

cut Valley trough

beds of bluish-gray limestone

ous limestone

SOUTH LONDONDERRY IGNEOUS SUITE

Biotite-quartz-plagioclase gneiss (Middle to Early Mesoproterozoic)—

egularly distributed within unit. Unit may be in part older than the tonalit

Mafic gneiss (Middle to Early Mesoproterozoic)—Dark-gray to black,

fine-grained, magnetite-garnet-hornblende-biotite-diopside-plagioclase gneiss,

commonly containing beds of dark-gray vitreous magnetite-garnet quartzite, 2 to

cm thick, tremolite-pyroxene gneiss, and biotite-rich, rusty-weathering garnet-

tonalitic gneiss and the Pharaoh Mountain Gneiss and is interpreted as

quartz schist and gray sulfidic sillimanite quartzite. Occurs as screens within

Vermont Valley sequence and Middlebury synclinorium

Hortonville Formation (Upper Ordovician)—Dark-gray siliceous shale and

ot gray to tan quartzite. Grades into limy shales ot the Stony Point Forma

Near base contains bluish-gray, granular, smooth-weathering tossiliterous

(Ohc). Unit mapped west of the Taconic allochthon, and northwest of the Sudbury

limestone (OhI) and locally a polymict limestone and dolostone-clast conglomerate

Stony Point Formation (Upper Ordovician)—Dark-gray calcareous shale and

ove. Contains basal limestone (OiI), locally referred to as the Whipple Marble

Walloomsac Formation (Upper Ordovician)—Same description as the Horton-

bonaceous highly graptoliferous phyllite (OwbI). Tectonically shredded,

Glens Falls Limestone (Upper Ordovician)—Dark-bluish-gray-weathering, thinly

grading locally upward into sooty-weathering shaly limestones containing beds rich

bedded, dark-gray to black granular limestones, and gray granular limestone,

Chazy, Black River, and Trenton Limestones, undifferentiated (Upper and

-----unconformity-----

Orwell Limestone (Upper Ordovician)—Dove-gray-weathering, black and

Middlebury Limestone (Middle Ordovician)—Buff-streaked, dark-bluish-gray,

dark-gray fine-grained limestone. Distinguished from the Middlebury Limestone

thinly bedded and well-foliated dolomitic limestone, shown above the Champlain

Chazy Group, undivided (Upper and Middle Ordovician)—Dark- to light-gray,

Valcour Formation (Upper Ordovician)—Dark- to light-gray fossiliferous limestone

Day Point Formation (Middle Ordovician)—Gray, thinly bedded to massively

Bridport Member—Thickly bedded, "beeswax-scored," orangey-beige-weath-

ring, yellowish-gray to light-bluish-gray dolostone, dark-gray fine-grained to

aphanitic dolostone, and minor beds of bluish-gray limestone. Transitions

Beldens Member—Light-gray to creamy-white-weathering fine-grained

Burchards Member—Light-bluish-gray mottled dolomitic limestone

Weybridge Member—Light-gray to cream-colored fine-grained calcite mark

Bascom Formation (Middle and Lower Ordovician)—Interbedded orangey-tan-

or calcite marble and calcareous sandstone. In southern Vermont east of the

buff-weathering dolostone and bluish-gray to gray mottled dolomitic limestone

Faconic Range, rocks mapped as Bascom Formation may include unmapped

thin dolomitic layers, locally crossbedded; may occur as lenses at several

limestone, orangey-buff-weathering dolostone, and reddish-streaked (hematite)

stward into the Beldens Member with addition of limestone beds. Equivalent

Crown Point Formation (Middle Ordovician)—Gray, massively bedded fossilif-

Middle Ordovician)—Shown locally west of the Taconic allochthon

with difficulty, especially in the area west of the Sudbury slice

Chazy Group (Upper and Middle Ordovician)

bedded sandstone and fossiliferous limestone

Chipman Formation (Middle Ordovician)

Providence Island Dolostone (Ofcpi)

positions within the Beldens Member

members of the Chipman Formation

(mapped south of Wings Point)

nassive tossiliterous limestone and calcareous sandstone

ties near and on Whipstock Hill constitute the Whipstock Breccia Member of

ember, and a polymict limestone conglomerate (Oilc). Unit mapped along east

Ira Formation (Upper Ordovician)—Same description as Hortonville Forma

paragneisses older than the tonalitic gneiss (Y²bt)

(above the Orwell and Champlain thrusts)

side of the Taconic allochthon south to Bennington

n fragments of the trilobite Cryptolithus

thrust south of Middlebury

erous limestone

beds of bluish-gray limestone

eiss and more mafic biotite-hornblende-pyroxene-quartz-plagioclase

Light-greenish-gray to pinkish-gray, well-foliated and well-layered quartz-rich

Ocu Cutting Dolostone (Lower Ordovician)—Gray, thinly bedded dolomitic

appear as sandy zones within rocks mapped as the Shelburne Marble

marble. Locally contains intermediate dolostone and gray limestone beds

Clarendon Springs Formation (Upper Cambrian)—Steel-gray-weathering

sandstone, grading upward into dolomitic limestone or mottled dolomitic marble.

Shelburne Marble (Lower Ordovician)—Predominantly light-gray- to white- and

bluish-gray-streaked calcite marble and massive white- and green-streaked calcite

nt-gray, massive calcitic dolostone grading upward into darker, more fissile

ocally contains light-bluish-gray to whitish-gray calcite marble (EspI) within

calcitic dolostone containing white quartz knots near top; unit locally brecciated.

Danby Formation (Upper Cambrian)—Thin, light-gray beds of vitreous quartzite

Winooski Dolostone (Middle Cambrian)—Well-bedded dolostone weathering

Monkton Quartzite (Middle Cambrian)—Reddish-brown, pebbly, thin- to

beige, cream, and buff, with green, red, or gray phyllite, siliceous partings, and thin

k-bedded sandstone, orangey-gray- and buff-weathering well-bedded

dolostone, and reddish-brown-weathering dolomitic quartzite. Unit discontinuous

Dunham Dolostone (Lower Cambrian)—Buff- and pink-mottled and massive, or

light-gray, pinkish-gray-weathering, and massive to poorly bedded dolostone.

Contains distinctive small pebbles and grains of well-rounded quartz; minor beds of

muscovite-quartz phyllite near top (Ecb); locally contains a mappable brown-

Dalton Formation, undivided—Heterogeneous unit consisting of rusty- to

tan-weathering flaggy feldspathic quartzite, tan-weathering quartz phyllite, and

Quartzite member—Tan to whitish-gray vitreous quartzite and minor

Dark phyllite member—Dark-gray to gray, rusty-weathering, well-laminated

ourmaline-biotite-muscovite-quartz phyllite containing thin beds of laminated

quartzite. Resembles dark phyllite of the Moosalamoo Formation (£Zmp), with

Feldspathic quartzite member—Light-tan to gray-weathering, massive to

Lustrous quartz schist member—Dark-gray to silvery-gray, tourmaline-

Phyllite member—Rusty-tan to gray, thinly layered phyllite, tourmaline-

Dolostone member—Buff, sandy, massive dolostone as lens in €Zdph

quartz-pebble wacke to conglomerate. Occurs at or near base of unit

Lower Cambrian and Neoproterozoic cover rocks of the Lincoln

Mountain massif and northwestern flank of the Green Mountain

Feldspathic quartzite and granofels member—Gray to dark-gray, biotite-

former resembles albitic rocks of the Hoosac Formation (CZhab)

atter resembles similar rocks of the Dalton Formation (£Zdfq), whereas the

Quartzite member—Light-tan to gray, vitreous and non-vitreous quartzite and

splintery sulfidic to non-sulfidic quartz phyllite and pebbly and gritty biotite

Gray phyllite and metawacke member—Dark-gray, sooty-weathering,

Magnetite metasiltstone member—Grayish-brown- to pale-green-

base contains magnetite-cemented quartz-pebble conglomerate and bedded

magnetite quartzite. Directly overlies dolostones of the Forestdale Formation

veathering, well-laminated, magnetite-studded chloritic metasiltstone; near

Moosalamoo Formation (Lower Cambrian and Neoproterozoic)

feldspathic quartzite and quartz conglomerate

piotite-muscovite-quartz phyllite, and quartzite mapped along western flank of

arse- to fine-grained quartz-pebble to -cobble, quartz conglomerate and

schistose quartz conglomerate. Locally dark-gray biotite-muscovite-blue-

EZhs of the Hoosac Formation exposed to the east

the Green Mountain massif in the South Wallingford area

hin-bedded, flaggy, tourmaline-muscovite-feldspar quartzite and interbedded

otite-quartz schist and feldspathic schist and quartzite. Occurs on

ern flank of the southern Green Mountain massif; similar in appearance to

Cheshire Quartzite (Lower Cambrian)—Light-gray- to tannish-gray-weathering,

weathering, gray to brown argillaceous quartzite member (€ca)

Dalton Formation (Lower Cambrian and Neoproterozoic)

and to the east with rocks of the Hoosac Formation)

teldspathic quartzite

blue-quartz-pebble quartzite

which it is in part correlative

(unit interfingers to the north with rocks of the Tyson Formation

dolostone and beneath the calcitic marbles of the overlying Shelburne Marble

and crossbedded sandy dolostone. Unit discontinuous in southern Vermont

beds of blue-quartz-pebble conglomerate and quartzite

In southern Vermont east of the Taconic Range, unit is not recognized and may

Forestdale Formation (Lower Cambrian and Neoproterozoic)

feldspathic gritty quartzite

blue- and gray-mottled sulfidic dolostone

-cobble conglomerate (€Zpc)

quartz-rich dolostone (€Zpwd)

feldspar conglomerate and quartzite

ded with calcareous metagraywacke

dolostone clasts in a sandy limestone matrix

Saxe Brook Formation by others in the Highgate area

in a limestone matrix, interbedded with sandstone

gray quartzose dolostone

quartz sand matrix

dolostone with thin sandstone beds

-cobble conglomerate

magnetite

Pinnacle Formation (Cambrian and Neoproterozoic)

dolostone; €Zfco is boulder and cobble dolostone conglomerate

Dolostone member—Upper part of €Zfd consists of orangey-tan- to brown-

eathering quartz-pebble dolostone and dolomitic crossbedded feldspathic

Quartzite member—Grayish-tan to light-gray vitreous quartzite and white

Phyllite and dolostone breccia member—Dark-gray to sooty-black carbona-

Pinnacle Formation, undivided—Gray, foliated muscovite-chlorite-biotite-

and local thin conglomeratic horizons are present. Feldspathic biotite phyllitic

metawacke is interlayered with lenses of quartz, feldspar, and gneiss-pebble to

Light-gray phyllitic conglomerate member—Feldspathic biotite phyllitic

etawacke interlayered with lenses of quartz, feldspar, and gneiss-pebble to

Metawacke member—Gray- to light-brownish-gray-weathering, massive to

bedded muscovite-biotite-chlorite metawacke, conglomerate, and blue-quartz

pebbly phyllite, wacke and feldspathic quartzite: heterogeneous unit consists of

Metawacke and phyllite member—Light-gray, medium-grained, massive

chlorite-muscovite-quartz schist, and phyllite or pebbly phyllite, locally rich in

Quartzite and quartz-pebble conglomerate member—Light-gray quartz-

supported quartz- and gneiss-cobble to boulder conglomerate, locally contain

ing quartzite boulders as large as 3 m in diameter, in a matrix ot gray-weathering

Metabasalt and volcaniclastic rocks, undifferentiated—Largely carbonate-

Amphibolitic greenstone member— Calcite-biotite-sphene-albite-actinolite-

Calcareous greenstone member—Rusty-weathering and pitted, dark-green

Feldspathic greenstone member—Olive-drab-weathering, dark-green,

Tibbit Hill Formation (Cambrian and Neoproterozoic)—Largely metabasalt and

metabasalt flows, pillow basalt, vesicular basalt composed of albite, epidot

the Pinnacle Formation. Volcanics are alkalic to transitional metabasalts

Cambrian to Middle Ordovician rocks of the St. Albans area

Morses Line Slate (Ordovician)—Medium-gray to black calcareous slate

chlorite (±actinolite); and interbedded phyllitic grits, feldspathic quartzite, chloritic

metawacke, and basaltic tuffaceous metasedimentary rocks, all similar to rocks of

Highgate Formation (Lower Ordovician)—Banded limestone and calcareous

Gorge Formation (Lower Ordovician and Cambrian)—Dolomite, and dolomite

Sweetsburg Formation (Lower Ordovician and Cambrian?)—Black to gray,

graphitic, quartzose phyllite and schist, with tan-weathering layers and pods of gray

Skeels Corners Slate (Lower Ordovician and Cambrian)—Laminated black

ate with thin orange dolostone beds; includes massive dolostones mapped as

Limestone matrix conglomerate member—Limestone and sandstone clasts

Sandy matrix conglomerate member—Limestone and sandstone clasts in a

Parker Slate (Cambrian)—Black arenaceous slate with dolomite horizons;

erbedded dolostone and sandstone breccia in a dolostone matrix; and massive

breccia composed of angular clasts of dolostone, sandstone, and chert in a buff to

slate with local lenses of conglomerate composed of limestone, sandstone, and

greenstone with laminae and splotches of calcareous material; locally interbed-

ine-grained greenstone with remnant plagioclase feldspar phenocrysts up to

ote-chlorite greenstone with dark-green porphyroblasts of actinolitic

Cobble and boulder conglomerate member—Poorly sorted, matr

magnetite-calcite-chlorite-muscovite-biotite-feldspar schist

epidote-albite-chlorite (±actinolite) greenstones

quartz-sericite-chlorite-albite metawacke, gray to grayish-green magnetite

coarse- to medium-grained clastic wacke, beige-weathering dolostone, and

feldspar-quartz schist, phyllite, and metagraywacke. Quartz is commonly bl

eous phyllite, interbedded dolostone boulder conglomerate to breccia, and

asandstone; lower part of €Zfd largely cream- to beige-weathering massive

Green Mountain massif

Ofcs Sciota Limestone Member (Middle and Lower Ordovician)—Light-gray, fine-

to the quartzite of the Root Pond Quartzite Member (Ofcrp)

Ogm Great Meadows Formation (Lower Ordovician)—Light-gray, medium-grained,

weathering fossiliferous limestone (OgmI)

containing layers of gray limestone (Ocwl)

surface texture

medium- to thick-bedded dolostone, locally cherty; contains lens of light-gray-

Winchell Creek Member—Tan-weathering, gray, well-bedded and crossbedded

Whitehall Formation (Lower Ordovician and Upper Cambrian)—Predominantly

light-gray and pinkish-gray, coarse-grained dolostone and cherty dolostone,

Ticonderoga Formation (Upper Cambrian)—Light-gray, yellowish-gray- to buff-

weathering quartzose dolostone, pebbly dolomitic quartzite, and interbedded

Potsdam Sandstone (Upper Cambrian)—Light-gray, tan, and dark-gray, well-

bedded pebbly quartzite, crossbedded vitreous quartzite, and local conglomerate

-----unconformity-----

Neoproterozoic and Mesoproterozoic rocks of the Adiron-

Diabase dikes (Neoproterozoic)—Dark-gray to greenish-gray, very fine grained,

ocellar basaltic to medium-grained augite-plagioclase diabasic dikes, occurring as a

subvertical northeast-trending discontinuous zone in the center of Bald Mountain

agnetite-biotite (\pm tourmaline) granite pegmatite, <1 m to 10 m thick. Crosscut:

Metagabbro (Late Mesoproterozoic)—Garnet-hornblende (±olivine) gabbro and

Granodioritic augen gneiss and quartz monzonite gneiss (Late

Mesoproterozoic)—Light-gray to pinkish-gray, garnet-biotite-plagioclase-micr

Pharaoh Mountain Gneiss of Wiener and others (1984) (Late to Middle

Mesoproterozoic)—Rusty-gravish-brown- to brown-weathering, knubbly coarse-

grained magnetite-garnet-hornblende and pyroxene-bearing charnockitic gneis

nd garnet-hornblende granite gneiss. Has large polycrystalline aggregates of

gioclase as much as 1.5 cm long, recrystallized from pre-Ottawan phenocrys

 (Y^2cs) , mafic diopside-hypersthene gneiss, and interbedded sillimanite-gar

Biotite tonalite gneiss (Y2bt) and mafic gneiss (Y2ba) (Middle

Mesoproterozoic)—Predominantly chalky-white-weathering, massive biotite

±37 Ma (McLelland and Chiarenzelli, 1990) obtained from exposure

enses and screens of rusty sulfidic garnet-biotite-feldspar-quartz schist, dark-grav

est of Austin Hill on the west side of South Bay, west of Whitehall, N.Y. Co

garnet-feldspar quartzite, and calc-silicate gneiss on south end of Austin Hill. Ur

Hague Gneiss of Alling (1918) (Middle Mesoproterozoic)—Yellowish-grayish-

sillimanite-feldspar gneissosity older than the regional Ottawan foliation

Quartzite (Middle Mesoproterozoic)—Light-tan to yellowish-gray, massive to

beds as much as 10 m thick. Occurs in two layers, one within or attached to the

Marble and calc-silicate gneiss (Middle Mesoproterozoic)—Medium-dark-gray

Hague Gneiss and one within biotite-guartz-plagioclase gneiss (Y²bpg) beneath the

Hague Gneiss. The latter is rich in microcline and passes through interbedding

een to rusty-sulfidic-weathering, garnet (large)-sillimanite-biotite-orthoclase-

ell-layered magnetite-garnet quartzite and magnetite-biotite-garnet quartzite in

s, layers or pods of quartzite, marble, or calc-silicate rock. Contains a coarse

agioclase-quartz schist or gneiss, locally containing mappable and discontinuous

1328±32 Ma (McLelland and Chiarenzelli, 1990)

conalite gneiss having screens, dikes, or sills of more mafic gneiss. Passes laterally

white, fine-grained trondhjemitic aplite near contacts with larger screens of

terpreted as intrusive into some paragneiss units that are here older than

eiss. U-Pb zircon Thermal Ionization Mass Spectrometry (TIMS) age of

vartzite (Y^2qz). Interpreted as largely intrusive but may contain some charnockitic

deformed phenocrysts (augen) aligned in old relict flow (?) foliation

gneiss of uncertain origin

into a quartzose facies of Y²bpg

thite augen granodioritic gneiss, locally massive but well foliated. Contains

dioritic gneiss; similar rock mapped in the Chittenden Intrusive Suite in Vermont

ttawan foliation and locally fills narrow, northeast-trending, steeply dipping

Pegmatite dikes (Late Mesoproterozoic)—Pinkish-gray to light-gray, unfoliated,

dacks in Vermont and in the Whitehall, N.Y., area

laminated quartzite and dolostone; sandy beds weather to a woody-grained

grained, and dark-gray, fossiliferous, and platy bluish-gray limestone. Contains

Ward Siltstone Member (Lower Ordovician)—Light-tan to gray, thinly bedded

and crossbedded, calcareous and dolomitic siltstone and quartzite in beds similar

tate)-Medium- to dark-gray and mottled, medium- to thick-bedded dolomitic

Fort Ann Formation (Lower Ordovician) (Shown only in New York

ol House, in the Benson quadrangle (J.E. Repetski, USGS, written