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 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] Brandon Lignite (lower Miocene)—Organic silt, sand and gravel and slumped and dismembered lignite occurring as elongate disrupted deposits in underlying kaolin, residual hematite, and ochre deposits near Brandon. Lignite was let down into kaolin perhaps by karst collapse along a concealed west-dipping normal fault between the Dunham Dolostone on the west and the Cheshire Quartzite on the east. Deposit largely concealed but known from historic underground workings fo kaolin, hematite ochre, and lignite White Mountain Igneous Suite (Early Cretaceous and Jurassic) Cuttingsville stock (Early Cretaceous)—Composite stock and intrusive breccia dikes consisting of augite and hastingsite syenite, nepheline and sodalite syenite

U.S. GEOLOGICAL SURVEY

essexite, and monzodiorite. Associated dikes of monchiquite, camptonite, bostonite, and spessartite. Average of five K-Ar ages 101 Ma; ages range between 103 ± 4 and 99 ± 2 Ma (Armstrong and Stump, 1971) Nepheline and sodalite syenite, hornblende syenite Quartz syenite Essexite (alkali gabbro) autoclasts of felsic alkalic and fine-grained mafic rocks

Andesite breccia containing xenoliths of Mesoproterozoic gneiss and Ascutney Mountain igneous complex (Early Cretaceous)—Consists of two plutons, a partial ring dike, and screens of volcanic rocks. K-Ar ages of 122 to 120 Ascutney Mountain stock Medium- to coarse-grained biotite-microperthite-orthoclase-albite granite Hornblende granite occurring as small intrusive masses in Kas Syenite-porphyrite to sericite-perthite-hornblende-biotite syenite; contains hists of the country rock. Shown only around main Ascutney Mountain stocl in structural continuity with rocks outside the contact aureole. Loc

minor fayalite, augite, and quartz; occurs as a partial ring dike in the Little Trachytic to rhyolitic tuffs, and breccias containing fragments of volcanic rocks ring trachytic flow structure and layering. Interpreted as volcanic rocks of Hornfels—Dense, compact hornfels consisting of recognizable but altered aluminous rocks of the Waits River Formation contain andalusite, sillimanite, cordierite, pleonaste, and corundum; calcareous pelites contain diopside, quartz-wollastonite, plagioclase, grossular garnet, and scapolite Little Ascutney stock A composite gabbro-diorite stock having two (eastern and western) intrusive centers defined by weakly developed igneous foliation. Gabbro is intruded by abundant, poorly defined areas of diorite. Includes two areas of syenite (Kas) Gabbro and diorite—Medium- to coarse-grained augite-hornblende-biotite gabbro infiltrated by hornblende and biotite diorite Paisanite dike—Fine-grained syenitic dike similar to spherulitic dikes found

hin the plutons and in the adjacent country rocks. One paisanite dike occur well outside the Ascutney Mountain stocks in the saddle between the Chester and Athens domes Barber Hill stock (Early Cretaceous) small, 0.5-km-long, northwest-trending stock consisting of a coarse-grained alkali 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)

Monadnock Mountain pluton (Middle Jurassic) Knox Mountain pluton—Light-gray, medium-grained, quartz-rich biotite-Composite stock of quartz syenite, syenite granite, and essexite. K-Ar age of 175±4 Ma (Foland and Faul, 1977) **East Barre plutons**—Gray, homogeneous, fine- to medium-grained muscovite-Quartz syenite—Greenish-gray to pink hornblende-biotite quartz syenite Granite—Hornblende-biotite-microperthite granite, gradational into quartz syenite East Bethel plutons—Very light-bluish-gray to white, medium-grained, muscovite-Essexite—Pyroxene-biotite-hornblende andesine gabbroic rock grading into quartz syenite Dikes associated with Monadnock Mountain pluton—Granite, syenite, quartz bostonite, camptonite, aplite, and pegmatite Dikes of White Mountain Igneous Suite—Largely Early Cretaceous, but some may be Middle Jurassic (McHone, 1992)

Black Mountain pluton of the Guilford dome—Weakly foliated, light-gray to associated with Monadnock Mountain pluton; (2) Early Cretaceous swarms associated with Barber Hill stock near Lake Champlain and extending eastward to swarm of hitish-gray, garnet-biotite-muscovite granite, minor pegmatite, and aplite dikes lamprophyre at western margin of Connecticut Valley trough; and (3) a southern (Dg). Rb/Sr muscovite age of 383±7 Ma (Naylor, 1971) and a U-Pb zircon upperly Cretaceous swarm of foidal felsic, mafic, and lamprophyre dikes associated with intercept age of 364±4 Ma, no. 48 (Aleinikoff and others, 2011) tons at Mount Ascutney and Cuttingsville and extending westward into the Tacon Granite and trondhjemite dikes of Chester and Athens domes and west of Commonly dikes are nondeformed and chilled, but locally they are offse the Connecticut Valley trough-Light-gray to white, garnet-muscovite-biotiinor 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 46 (Aleinikott and others, 2011), from rims on Proterozoic-age cores (J. Aleinikoff, USGS, written commun., 2002); and whitish-gray muscovite-rich quartz monzonite and granodiorite, granite pegmatite, and aplite which occur as rosscutting nonfoliated dikes within the core of the domes and as folded and vell-foliated dikes on the east and west flanks of the domes; also granite dikes and mall stocks of very light gray to white, muscovite-rich, locally garnet-bearing, fineo medium-grained biotite-muscovite guartz monzonite and granodiorite. loca (four general designators are used: Dbg, binary and biotite granite and granodic ular, that intrude cover rocks east of the Green Mountain massif from Jama orthfield, including the Liberty Hill locality and the granodiorite stock eas rite, undifferentiated; Dqm, quartz monzonite; Ddg, diorite and gabbro; and Dg, th. The latter contains inherited zircon with rims having an imprecise small dikes. Only Dbg and Dg are shown in the Description of Map Units) $\frac{1}{2}$ HRIMP age of about 380 to 390 Ma (Aleinikoff and others, 2011); a similar dike Binary and biotite granite and granodiorite, undifferentiated—Includes small 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 of the Bethel area and dikes in the Chester and Athens domes: also resemble sma Igneous rocks of the Northeast Kingdom batholith of Ayuso and Arth dikes of granite, trondhjemite, and quartz monzonite largely west of the Connecticut Valley trough Derby pluton—Light-gray, medium- to coarse-grained, massive, epidote-biotitemuscovite porphyritic granodiorite and minor tonalite (Ddbg), with a rim zone of ROCKS OF THE LAURENTIAN MARGIN granodiorite (Ddrz). Rb/Sr whole-rock isochron age of 370±17 Ma (Ayuso and Adirondack lowlands and Lake Champlain lowlands Echo Pond pluton—Light-gray to pink, medium- to coarse-grained, massive, (west of the Orwell and Champlain thrusts) riate to porphyritic granodiorite and granite (Debg) and outer zone of quartz gabbro and quartz diorite (Dedg), and inner zone of granite (Degr) sandstone, and chert within beds of black shale and chert ous beds of crossbedded and graded dolomitic siltstone West Charleston pluton—Dark-gray, medium to coarse-grained, massive, beds of bluish-gray limestone Nulhegan pluton—Light-gray to dark-gray, medium- to coarse-grained, massive, biotite-clotted, hornblende-quartz monzodiorite, minor granodiorite, and granite divided into a western zone (Dnwz), inner zone (Dniz), and core of quartz monzonite (Dnqm). Rb/Sr whole-rock age of 390±14 Ma (Ayuso and Arth, 1992)

ous limestone

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

New Hampshire Plutonic Suite

Devonian intrusive rocks

(1992)—Plutons identified on map

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

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-

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

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

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

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

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

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 bioclastic limestone, bluish-gray calcareous shale, and laminated shale Glens Falls Limestone (Upper Ordovician)—Dark-bluish-gray-weathering, thinly ed dark-gray to black granular limestone; locally grades upward into sootyweathering shaly limestone beds rich in fragments of the trilobite Cryptolithus Black River Group, undivided (Upper Ordovician)—Thin-bedded to massive dolostone, sandy dolostone, and light-gray limestone; vertical burrows in basal beds; upper beds fossiliferous with black chert Orwell Limestone (Upper Ordovician)—Dove-gray-weathering, black to darkgray, fine-grained poorly fossiliferous limestone Chazy Group (Upper and Middle Ordovician) Chazy Group, undivided (Upper and Middle Ordovician)—Dark- to light-gray, massively bedded fossiliferous limestone and calcareous sandstone Valcour Formation (Upper Ordovician)—Dark- to light-gray fossiliferous limestone Crown Point Formation (Middle Ordovician)—Gray, massively bedded fossilifer-

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

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

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

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

bluish-gray, fine-grained, foliated and lineated

Devonian granitic rocks of southern Vermont

agnetite-biotite (\pm tourmaline) granite pegmatite, <1 m to 10 m thick. Crosscut: ttawan foliation and locally fills narrow, northeast-trending, steeply dipping gneiss of uncertain origin Odp Day Point Formation (Middle Ordovician)—Gray, thin-bedded to massive sandstone and fossiliferous limestone Beekmantown Group (Middle Ordovician to Upper Cambrian) 1328±32 Ma (McLelland and Chiarenzelli, 1990) Obku

Beekmantown Group, undivided (Middle Ordovician to Upper Cambrian)—Gray mestones, fossiliferous limestones, and dolostones Providence Island Dolostone (Middle and Lower Ordovician)—Light-buff-tanweathering, massive to thick-bedded, fine-grained dark-gray dolostone: has "beeswax-scored" surfaces: contains thin layers of fossiliferous bluish-gray mestone (largely equivalent to the Bridport Member of the Chipman Formation, Fort Cassin Formation (Middle and Lower Ordovician)—Shown locally from

Metagabbro (Late Mesoproterozoic)—Garnet-hornblende (±olivine) gabbro and dioritic gneiss; similar rock mapped in the Chittenden Intrusive Suite in Vermont Granodioritic augen gneiss and quartz monzonite gneiss (Late Mesoproterozoic)—Light-gray to pinkish-gray, garnet-biotite-plagioclase-micr thite augen granodioritic gneiss, locally massive but well foliated. Contains deformed phenocrysts (augen) aligned in old relict flow (?) foliation Pharaoh Mountain Gneiss of Wiener and others (1984) (Late to Middle Mesoproterozoic)—Rusty-gravish-brown- to brown-weathering, knubbly coarsegrained 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 vartzite (Y^2qz). Interpreted as largely intrusive but may contain some charnockitic Biotite tonalite gneiss (Y2bt) and mafic gneiss (Y2ba) (Middle **Mesoproterozoic)**—Predominantly chalky-white-weathering, massive biotite conalite gneiss having screens, dikes, or sills of more mafic gneiss. Passes laterally white, fine-grained trondhjemitic aplite near contacts with larger screens of eiss. U-Pb zircon Thermal Ionization Mass Spectrometry (TIMS) age of ±37 Ma (McLelland and Chiarenzelli, 1990) obtained from exposure est of Austin Hill on the west side of South Bay, west of Whitehall, N.Y. Co enses and screens of rusty sulfidic garnet-biotite-feldspar-quartz schist, dark-grav garnet-feldspar quartzite, and calc-silicate gneiss on south end of Austin Hill. Ur terpreted as intrusive into some paragneiss units that are here older than Hague Gneiss of Alling (1918) (Middle Mesoproterozoic)—Yellowish-grayisheen to rusty-sulfidic-weathering, garnet (large)-sillimanite-biotite-orthoclaseagioclase-quartz schist or gneiss, locally containing mappable and discontinuous s, layers or pods of quartzite, marble, or calc-silicate rock. Contains a coarse sillimanite-feldspar gneissosity older than the regional Ottawan foliation Quartzite (Middle Mesoproterozoic)—Light-tan to yellowish-gray, massive to ell-layered magnetite-garnet quartzite and magnetite-biotite-garnet quartzite in beds as much as 10 m thick. Occurs in two layers, one within or attached to the Hague Gneiss and one within biotite-guartz-plagioclase gneiss (Y²bpg) beneath the Hague Gneiss. The latter is rich in microcline and passes through interbedding into a quartzose facies of Y²bpg Marble and calc-silicate gneiss (Middle Mesoproterozoic)—Medium-dark-gray

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

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

Biotite-quartz-plagioclase gneiss (Middle to Early Mesoproterozoic)— Light-greenish-gray to pinkish-gray, well-foliated and well-layered quartz-rich eiss and more mafic biotite-hornblende-pyroxene-quartz-plagioclase 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 garnetquartz schist and gray sulfidic sillimanite quartzite. Occurs as screens within tonalitic gneiss and the Pharaoh Mountain Gneiss and is interpreted as paragneisses older than the tonalitic gneiss (Y²bt) Vermont Valley sequence and Middlebury synclinorium (above the Orwell and Champlain thrusts) 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 limestone (OhI) and locally a polymict limestone and dolostone-clast conglomerate (Ohc). Unit mapped west of the Taconic allochthon, and northwest of the Sudbury Stony Point Formation (Upper Ordovician)—Dark-gray calcareous shale and beds of bluish-gray limestone Ira Formation (Upper Ordovician)—Same description as Hortonville Forma

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

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

n fragments of the trilobite Cryptolithus

thrust south of Middlebury

erous limestone

Shelburne Marble (Lower Ordovician)—Predominantly light-gray- to white- and bluish-gray-streaked calcite marble and massive white- and green-streaked calcite marble. Locally contains intermediate dolostone and gray limestone beds Clarendon Springs Formation (Upper Cambrian)—Steel-gray-weathering nt-gray, massive calcitic dolostone grading upward into darker, more fissile calcitic dolostone containing white quartz knots near top; unit locally brecciated. ocally contains light-bluish-gray to whitish-gray calcite marble (EspI) within dolostone and beneath the calcitic marbles of the overlying Shelburne Marble Danby Formation (Upper Cambrian)—Thin, light-gray beds of vitreous quartzite and crossbedded sandy dolostone. Unit discontinuous in southern Vermont Winooski Dolostone (Middle Cambrian)—Well-bedded dolostone weathering beige, cream, and buff, with green, red, or gray phyllite, siliceous partings, and thin beds of blue-quartz-pebble conglomerate and quartzite Monkton Quartzite (Middle Cambrian)—Reddish-brown, pebbly, thin- to 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. ove. Contains basal limestone (OiI), locally referred to as the Whipple Marble ember, and a polymict limestone conglomerate (Oilc). Unit mapped along east side of the Taconic allochthon south to Bennington Walloomsac Formation (Upper Ordovician)—Same description as the Hortonweathering, gray to brown argillaceous quartzite member (€ca) bonaceous highly graptoliferous phyllite (OwbI). Tectonically shredded, ties near and on Whipstock Hill constitute the Whipstock Breccia Member of Dalton Formation (Lower Cambrian and Neoproterozoic) (unit interfingers to the north with rocks of the Tyson Formation and to the east with rocks of the Hoosac Formation) Glens Falls Limestone (Upper Ordovician)—Dark-bluish-gray-weathering, thinly bedded, dark-gray to black granular limestones, and gray granular limestone,

Contains distinctive small pebbles and grains of well-rounded quartz; minor beds of Cheshire Quartzite (Lower Cambrian)—Light-gray- to tannish-gray-weathering, 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 teldspathic quartzite Quartzite member—Tan to whitish-gray vitreous quartzite and minor blue-quartz-pebble quartzite 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 which it is in part correlative Feldspathic quartzite member—Light-tan to gray-weathering, massive to hin-bedded, flaggy, tourmaline-muscovite-feldspar quartzite and interbedded Lustrous quartz schist member—Dark-gray to silvery-gray, tourmalinepiotite-quartz schist and feldspathic schist and quartzite. Occurs on ern flank of the southern Green Mountain massif; similar in appearance to EZhs of the Hoosac Formation exposed to the east Phyllite member—Rusty-tan to gray, thinly layered phyllite, tourmalinepiotite-muscovite-quartz phyllite, and quartzite mapped along western flank of the Green Mountain massif in the South Wallingford area Dolostone member—Buff, sandy, massive dolostone as lens in €Zdph se- to fine-grained quartz-pebble to -cobble, quartz conglomerate and schistose quartz conglomerate. Locally dark-gray biotite-muscovite-bluequartz-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

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

appear as sandy zones within rocks mapped as the Shelburne Marble

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

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

Moosalamoo Formation (Lower Cambrian and Neoproterozoic) Feldspathic quartzite and granofels member—Gray to dark-gray, biotiteatter resembles similar rocks of the Dalton Formation (£Zdfq), whereas the former resembles albitic rocks of the Hoosac Formation (CZhab) Quartzite member—Light-tan to gray, vitreous and non-vitreous quartzite and feldspathic quartzite and quartz conglomerate Gray phyllite and metawacke member—Dark-gray, sooty-weathering, splintery sulfidic to non-sulfidic quartz phyllite and pebbly and gritty biotite

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

Forestdale Formation (Lower Cambrian and Neoproterozoic) Dolostone member—Upper part of €Zfd consists of orangey-tan- to browneathering quartz-pebble dolostone and dolomitic crossbedded feldspathic asandstone; lower part of €Zfd largely cream- to beige-weathering massive dolostone; €Zfco is boulder and cobble dolostone conglomerate Quartzite member—Grayish-tan to light-gray vitreous quartzite and white feldspathic gritty quartzite Phyllite and dolostone breccia member—Dark-gray to sooty-black carbonaeous phyllite, interbedded dolostone boulder conglomerate to breccia, and blue- and gray-mottled sulfidic dolostone Pinnacle Formation (Cambrian and Neoproterozoic) Pinnacle Formation, undivided—Gray, foliated muscovite-chlorite-biotitefeldspar-quartz schist, phyllite, and metagraywacke. Quartz is commonly bl and local thin conglomeratic horizons are present. Feldspathic biotite phyllitic metawacke is interlayered with lenses of quartz, feldspar, and gneiss-pebble to -cobble conglomerate (€Zpc) Light-gray phyllitic conglomerate member—Feldspathic biotite phyllitic etawacke interlayered with lenses of quartz, feldspar, and gneiss-pebble to -cobble conglomerate 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 coarse- to medium-grained clastic wacke, beige-weathering dolostone, and quartz-rich dolostone (€Zpwd) Metawacke and phyllite member—Light-gray, medium-grained, massive quartz-sericite-chlorite-albite metawacke, gray to grayish-green magnetite chlorite-muscovite-quartz schist, and phyllite or pebbly phyllite, locally rich in magnetite Quartzite and quartz-pebble conglomerate member—Light-gray quartzfeldspar conglomerate and quartzite Cobble and boulder conglomerate member—Poorly sorted, matr 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 magnetite-calcite-chlorite-muscovite-biotite-feldspar schist Metabasalt and volcaniclastic rocks, undifferentiated—Largely carbonate-

epidote-albite-chlorite (±actinolite) greenstones Amphibolitic greenstone member— Calcite-biotite-sphene-albite-actinoliteote-chlorite greenstone with dark-green porphyroblasts of actinolitic Calcareous greenstone member—Rusty-weathering and pitted, dark-green greenstone with laminae and splotches of calcareous material; locally interbedded with calcareous metagraywacke **Feldspathic greenstone member**—Olive-drab-weathering, dark-green, ine-grained greenstone with remnant plagioclase feldspar phenocrysts up to Tibbit Hill Formation (Cambrian and Neoproterozoic)—Largely metabasalt and metabasalt flows, pillow basalt, vesicular basalt composed of albite, epidot chlorite (±actinolite); and interbedded phyllitic grits, feldspathic quartzite, chloritic metawacke, and basaltic tuffaceous metasedimentary rocks, all similar to rocks of 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 Highgate Formation (Lower Ordovician)—Banded limestone and calcareous slate with local lenses of conglomerate composed of limestone, sandstone, and dolostone clasts in a sandy limestone matrix Gorge Formation (Lower Ordovician and Cambrian)—Dolomite, and dolomite breccia composed of angular clasts of dolostone, sandstone, and chert in a buff to gray quartzose dolostone 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 Saxe Brook Formation by others in the Highgate area **Limestone matrix conglomerate member**—Limestone and sandstone clasts in a limestone matrix, interbedded with sandstone 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

quartz sand matrix

dolostone with thin sandstone beds

Sandy dolostone member—Sandy dolostone containing limestone clasts, interfingered with sandy dolostone containing dolostone clasts contact that crosscuts paragneiss units. Unit also in Lincoln Mountain massit and at Brandon Gap; similar rock mapped in the Adirondacks Dark conglomerate member—Conglomerate consisting of round clasts of orange dolostone in a black arenaceous matrix coarse-grained biotite-microcline megacrystic granite and monzogranitic gneiss; passes locally into more equigranular granitic gneiss (Y^{3A}g) and locally into Ordovician, Cambrian, and Neoproterozoic cover rocks extensive areas of biotite pegmatoid granitic gneiss (Y^{3A}pg), locally muscovite north of the Lincoln Mountain massif West Bridgewater Formation (Middle Ordovician) FPb zircon ages of $1,119\pm3.3$ Ma (no. 15) and $1,121\pm1.4$ Ma (no. 1 Black to dark-gray, sulfidic to nonsulfidic, carbonaceous, fine-grained, well-foliated determined on samples near Sherburne Center and on Telegraph Hill east of otite-muscovite-quartz phyllite; contains pods and thin beds of medium-dark-gra Chittenden Reservoir by Karabinos and Aleinikoff (1990) 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 Microcline-magnetite augen gneiss at Brandon Gap—Pinkish-gray to medium--Whiterockian at West Bridgewater and Whiterockian at Buels Gore and Wes SHRIMP age of 1 149+8 Ma no 13 (Aleinikoff and others 2011). Unit is associ Bolton (Ratcliffe and others, 1999; Thompson and others, 2002) d with minor exposures of metadiorite to tonalitic gneisses; crosscuts a gne in country rocks and may extend northward along eastern limb of Lincoln Dark-gray and green phyllite member—Interbedded dark-gray and grayish een chlorite-muscovite-quartz-knotted albitic phyllite, containing pods of bluish-gray dolostone. (Correlation with West Bridgewater Formation Granitic gneiss of Chittenden Intrusive Suite (?)—Light-gray, coarse-grained, uncertain.) Mapped only in the area west of Granville -----unconformity-----Fairfield Pond Formation (Cambrian and Neoproterozoic)—Light-gray to light-green, quartz-sericite-chlorite (±magnetite±biotite) phyllite and foliated quartzite White Brook Formation (Cambrian and Neoproterozoic)—Buff to creamored massive dolomite and dolomitic sandstone, containing prominent zone of massive and specular hematite near top at Sheldon

Dolostone member—Massive beds of white to buff dolostone

and sandstone clasts in a calcareous sandy matrix

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

biotite-microcline megacrystic to even-grained granite gneiss closely associated with 1,149- to 1,120-Ma augen gneisses, in the northern part of the Green Mountain massif. Not distinguishable with certainty from older granitoids of the Stratton Mountain Intrusive Suite of the central and southern Green Mountains Microcline augen gneiss of Lincoln Mountain massif—Light- to medium-gra medium-grained, biotite-quartz-plagioclase-microcline gneiss; contains microcline augen as much as 4 cm in length Stratton Mountain Intrusive Suite (Middle Mesoproterozoic) (1,244±8 Ma to 1,221±4 Ma) Underhill Formation (Cambrian and Neoproterozoic)—Silvery-green quartz-Biotite-granitic gneiss—A heterogeneous unit consisting of granitic and grano 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 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 Londonderry Igneous Suite Greenstone and amphibolite member—Thinly bedded carbonate-albite Aplitic gneiss—Light-gray to white, fine-grained aplitic granite gneiss as border of te greenstone and massive magnetite-albite-amphibole-biotite-ep gg or as thin dikes or sills in paragneiss units albite-amphibole schist; dark-green, coarse-grained, weakly foliated epidote-College Hill Granite Gneiss—Light-gray to medium-dark-gray, porphyri biotite-albite-amphibole amphibolite lineated, and saturated with less deformed later pegmatite; grades outward into Quartz-laminated schist member—Light-gray to tan and rusty-weathering, migmatitic border exhibiting decreasing concentration of microcline megacry ine-grained, well-foliated mylonitic albite-chlorite-muscovite-quartz (±dolomite)-laminated schist

Forms a single large intrusive mass on College Hill in Jamaica and west of Stratto 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) Hazens Notch Formation (Cambrian and Neoproterozoic) Granitic gneiss of Lincoln Mountain massif (Middle Mesoproterozoic)—Heteronit consisting of medium-grained biotite-microcline-plagioclase gneis Hazens Notch Formation, undivided—Schist, gneiss, and quartzite; lark-rusty-brown graphitic biotite-muscovite-chlorite-quartz (±garnet) schist and Interpreted as intrusive granitic rock older than Y^3 rocks of Chittenden Intrusive gneiss; black albite porphyroblasts, large euhedral pyrite, and beds of dark-gray foliated quartzite are common. Unit includes rusty-weathering schist without graphite and rocks identical to Fayston Formation Migmatitic and mylonitic rocks of uncertain origin Greenstone and amphibolite member—Dark-green, pitted-weathering, schist to massive greenstone containing varying amou Migmatitic gneiss (Middle Mesoproterozoic)—Light-gray and pinkish-gray to chlorite, albite, carbonate, epidote, amphibole, and sphene; and amphibolite wish-gray, massive, medium-grained plagioclase granitic gneiss, and mi containing varying amounts of hornblende, actinolite, albite, chlorite, epidote, biotite, magnetite, and sphene ester dome, and in Weston where it appears to form an integral part bg, but also locally appears to be intrusive. A mixed rock of uncertain or Schist member—Rusty-weathering, non-graphitic, sulfidic chlorite-muscovite-U-Pb zircon SHRIMP age of 1,326±4 Ma, no. 8 (Aleinikoff and others, Fayston Formation (Lower Cambrian and Neoproterozoic) Albite schist member—Silvery-green to grayish-green, medium-grained albite-chlorite-muscovite-quartz (±garnet±magnetite) schist with white albite 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

grained quartz-albite-biotite gneiss

suggests affinity with metamorphic and igneous events associated with the Mido Mesoproterozoic Ludlow Mountain and Proctor Hill granodiorite gneisses of the South Londonderry Igneous Suite. Age of migmatization is younger than 1,326 Ma Mylonitic gneiss (age uncertain)—Highly schistose, biotite-muscovite (±chlorite) pathic mylonite and mylonitic gneiss mapped near Brandon Gap; in the Pine South Londonderry Igneous Suite (Middle and Early Mesoproterozoic) (1,393±9 Ma to 1,309±6 Ma) Ludlow Mountain granodiorite gneiss (Middle Mesoproterozoic)—Light-gray, edium- to fine-grained garnet-biotite-microcline-perthite granodiorit magnetite-studded white aplite, and kyanite-tourmaline pegmatite. Conta ¹rs), and calc-silicate rocks on Ludlow Mountain. U-Pb zircon SHRIMP age o 1,309±6 Ma, no. 9 (Aleinikoff and others, 2011)

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

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

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)

(1,149±8 Ma to 1,119±3 Ma)

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

the identification of primary emplacement relations. For example, the bound and distinction between the Bird Mountain and Giddings Brook slices is particu 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 descriptive purposes (see Zen, 1961, 1964, 1967). Ofh Forbes Hill conglomerate and breccia in the Ira and Hortonville Formations (Upper Ordovician)—Black slate containing angular to irregular chips of green gray to yellowish-gray slate, quartz wacke, and limestone; interpreted by Zen (1961) as sedimentary wildflysch Vesicular basalt breccia at East Hoosick (Upper Ordovician)—In the Walloomsac Formation; perhaps intrusive Whipstock Breccia in the Walloomsac Formation (Upper Ordovician)—Largely a tectonic breccia formed in situ; contains abundant pseudo-pebbles 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 slate, wacke, and punky-weathering bluish-gray limestone, interpreted as sedin 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 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 compositional layering. Units are retained although interpretation as sedimentar wildflysch deposits is in part questionable

THE TACONIC ALLOCHTHON Five structural slices of the Taconic allochthon in Vermont (Zen, 1961, 1972; Potter, 1972) contain rocks ranging in age from Neoproterozoic to Ordovician. The lowermost slices, the Sunset Lake, Giddings Brook, and North Petersburg slices, contain the complete stratigraphic range whereas the higher and more easterly Bir Mountain and Dorset Mountain slices are inferred to contain largely Cambrian and Neoproterozoic rocks and to exhibit different facies from those of the lower slices tructural boundaries among the slices are commonly late post-e imbricate thrust faults, thus complicating both the inferred stacking sequence a

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

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

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

Contains thin belts of amphibolite and calc-silicate gneiss

coarse-grained garnet-biotite-plagioclase-quartz schist EARLY TO LATE TACONIAN ACCRETED TERRANE OF THE ROWE-HAWLEY ZONE Eastern allochthonous sequence, oceanic and accretionary realm, ultramafic inclusions, volcanic-arc intrusives, and volcanic rocks 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 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 Pelitic schist—Silvery-gray, medium-grained schist composed of white mica, quartz, chlorite (±garnet±albite±glaucophane±chloritoid); local centimeter-thick 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 gneiss at the base of the Belvidere Mountain Structural Complex

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

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

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,

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

Biotite-plagioclase schist and gneiss member—Gray and light-gray-weath-CONNECTICUT VALLEY TROUGH gneiss, commonly flecked with large cross-biotite. Locally contains coarse garne Gile Mountain Formation (Lower Devonian) Cooper Hill Member—Dark-gray or green, dull-gray- and rusty-weathering slabby, well-foliated, quartz-rich muscovite-biotite-plagioclase-quartz schist, Gile Mountain Formation, undivided—Shown in cross section only garnet schist, and splintery chlorite-chloritoid-muscovite-plagioclase (±garnet)-quartz schist, with minor feldspathic biotite gneiss. Unit noncarbona-Quartzite and metapelite member—Gray to light-gray, fine-grained ceous and atypical of the Ottauquechee Formation except for minor layers of micaceous quartzite a few centimeters to tens of centimeters thick, interbedded with dark-gray graphitic slate, phyllite, or schist Meetinghouse Slate Member—Dark-gray slate and phyllite containing sparse o moderately abundant beds of light-gray, fine-grained metasandstone and containing thin beds of dark-bluish-gray vitreous quartzite. Restricted to occurrence in £Zrch, along the base of the major amphibolite above £Zi and within amphibolite at a structurally high position within the Rowe Sch Felsic metavolcanic member—Very light gray, fine-grained porphyritic near the Massachusetts State line. Closely resembles rocks typical of the Ottauquechee Formation but at a different structural or stratigraphic level netafelsite schist or granofels near Maidstone Lake. Groundmass recrystallize to an aggregate of quartz, microcline, plagioclase, biotite, muscovite, and Chlorite schist member—Rusty-gray- to yellowish-brown-weathering, lustrous apatite: grain size about 0.05 mm. Relict phenocrysts of embayed quartz. 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 glomerate, commonly having abundant dark-gray pelitic matrix interlayered vith sandstone, pelite, and porphyritic rhyolite (Dgmr). Conglomerate contains rounded clasts of rhyolite, fine-grained granitoid, and angular clasts of dark-gray slate. Correlative with Halls Stream Grit Member of the Ironbound Mountain Formation (of Myers, 1964) to the north Quartz-pebble metaconglomerate member—Thin lens of metadiamictite of the Meetinghouse Slate Member (Dgm), south of Bradford

viotite-muscovite feldspathic quartzite and muscovitic quartz schist

garnetiferous variant (Omgt)

ultramafic rocks in Roxbury

amphibolite and dark-gray quartzite

muscovite-chlorite-quartz phyllite

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

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-

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

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

non-carbonaceous, well-foliated chlorite-quartz-muscovite (±plagioclase) schist Garnet-biotite feldspathic schist member—Dark-grayish-brown-weathering, Rhythmically graded member—Light- to medium-gray, fine-grained micaceous quartzite to dark-gray muscovite-quartz-biotite carbonaceous phyllite 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 decrease in thickness of quartzite beds Amphibolite member—Hornblende amphibolite and hornblende-plagioclasequartz granofels; interpreted as metabasaltic and volcaniclastic rocks

114±4 Ma, no. 40, and 412±2 Ma, no. 41 (Lyons and others, 1997; Moench and gneiss; forms sills in overlying Ammonoosuc Volcanics

Biotite-quartz diorite gneiss of Vernon dome (Late Ordovician)—Light-gray, vell-foliated subporphyritic biotite (±hornblende)-quartz diorite and trondhjemite Highlandcroft Plutonic Suite (Early Silurian to Middle Ordovician Epizonal to mesozonal, foliated and metamorphosed (greenschist facies) plutons exposed northwest of the Ammonoosuc fault. Compositions range from granite to diorite to lesser amounts of gabbro Lost Nation granite—Foliated biotite and (or) hornblende granite; locally diorit 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 Granodiorite of Billings (1935, 1937)—Medium-greenish-gray to dark-greenish-gray, medium-grained, foliated metamorphosed granite, granodiorite, and tonalite containing quartz, microcline, saussuritized plagioclase, Nonconformably overlain by the Clough Quartzite and Fitch Formation. U-Pb zircon age of 450±5 Ma, no. 28 (Lyons and others, 1986) 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, 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) Oliverian Plutonic Suite (Late Ordovician) Hornblende metagabbro—Dark-green, coarse-grained, well-foliated hornblende-andesine metagabbro Oobg Biotite granite—Pink, medium-grained muscovite-biotite-microcline-perthite granite and gneissic granite, and aplite of the Lebanon dome Granodioritic to quartz dioritic gneissic border phase of Oobg, perhaps in part Stratified rocks of the Bronson Hill arch and Sawyer Mountain belt Littleton Formation (Lower Devonian)—Medium-dark- to dark-gray slinterlayered with light-gray fine-grained micaceous quartzite: in southeaste

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 microcline phenocrysts. U-Pb zircon age of 407.5±3.9 Ma, no. 44 (Rankin Metamorphosed mafic volcanic rocks Fitch Formation (Lower Devonian and Upper Silurian)—Metamorphosed nestone, calcareous sandstone, siltstone, and pelite. Some limestone conglom ate and polymict conglomerate with calcareous matrix. Locally equivalent t Madrid and Smalls Falls Formations in Chesterfield, N.H., area Sawyer Mountain Formation (Devonian and Silurian)—Greenish-gray

strongly foliated felsite Clough Quartzite (Lower Silurian)—Quartzite and quartz-cobble metaconglom Skitchewaug Mountain, upper quartzite (Scq) and lower conglomerat abundant dark-gray phyllite matrix that resembles phyllite of the Littleton Formation Partridge Formation (Upper Ordovician)—Dark-gray to grayish-black, rusty-weathering sulfidic slate and phyllite interlayered with felsic volcanic rocks and tuffs, and amphibolite (Opa) Metarhyolite—Greenish-gray, light-bluish-gray, or medium-bluish-gray me 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 lava. Sedimentary protoliths include dark-gray sulfidic shale, ironstone siltstone, graywacke, volcanic conglomerate, and rare limestone Greenish-gray, light-bluish-gray, or medium-bluish-gray metarhyolite tuff, lapilli

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

tuff, tuff breccia, and lava. Generally porphyritic with 5 to 20 percent plagioclase and, in some places, quartz phenocrysts. Generally strongly foliated with waxy sheen on foliation surfaces ark-greenish-gray to medium-bluish-gray metamorphosed andesitic an basaltic tutt, crystal tutt, and tutt breccia; minor pillow lava. Commonly contains plagioclase and (or) altered mafic phenocrysts

Investigations Map 3184, 3 sheets, scale 1:100,000. GIS database compiled by Gregory J. Walsh and Marjorie H. Gale Digital cartography by Linda M. Masonic Edited by James R. Estabrook The Vermont Geological Survey would like to thank former State Geologists Charles Ratté for initiating State support and Diane Conrad for continued world

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