U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Preliminary Bedrock Geologic Map of the Saxtons River 7.5 x 15-minute quadrangle, Windham and Windsor Counties, Vermont

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Open-File Report 95-482

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1995

DESCRIPTION OF MAP UNITS

(major minerals listed in order of increasing abundance)

Kfd — Felsic dike (Cretaceous)--Light-gray to pinkish-tan-weathering, very fine-grained, blocky-fractured, felsic dike, texture suggests presence of devitrification structures and spherulites

Dg — Granite dikes (Devonian)--Light-gray- to whitish-gray-weathering, medium-grained, weakly foliated to nonfoliated, biotite-muscovite and plagioclase-rich granite, commonly with finer grained borders

Dp — Pegmatite (Devonian)--Pinkish-gray to whitish-gray weathering, muscovite granite pegmatite that occurs in irregular discordant masses

Cover Sequence of the Chester-Athens dome

Waits River Formation (Devonian and Silurian)--

DSw — Schist member--Dark-gray to light-steel gray, brown-weathering, patchy carbonaceous, garnet-chlorite-plagioclase-quartz ± biotite ± epidote ± carbonate schist and phyllite. 1 to 5 mm garnets occur throughout unit and are commonly larger (5 to 10 mm) near 1- to 30-m-thick discontinuous beds of gray to brown, punky weathering, muscovite-epidote-plagioclase-carbonate-chlorite ± garnet ± biotite calc-silicate rock

DSwf — Felsic volcaniclastic member--Purplish-gray to light-creamy-gray, 1- to 5-m-thick beds of biotite-chlorite-muscovite-quartz-plagioclase ± carbonate ± garnet granofels and grits with 1- to 10-mm-thick laminations of carbonaceous schist between granofels beds. Unit comprises 30- to 150-m-thick zone that includes structurally lowest to highest beds of granofels. Coarse interlocking plagioclase and quartz grains may be relict, and detrital. Individual beds range in thickness from 5 cm to 2 m. Occurs within Waits River schist member (DSw)

DSwq — Quartzite member--Light-steel-gray- to light-gray-weathering, dark-gray, muscovite-chlorite-plagioclase-quartz quartzite. Occurs within schist member (DSw) as 10- to 25-m-thick zone of 0.5- to 3-m-thick quartzite beds within thin (1 mm to 1 cm) carbonaceous schist laminations. May contain detrital blue quartz grains. Unit occurs in both upper and lower parts of the formation

DSwg — Garbenschiefer member--Silvery-gray- to light-gray-weathering, epidote-muscovite-biotite-chlorite-garnet-hornblende-quartz-plagioclase schist with very distinctive 1 to 3 cm sprays of hornblende and clusters of 1 to 10 cm garnets. Unit is interlayered with carbonaceous schist (DSw) and volcaniclastic rocks (DSwc, DSwvf, DSwv)

DSwc — Rusty felsic volcanic member--Rusty-brown-weathering, tan colored, fine-grained, ilmenite-chlorite-muscovite-quartz-plagioclase schist, characterized by heterogeneous rusty weathering on foliation surfaces. Unit commonly overlies or is interlayered with garbenschiefer (Dswg) and mafic volcaniclastic member (DSwv)

DSwv — Mafic volcaniclastic member--Light- to dark-gray and bluish-gray, coarse- to fine-grained, plagioclase-spotted, muscovite-biotite-quartz-chlorite-hornblende-plagioclase$\pm$garnet schist and gneiss with distinctive 5- to 20-cm-thick laminations of hornblende-present and hornblende-absent layers. Hornblende commonly forms distinctive 1 to 2 cm sprays or fascicles on foliation surface. Rock is locally characterized by 2 to 5 mm plagioclase megacrysts (microlites?) which may have a volcanic origin. Unit is locally interlayered with amphibolite (DSwa), rusty volcanics (DSwc), garbenschiefer (DSwg), and felsic volcanics (Dswvf) members

DSwvf — Felsic volcanic member--Light-gray to bluish-gray-weathering, cream-colored, fine-grained, muscovite-quartz-chlorite-plagioclase schist and gneiss with distinctive 1 to 3 mm plagioclase crystals. Unit is not well layered and bedding is indistinguishable. Unit is lighter colored than DSwv. Locally interlayered with garbenschiefer (DSwg), and amphibolite (DSwa)

DSwa — Amphibolite member--Dark-green, fine-grained, laminated, epidote-carbonate-hornblende-chlorite-plagioclase gneiss (amphibolite) with laminations 1 to 4 mm thick of carbonate-chlorite and plagioclase. Discontinuous laminations are parallel to foliation. Contacts with surrounding units are sharp

DSwmg — Mafic gneiss member--Blue-gray to dark-green, coarse-grained, weakly foliated, massive epidote-chlorite-plagioclase-hornblende gneiss, possibly of intrusive origin. Intergrowths of hornblende with plagioclase are ubiquitous, forming a possible replacement for relict ophitic texture. Contacts with surrounding DSwa amphibolite are sharp

Northfield Formation (Devonian and Silurian)

DSn — Schist member--Gray- to dark-gray, carbonaceous, plagioclase-garnet-chlorite-quartz-muscovite-quartz$\pm$carbonate$\pm$epidote schist and phyllite with 1 to 6 mm garnet porphyroblasts that produce distinctive "bumps" on foliation surfaces. Locally includes thin, discontinous, 10 cm- to 1-m-thick vitreous, white to light gray quartzite layers with abundant 0.5 to 1.5 mm detrital blue quartz grains and rare, discontinuous beds of quartz pebble conglomerate 1 m thick. Pebbles are typically flattened. The member is typically interlayered with garnet-bearing sulfidic schist near and along its western extent; locally contains thin, 1 cm- to 5 cm-thick tan, sulfidic, plagioclase schist layers within this zone which display graded bedding

DSnq — Quartzite Member--Thin, discontinuous, 10 cm- to 1 m-thick vitreous, white to light-gray quartzite layers with abundant 0.5 to 1.5 mm detrital blue quartz grains and rare, discontinuous beds quartz-pebble conglomerate 1 m thick. Pebbles are typically flattened. Quartzite unit is identical to unit previously mapped as Shaw Mountain Formation by Doll and others (1961) and as Russell Mountain Formation by Hepburn and others (1984) in this region

DSng — Grit member--Medium- to dark-gray, steel-gray-weathering, biotite-plagioclase-quartz granofels, impure quartzite and minor quartz-pebble conglomerate, occurs near base of unit interbedded with layers of schist or phyllite; thickness varies from 0 to 10 m

Metasedimentary Metavolcanic Rocks (cover sequence rocks)

COVER SEQUENCE ROCKS OF THE CHESTER AND ATHENS DOME

Cram Hill Formation (Ordovician)

(c denotes coticule in all units)

Cram Hill Formation east of the Athens dome in Cambridgeport and Rockingham

Ochvg — Volcanics and volcaniclastic member--Light-gray to medium-gray, massive, medium- to coarse-grained, epidote-chlorite-quartz-plagioclase granofels and felsic gneiss with several 0.5 to 2 m-thick layers of medium- to dark-green, fine-grained, epidote-hornblende-plagioclase-chlorite-amphibolite. Both rock-types may have either a volcanic or volcaniclastic origin. Foliation-parallel layering appears to be bedding. Unit is locally intruded by dikes of light to medium-green, massive, epidote-ilmenite-sphene-chlorite-hornblende-plagioclase-pyrite$\pm$calcite amphibolite, too thin to portray on the map, but identical to the Whitneyville Facies of the Branch Brook Dike and Sill Complex, in southern Vermont

(Armstrong, 1994). The dikes commonly contain a porphyritic to glomeroporphyritic texture defined by fine-grained groundmass and 3 to 10 mm euhedral, tabular, and anhedral plagioclase metacrysts (metamorphosed phenocrysts) which comprise 5 to 50 volume percent of the entire rock. Typically occurs as a series of anastomosing dikes or sills which show 1 mm- to 100 cm-thick, fine-grained, relict chilled margins, defined by progressive allotriomorphic texture and absence of plagioclase metacrysts

Och — Schist member--Homogeneous, rusty- and tan-weathering, dark- to light-gray, pyritiferous ilmenite-muscovite-chlorite-plagioclase-quartz ± garnet ± staurolite schist

Ochb — Black quartz-phyllite and ironstone member--Dark-gray- to dull-black-weathering very fine grained, siliceous phyllite and phyllitic metasiltstone(?). Forms thin beds of splintery, highly fractured rock, contains beds of pale gray-green- to steel-gray-weathering sulfidic cummingtonite-magnetite-plagioclase-quartz amphibolite as much as 3 m thick. Discontinuous very rusty, manganiferous garnet quartzite, ironstone, and pinkish layers of coticule 1 to 2 cm thick

Ochg
Ochag — Greenstone member--Medium-green to gray-green, highly foliated, hornblende-plagioclase-greenstone, marked by distinctive irregular, clots, or indistinct patches of more plagioclase-rich inclusions as much as 3 cm in length set in a more uniform amphibolite matrix giving rock a fragmental appearance. Passes into zones of highly ankeritic greenstone; one prominent zone near base, mapped as Ochag, contains lens of buff gray- to orangish gray-weathering dolostone, quartzite and coticule. Greenstone interpreted as basaltic to andesitic tuff breccia and volcaniclastic rock

Ochc — Quartzite and coticule member--Discontinuous beds and zones of gray- to light-gray weathering quartzite, quartz-pebble conglomerate and well-bedded feldspathic granofels and coticule, as much as 2 m thick, but commonly 0.5 to 1 m thick interbedded in Ochm or Ochg at or near their mutual contact

Ochhg — Hornblende-plagioclase-quartz granofels member--Light-gray-weathering, medium- to coarse-grained, garnet-biotite-hornblende-plagioclase-quartz granofels, marked by abundant sprays of large hornblende as much as 5 cm in length, interbedded with layers of biotitic amphibolite and hornblende-garnet amphibolite. The coarseness of the hornblende and grain size of plagioclase in granofels distinguishes this unit from similar hornblende fascicle granofels and schist in the Moretown Formation; unit resembles the Marlboro member of the Cram Hill Formation of Armstrong (1994)

Ochfg — Feldspathic granofels member--Medium- to dark-gray, well-bedded, biotite-quartz-plagioclase granofels, biotite schist, minor amphibolite and hornblende fascicle schist. Unit gradational with Ochhg through interbedding

Ochgs
Ochq — Papery thin schist and phyllite member--Pale gray-brown- to whitish tan-weathering, fine-grained, biotite-garnet-muscovite schist and carbonaceous phyllite. Unit contains beds rich in tiny 1- to 2-mm diameter garnets that are similar to garnet-rich phyllites of the Northfield Formation. Passes laterally into a darker gray- to slightly rusty-weathering siliceous phyllite or schist that contains discontinuous layers of steel-gray quartzite. Locally unit contains a distinctive, steel-gray- to yellow-tan-weathering quartzite and quartz-pebble conglomerate (Ochq) as much as 2 m thick, that closely resemble a conglomerate unit (Ochc) in the upper part of the Cram Hill Formation. Unit Ochgs closely resembles phyllite

and schist in the Whetstone Hill Member of the Mississquoi Formation of Doll and others (1961). Unit is gradational into Ochv

Ochv — Felsic and mafic volcaniclastic member--A heterogeneous unit consisting of well-layered, light-gray-weathering, felsic biotite-hornblende-quartz plagioclase gneiss intimately interlayered with darker gray-green hornblende-biotite-plagioclase amphibolite and hornblende-plagioclase granofels and gneiss. The proportion of felsic to mafic layers varies greatly and the thickness of the mafic layers which are generally subordinate, range from one to several meters in thickness. The rusty weathering-biotite-muscovite-quartz schist, feldspathic granofels and layers of coticule present throughout indicate a collection of volcaniclastic rocks and interbedded metasediment, for this reason unit is interpreted as a member of the Cram Hill Formation. Contact relations with underlying units uncertain, may disconformably overlie both the Moretown Formation and metatrondhjemite (Ontr) of the North River Igneous Suite. The same unit locally occur at or near the base of the Cram Hill Formation in the Spring Hill area

Ochf — Biotite-plagioclase granofels and schist member--Rusty-brown to gray-weathering, medium-grained, chlorite-hornblende-muscovite-biotite-quartz-plagioclase granofels with conspicuous 5 mm to 3 cm long hornblende porphyroblasts. Similar to Omfg unit

Cram Hill Formation in the Spring Hill syncline

Ochfs — Feldspathic schist and granofels member--A heterogeneous unit consisting of medium- to dark-gray-weathering, biotite-muscovite-plagioclase-quartz granofels, and dull-gray-weathering carbonaceous schist and coarse-grained, silvery gray, muscovite-spangled, quartz-knotted garnet-biotite-plagioclase quartz schist

Ochmc — Magnetite coticule member--Light pinkish- to purplish-gray-weathering, very fine-grained and finely-laminated, magnetite-hornblende-quartz-garnet coticule, contains magnetite-rich layers 1-2 cm thick, and passes laterally into yellow-gray weathering garnetiferous quartzite too thin to map or Ochfs. Contact with underlying Ocha is sharp

Ocha — Amphibolite member--Dark-green to black, coarse- to medium-grained hornblende-plagioclase amphibolite, coarser grained varieties have chunky hornblende 1-2 cm in length and distinctive white, rectangular to elipsoidal patches of plagioclase .2 to .7 cm in length, possibly relict phenocrysts. Finer grained varieties, are imperfectly layered and contain thin layers of very dark- gray biotite-plagioclase-quartz granofels. Unit interpreted as collection of basaltic lava flows or thick sills

Ochag — Ankeritic greenstone member--Medium-dark green to pale-green, chloritic, ankerite-pitted hornblende-plagioclase amphibolite. Locally contains layers, pods or knots of calcite and dolomite as much as 10 cm thick

Ochc — Coticule and quartzite member--Yellow-gray to tan-weathering-garnetiferous quartzite and laminated pinkish-gray coticule in thin layers 0.5 to 1 m thick in discontinuous layers within Ocha

Ochgs — Garnet schist member--A light-yellowish-gray to dark-gray, fine-grained carbonaceous schist or phyllite having 1 mm garnets that produce a distinctive bumpy texture to the otherwise very fine-grained silvery-gray to dark-gray muscovitic-rich foliation surfaces. Passes laterally into similar schist (Ochs) lacking abundant garnets

Ochs — Schist member--Dark-gray- to rusty-weathering, carbonaceous, fine-grained, biotite-rich, muscovite-biotite-quartz schist, locally sulfidic and containing rusty-weathered, slabby layers of biotite amphibolite too thin to map and layers of medium-gray feldspathic biotite granofels similar to Ochfg

Ochq — Quartzite and quartz-pebble conglomerate member--Discontinuous lenses of yellow-tan- to gray-weathering muscovite quartzite and quartz-pebble conglomerate, 1 to 2 m thick, interbedded in Ochgs, or Ochs at or near the contact with Ocha or Ochfg

Ochra — Rusty-weathering amphibolite member--Dark gray-brown to rusty-brown weathering, hornblende amphibolite and layered sulfidic splintery biotite schist and plagioclase-hornblende-biotite granofels

Ochv — Felsic and mafic volcaniclastic member--Unit same as described for the Cram Hill Formation in the Rockingham and Cambridgeport area

Ochbg — Feldspathic biotite granofels and gritty biotite schist member--Dark-gray to dull-steel-gray weathering, biotite-spotted or -flecked, medium-grained biotite-plagioclase-quartz granofels and gritty schist, locally contains coarser grained more quartz-rich layers of feldspathic grit and minor layers of quartz-rich amphibolite and dull-whitish gray quartzite in layers as much as 0.5 m thick

Intrusive rocks of the North River Igneous Suite (Ordovician)

Ontr — Trondhjemite gneiss--Light-gray- to chalky-white-weathering, massive medium-grained, biotite$\pm$garnet-quartz-plagioclase gneiss. Lacks mafic layers present in Ochvc member of the Cram Hill Formation and is interpreted as intrusive into Omgg, Omhg and Oml members of the Moretown Formation

Ont

Tonalite gneiss member--Medium-gray- to gray-green-weathering, medium-grained, hornblende-biotite tonalite, tonalitic gneiss and biotite tonalite, contains distinctive layers or zones of darker colored hornblende-biotite metabasalt, or metabasaltic andesite or mafic dikes that contain irregularly shaped, white weathering segregations of glomeroporphyritic plagioclase. Unit contains ovoidal patches of white-weathering biotite trondhjemite as much as 0.5 m in diameter and more indistinct plagioclase-rich inclusions 0.5 to 1 cm in diameter throughout the tonalite host. The more mafic dikes or enclaves, and the felsic inclusions suggest a comagmatic association of mafic, intermediate, and felsic plutonic to subvolcanic rocks. Unit is overall, intrusive into Oml of the Moretown Formation

Onrg

Ruger Hill tonalite gneiss member--Light- to medium-gray-weathering, coarse- to medium-grained, hornblende tonalite and interlayered biotite tonalitic gneiss which intrude 0.5 to 2 m-thick layers of green, hornblende-biotite-plagioclase-chlorite amphibolite (metabasalt), dark gray to greenish-gray, well bedded, biotite-chlorite-muscovite-quartz-plagioclase gneiss (meta-andesite). Tonalites and host rocks are cut by distinctive, dark green, mafic dikes that contain irregularly shaped, white weathering segregations of glomeroporphyritic plagioclase. Unit contains ovoidal patches of white-weathering biotite trondhjemite (Ontr) as much as 0.5 m in diameter and more indistinct plagioclase-rich inclusions 0.5 to 1 cm in diameter throughout the tonalite host. This entire complex of metaigneous rocks contains several large screens of garnet schist and granofels of the surrounding Moretown Formation (unit Omgs)

Ultramafic Rocks

OZu
OZt

Talc and talc carbonate rock and serpentinite (Ordovician Cambrian or Late Proterozoic)--Massive to well foliated serpentinite (OZu), locally exhibiting replacement of orthopyroxene or olivine, or massive serpentinite without any trace of relict pseudomorphic structure, confined to the core regions of the large bodies of ultramafic rock, or well foliated talc-serpentinite $\pm$ carbonate rocks (OZt) found as small lenticular to tabular bodies within schist or as margins or tails of larger masses of serpentinite. Numerous abandoned quarries are present in the area. The Hamm Quarry is currently active. Interpreted as tectonic blocks of dunitic to harzburgitic rocks or locally as bedded serpentinite-talc deposits in the Moretown Formtion at or near its contact with other units

Moretown Formation (Ordovician)

East and west of the dome

Omgs
Omfq

Garnet schist and granofels member--Light-gray- to gray-green-weathering, garnet-biotite-chlorite-muscovite-quartz schist and schistose biotite-garnet-plagioclase-quartz granofels, contains discontinuous light-tan-weathering, thinly layered muscovite-biotite plagioclase quartzite (Omfq) near base

Omd

Hornblende-plagioclase dioritic amphibolite--Medium-grained, black and white spotted, dioritic appearing amphibolite consisting of subequal amounts of hornblende and plagioclase having a crude diabasic appearing texture that results from growth of metamorphic hornblende, either a dike or recrystallized intermediate volcanic rock

Omhg — Hornblende granofels and schist member--Light-gray-green, lustrous, chlorite-biotite-muscovite-quartz schist containing abundant layers of dark-gray garnet-hornblende amphibolite and garnet-biotite-hornblende-plagioclase granofels layers commonly 0.1- to 0.5-m-thick, unit interbedded and gradational into Oml below and Omgg above and laterally into OMa

Oma — Amphibolite member--Varies from dark-green, fine-grained, epidote-knotted well-foliated plagioclase-hornblende amphibolite to a more plagioclase-rich and coarser-grained, spotted amphibolite, both are mapped in the cover sequence west of the Chester dome. Occurs throughout Omhfs and in Omgs, correlation with similar amphibolites in the eastern cover sequence east of the dome uncertain but the lowermost amphibolite west of the dome is in the same structural position as amphibolite Oma? east of the dome and the two may be correlative

Oma? — Amphibolite member--Possibly the same as Oma west of the dome

Oml
Omq — Laminated feldspathic quartzite member--Light-gray- to whitish-gray-weathering, pinstriped, muscovite-chlorite-biotite-plagioclase quartzite and quartz-plagioclase granofels (Oml); distinctive more quartzofeldspathic layers are separated by 1 to 0.5 mm layers richer in muscovite, biotite and chlorite which parallel a strongly developed transposition schistosity; locally beds of vitreous quartzite (Omq) range from 1 to 3 cm thick to less common well bedded layers as much as 1 m thick

Omfg — Feldspathic granofels and schist member--Medium-dark-gray, well-layered biotite-quartz-plagioclase granofels containing abundant thin layers 1 to 2 cm thick of hornblende-plagioclase-quartz granofels and garnet-chlorite muscovite-biotite-plagioclase-quartz schist

Units present only in Moretown Formation west of Chester dome

Omhs — Hornblende fascicle schist member--Light-gray to gray-green, chlorite-muscovite-biotite-plagioclase-quartz schist and granofels marked by conspicuous sprays of hornblende and distinctive, large 5 mm to 1 cm porphyroblasts of cross-foliation biotite, abundant irregular layers of coticule 1 to 2 cm in thickness, and abundant layers of pinstriped light-gray biotite-quartz granofels like Oml. May be correlative with Omhg and Oml east of the dome

Omhfg — Hornblende feldspathic granofels member--Light-greenish-gray-weathering, hornblende-chlorite-muscovite-biotite-quartz-plagioclase granofels containing distinct fascicles of actinolite, magnetite and chlorite replacing hornblende set in a medium-grained equigranular matrix of plagioclase, quartz, chlorite, and biotite; unit grades into Oml and Oma through interbedding

Omhgs — Hornblende-garnet schist member--Very coarse-grained, large-garnet and hornblende schist, biotite-muscovite-quartz schist, gradational with Omhfg, Omhs, and Oma

Ombs Ombq — Biotite schist member-A heterogeneous unit consisting of dark gray, sooty weathering sulfidic biotite-quartz-plagioclase ± garnet-quartz schist; unit contains abundant thin beds of pinkish gray, 1 cm-thick small garnet quartzite or coticule beds and dark gray to tan feldspathic quartzite (Ombq) as much as 1 m thick. Quartzite may be dark gray and vitreous or very feldspathic, deeply pitted and yellowish-tan-weathering, especially where associated with talc schist and talc-carbonate rock (OZt). Locally at or near amphibolite (Omba), the schist is very dark gray, carbonaceous and quite sulfidic and contains abundant layers of coticule

Omba — Biotite schist and amphibolite member--Dark-green to rusty-brown, punky-weathering, hornblende-plagioclase amphibolite and schist, occurs at or near the contact with Oml and Omgs, locally contains magnetite-rich layers 1 to 3 cm thick and associated thin layers of coticule

Rowe Schist (Cambrian)

Ɛrgt — Coarse garnet schist member--Yellow-gray to slightly rusty-tan weathering, coarse-grained, garnet-biotite-muscovite-plagioclase-quartz-schist, contains large euhedral garnets as much as 3 cm in diameter and accessory kyanite, and or staurolite. Occurs as lenses in two structural positions on the west flank of the dome, where it is normally in contact with amphibolite (Ɛra). Similar coarse-grained garnet schist occurs, associated with amphibolite and feldspathic schists, in the southwestern part of the map. Garnet schist in the Stowe (Ɛsgt) tends to be, more feldspathic and less pinstriped, less muscovitic and more biotitic than Ɛrgt. The one belt of garnet schist, Ɛrgt mapped east of the dome is not as coarse-grained, is more rusty weathering and more biotitic than west of the dome

Ɛra — Amphibolite member--Dark-green to almost black, medium- to fine-grained, plagioclase-hornblende amphibolite, commonly strongly folded, foliated and containing pods and veins of epidote, especially near contacts

Ɛrs — Chlorite schist member--West of the dome a fine-grained, chlorite-muscovite quartz-schist, with or without magnetite, often containing abundant knots or eliptical pods of polygranular quartz on east of the domes, a very-fine grained, pale-lustrous green, phyllonitic chlorite-quartz-muscovite schist, with minor cross biotite, interpreted as a mylonitic variety of OƐrs

ϵrfb — Feldspathic biotite schist and granofels member--Light- to medium-dark gray, medium-grained, biotite-quartz-plagioclase schist or granofels, containing abundant biotite and little chlorite

ϵrcf — Rusty carbonaceous feldspathic schist member--Medium-dark-gray weathering, slightly rusty-weathering muscovite-biotite-quartz-plagioclase schist and granofels, contains tiny porphyroblasts of plagioclase and widely scattered carbonaceous patches, overall quite feldspathic and granulose

ϵrch — Cooper Hill Member--Medium to dark gray, feldspathic, muscovite-chlorite biotite-plagioclase-quartz schist, locally a splintery gray-green, more chloritic quartz schist with or without small scattered garnet, not notably carbonaceous

ϵrr — Carbonaceous rusty schist member--Dark-gray, fine-grained phyllite or biotite carbonaceous schist, associated with thin beds of rusty weathering amphibolite, schist commonly has yellow sulfidic weathering stains and minor thin layers of gray feldspathic quartzite as much as 0.5 m thick

Stowe Formation (west of the dome) (Ordovician and Cambrian)

(may be equivalent to all or part of the Rowe Schist resting on the domes)

Oϵsgt — Garnet schist and granofels member--Light-gray to rusty-gray-brown weathering, somewhat pinstriped or laminated chlorite-muscovite-biotite-spotted, garnet-plagioclase-quartz schist or granofels; has large 1 to 2 cm poikiloblastic garnets and distinctive cross biotite, may pass into a more muscovite-rich large garnet-schist near amphibolite Oϵsa

Oϵsg — Chlorite schist member--Pale-green, to yellow-green, lustrous, fine-grained, biotite-chlorite-muscovite-quartz schist, with or without magnetite and small garnets. Overall unit indistinguishable from Oϵrs except for the presence of abundant porphyroblasts of biotite in the Stowe chlorite schist member

OЄsa — Amphibolite member--Either dark-green finely foliated, plagioclase-hornblende ± epidote amphibolite, or a pale-green, chloritic and ankeritic-pitted greenstone. The latter occurs near the top of the unit and is associated with coarse garnet schist OЄsgt

Ottauquechee Formation (Cambrian)

Єo — Schist member--Predominantly, dark gray to sooty gray-black weathering, fine-grained sulfidic, carbonaceous biotite-muscovite-quartz schist or phyllite, distinctly fissil and deeply weathered. The one belt of rocks that enters the quadrangle from the north probably is coextensive with the type Ottauquechee Formation in the Plymouth area

Єoa — Amphibolite member--Dark-green to rusty-brownish-green weathering, finely foliated, slabby, fine-grained amphibolite

Єoq — Quartzite member--Light steel-gray vitreous quartzite, occurs at one locality approximately 1 km north of Lawrence Four Corners in a fault slice

Pinney Hollow Formation (Cambrian)

Єph — Light-greenish-gray to pale-green-lustrous fine-grained, chlorite-muscovite-quartz schist ± magnetite chloritoid and minor garnet, unit resembles unit OЄs of the Stowe Formation but lacks the interbedded feldspathic rocks and abundant cross biotite prevalent in the Stowe. Unit is coextensive to the north with Pinney Hollow Formation at its type locality in the Plymouth Quadrangle. To the south unit is coextensive with rocks mapped the Єrs member of the Rowe Schist(?) (Ratcliffe, 1995)

Hoosac Formation (Cambrian and Late Proterozoic)--

ϵZhgab — Green albitic member--Light-greenish-gray-weathering, medium-grained chlorite-biotite-muscovite, white-albite-studded quartz granofels and magnetite-albitic granofels. Unit grades into a grayer variety that contains less chlorite and more biotite

ϵZhrab — Rusty-weathering albitic schist--Predominantly slightly rusty weathering muscovite-biotite-quartz schist and dark-gray biotite-muscovite-albite granofels; unit similar to ϵZh but contains more muscovite, is more schistose and more poorly bedded than ϵZh

ϵZhtm — Turkey Mountain Member--Dark-green to black calcite-epidote-chlorite-actinolite-plagioclase greenstone or hornblende$\pm$garnet-plagioclase amphibolite, locally interbedded with surrounding units, contains thin silty to sandy epidote and magnetite laminated graywacke. Interpreted as basaltic lava flows and volcaniclastic beds

ϵZh — Hoosac Formation undivided--A heterogeneous unit consisting mainly of dark-gray to medium-light gray-weathering, white plagioclase-studded schist and granofels, gray slabby quartz-rich muscovite-biotite schist and rare layers of dark-gray quartzite. East of the Chester dome unit tends to be more schistose, less-well bedded and more rusty weathering perhaps the result of deformation or due to facies changes

ϵZhab — Gray albite granofels member--Light-gray to medium-gray-weathering biotite-plagioclase-quartz granofels, locally distinctly well bedded on a 0.5 m to 1 cm scale, and marked by an abundance of white porphyroblasts of albite making up as much as 60 percent of the rock

€Zhc — Conglomerate and grit member--Light-gray, biotite-albitic-quartz-pebble conglomerate containing finer grained beds of quartzite having 1 to 2 mm grains of subrounded bluish quartz. Unit recognized at three localities along the base of the Hoosac at the Mount Holly contact

€Zhgt — Chlorite-garnet-muscovite-plagioclase schist member--Light-gray to lustrous-gray-green, rusty weathering, chlorite-garnet-muscovite-plagioclase schist, having large 1- to 2 cm diameter deep-red garnets, abundant accessory tourmaline and variable amounts of biotite, passes laterally into a very plagioclase-rich garnet bearing-biotite-plagioclase-quartz granofels

€Zh? — Hoosac Formation(?)--A light-gray to medium-dark-gray weathering, strongly foliated, muscovite-biotite-plagioclase-quartz granofels and mylonitic granofels located at or near contact with the Bull Hill Gneiss along the eastern margin of the Chester dome. Locally unit is gradational, through decreasing mylonitization into the Bull Hill Gneiss and unit may be entirely or in part derived by mylonitization of the Bull Hill Gneiss and other non-identifiable units of the cover sequence east of the Chester dome, here assigned provisionally to the Hoosac Formation as indicated by the querry mark

CORE ROCKS OF THE CHESTER-ATHENS DOMES

Ybh — Bull Hill Gneiss Member of the Cardinal Brook Intrusive Suite (Middle Proterozoic)--Light-pinkish gray to gray, very coarse-grained to medium-grained, highly mylonitic, biotite-plagioclase-quartz-microcline augen gneiss, distinguished by large rectangular to ovoidal microcline crystals as much as 2 cm in diameter or length, set in a finer-grained highly mylonitic matrix. Microcline crystals may constitute as much as 50 percent of the rock. Coarse relict microcline crystals are

well preserved in the belt extending north and south from the exposures at the type locality on Bull Hill. Similar very coarse-grained rocks having ovoidal microcline and thin plagioclase rims are present on Bear Hill on the west side of the Athens dome. Unit is intrusive into the Mount Holly Complex

Ybhi — Intrusive breccia--Medium-light-gray, medium-grained, microcline phenocrystic biotite granite that contains gneiss xenoliths of Mount Holly Complex occurs at the western margin of the Bull Hill Gneiss, 3/4 km due west of Bull Hill

MOUNT HOLLY COMPLEX (MIDDLE PROTEROZOIC)

Intrusive Rocks of the Mount Holly Complex

Yp — Pegmatite--Highly deformed, well-foliated, light-gray to pinkish-gray, biotite-hornblende(?)-muscovite-pegmatite commonly altered to chlorite, epidote-albite and sericite and containing large plates of ilmenite. Forms small 1- to 2-meter thick pods to masses as much as 1 km long, most abundant in or near rusty weathering schist and quartzite units (Yrg, Yrs, Yrq) and in the Cavendish Formation. Occurs as thin nonmappable pods, stringers or layers in all units of the Mount Holly Complex

Ygg — Granitic and migmatitic gneiss--Light-gray to pinkish-tan-weathering, fine-grained ropy-structured to well foliated, biotite-quartz-microcline-plagioclase granite gneiss, commonly having indistinct layers and or augen of microcline and intergrown plagioclase as much as 2 cm in diameter. Unit resembles Ygp but contains abundant fine-grained 1-2 mm, grains of microcline subequal in abundance to plagioclase, which commonly forms larger 3-5 mm diameter grains. Accessory metamorphic muscovite and coarse epidote common. Finer-grained varieties may contain abundant scattered magnetite. Unit interpreted as original

feldspathic volcanic rock migmitized in the Middle Proterozoic. Unit may correlate with Yfg unit of the Mount Holly complex, as mapped in the Mount Holly area (Ratcliffe, 1992)

Yt — Trondhjemite gneiss--Light-gray to chalky-white weathering, medium-grained, biotite-quartz-plagioclase gneiss, containing irregular areas of hornblende bearing and biotite spotted gneiss; unit poorly exposed in western part of the map at east edge of Green Mountain massif

Layered paragneiss and metavolcanics? of the Mount Holly Complex

Ybg — Biotite-quartz-plagioclase gneiss--A heterogeneous assemblage of dark- to medium-gray, nonrusty weathering, quartz-rich biotitic gneisses, all characterized by having abundant plagioclase and epidote and little or no microcline. Distinctive other rock types include: light-gray-weathering, magnetite-muscovite-biotite-plagioclase-quartz gneiss containing thin layers of hornblende-spotted gneiss; a very dark-gray, biotite-rich plagioclase-quartz gneiss commonly associated with epidotic quartzite, and medium- to dark-gray, white-albite-spotted-biotite-quartz gneiss. Muscovite is a common accessory in most rocks and small garnet may be present as well. The biotite-quartz-plagioclase gneiss unit contains numerous layers of other distinctive rocks interlayered throughout; where thick enough to map, these units, listed below, are mapped separately

Ya — Amphibolite--Dark-green- to dull-gray-weathering, fine- to coarse-grained biotite-hornblende and hornblende-garnet-plagioclase amphibolite, commonly associated with Yrs or Ycs

Yrs — Rusty muscovite-chlorite schist--Light-silvery- to greenish-gray, rusty-weathering, lustrous, biotite-muscovite-chlorite-quartz schist, marked by irregular plates, and clots of chlorite and locally contains garnet. Unit is spatially related to contact of pegmatites with other rusty gneiss units such as Yrg

Yrg — Rusty muscovite-biotite-plagioclase-quartz gneiss--Dark-brown to gray, rusty weathering, gneiss and schist containing abundant layers of schistose quartzite, biotite-garnet quartzite, and rusty sulfidic amphibolite. The distinction between Yrg and Yrs is difficult to make, but generally Yrg is less muscovitic, more gneissic and more uniformly biotitic, but it passes laterally into Yrs and locally contains lenses of Yrs too small to map

Ycs — Calc-silicate gneiss--Commonly coarse-grained, hornblende-plagioclase-calcite$\pm$ diopside$\pm$actinolite calc-silicate knotted rock, as pods, stringers or lenses in other rock types, interlayered with beds of coarse- grained calcite, calcite-diopside-actinolite marble or amphibolite. Talc-chlorite-calcite-serpentinite rock quarried as soapstone on Quarry Pond in Ybg appears to be an altered calc-silicate rock, similar to other occurrences of soapstone quarried in Chester and Athens and shown separately as Ysp

Ym — Marble--Small pods and lenses of very coarse-grained, white, calcite-phlogopite marble and gray, medium-grained, calcite-dolomite marble

Yq — Quartzite--Light-gray, vitreous, well laminated magnetite-epidote-quartzite in beds as much as 5 m thick but commonly 1 to 2 m thick, bedded with and passes laterally into muscovite-biotite-garnet quartz schist or gneiss (Yrg or Yrs) and into coarse hornblende-plagioclase-gneiss and calc-silicate

Ysp — Soapstone--A minor unit, confined to a series of exposures in the abandoned soapstone quarries southeast of Grafton, where bedded chlorite-talc ± magnetite ± serpentine ± tremolite rocks occur as layers as much as 15 m thick. Interpreted as an altered magnesian calc-silicate rock. Unit appears to be locally continuous and bedded in the Mount Holly Complex. Similar smaller occurrences are at the abandoned quarry at Quarry road, and west of Perkinsville at Quarry Pond in the Chester Quadrangle where it also was quarried for soapstone

Yfg — Felsic magnetite gneiss--Light gray weathering, fine-grained biotite-magnetite, quartz-plagioclase gneiss or aplitic gneiss, unit distinctly fine-grained and noticably poor in biotite, conspicuously dotted with 0.5 to 1 mm scattered octahedra of magnetite. Interpreted as a felsic (dacitic) volcanic rock

Ymhu — Mount Holly Complex felsic gniesses undifferentiated--Predominantly, light-gray to pinkish gray granitic gneiss including some potash feldspar augen gneiss and very minor occurrences of well-layered biotite-quartz-plagioclase gneiss exposed in the core of the Butternut Hill fold. Correlation uncertain, possibly equivalent to Ygg as mapped elsewhere

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Hepburn, J.C., Trask, N.J., Rosenfeld, J.L., and Thompson, J.B., Jr., 1984, Bedrock Geology of the Brattleboro quadrangle, Vermont-New Hampshire: Vermont Geological Survey Bulletin, n. 32.

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___1995a, Digital bedrock geologic map of the Cavendish Quadrangle, Vermont: U.S. Geological Survey Open-File Report OF95-0323, 2 plates, scale 1:24,000.

___1995b, Bedrock geologic map of the Jamaica and part of the Townshend Quadrangles, Windham and Bennington Counties, Vermont: U.S. Geological Survey Miscellaneous Investigation Map, I-2453, two sheets, text, scale 1:24,000.

EXPLANATION OF MAP SYMBOLS

Contact--Solid accurately located; dashed where approximately located; dotted where concealed by water

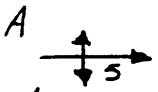
Major Faults--Solid accurately located; dashed where approximately located; dotted where concealed by water

Thrust fault--Teeth on upper plate

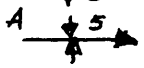
FOLDS

(Axial trace of major folds--arrow shows approximate direction of plunge where known. Relative age identified by color and subscript; the greater the subscript number, the younger the fold)

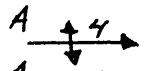
Upright Acadian fold (shown by A)



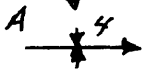
F_5 antiform



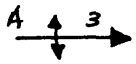
F_5 synform



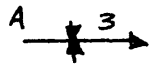
F_4 antiform



F_4 synform

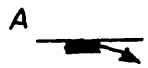


F_3 antiform



F_3 synform

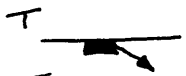
Inclined Acadian fold--Barb shows dip direction of axial surface. Arrow shows approximate plunge where known. Generation shown by subscript where known



Inclined

Vertical

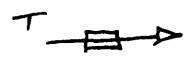
Taconian fold--Barb shows dip direction of axial surface. Arrow shows approximate plunge direction where known (shown in black, or by T)



F_2 inclined

F_2 vertical

F_1 inclined



F_1 vertical

Middle Proterozoic fold

PLANAR STRUCTURES

(May be combined; jointed at point of observation)

Strike and dip of bedding

Inclined

Vertical

Strike and dip of compositional layering or gneissosity of probable Middle Proterozoic age

Inclined

Vertical

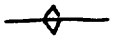
Strike and dip of gneissosity or coarse foliation of probable Middle Proterozoic age in granitic Middle Proterozoic rocks

Inclined

Vertical

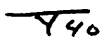
Strike and dip of foliation or schistosity of Paleozoic age formed in early generations of Paleozoic deformation (Taconian) or foliation of uncertain age, possibly Acadian (shown in black)

Inclined



Vertical

Strike and dip of foliation or schistosity of Paleozoic age and parallel bedding formed in early generation of Paleozoic deformation (Taconian, S_1)



Inclined

Vertical

Strike and dip of mylonitic foliation (S_2) spatially associated with thrust faults or ductile deformation zones of Paleozoic F_2 structures (Taconian); a second generation foliation commonly developed in zones of highly plicated schistosity

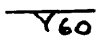
Inclined

Horizontal

General strike and dip of highly plicated foliation schistosity or gneissosity of Middle Proterozoic or pre-Silurian age

Inclined

Strike and dip of foliation and parallel bedding in Silurian or younger rocks, the first Acadian foliation



Inclined

Vertical

Strike and dip of Acadian crenulation cleavage not distinguished by relative age

Inclined

Vertical

Strike and dip of highly plicated schistosity or foliation in Silurian or younger rocks

Inclined

Acadian schistosity developed in Silurian or younger rocks as well as older rocks

Inclined

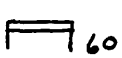
Vertical

Strike and dip of schistosity in pre-Silurian rocks of uncertain age either Taconic or Acadian, quite possibly composite

Inclined

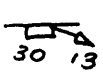
Vertical

Strike and dip of brittle fractures or mineralized zones associated with high-angle faulting event (Acadian?)--Commonly contain quartz veins, chlorite, magnetite, dolomite or quartz



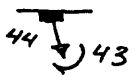
Inclined

Vertical

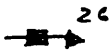


Strike and dip of axial surface of early generation Paleozoic fold--Arrow shows direction and amount of plunge of fold axis

Strike and dip of axial surface of Taconic minor fold of second (F2) generation--Commonly associated with thrust faults and zones of mylonite. Where shown, arrow indicates direction and amount of plunge of fold axis



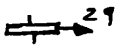
Inclined--Open semicircular arrow shows rotation sense of asymmetric fold as viewed down plunge. Where lineations having two senses of rotation are shown on the same axial surface, the bisectrix of the two plunge directions approximates the azimuth of the slip direction of the faults



Vertical

Strike and dip of axial surface of Acadian minor fold. Closed arrow shows direction and amount of plunge of fold axis. Open semicircular arrow shows sense of rotation of aysmmetric minor fold viewed down plunge

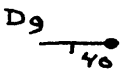
Inclined



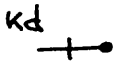
Vertical

Strike and dip of dike--Dike is too narrow to map at scale

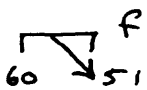
Dg indicates Devonian granite, Kd indicates Cretaceous dike



Inclined



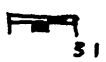
Vertical



Strike and dip of brittle fracture or fault with bearing and plunge of slickenline

COMBINED PLANAR SYMBOLS

Strike and dip of Acadian axial surface of minor fold and parallel crenulation cleavage

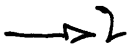


Inclined

Vertical

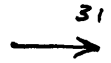
LINEAR FEATURES

(May be combined with planar structures)



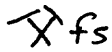
Bearing and plunge of hinge line or fold axis of minor fold of bedding or of gneissic layering. Semicircular arrow shows rotation sense of aysmmetric minor fold viewed down plunge)

Bearing and plunge of prominent mullion structure, smear lination, or quartz rodding or hingeline of fold in mylonitic rocks--Indicates transport direction

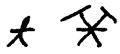


Bearing and plunge of mineral lineation of Acadian age

Quarries--t, talc; sp, soapstone; g, granite; m, marble; fs, flagstone; s, serpentine



Active



Inactive

Symbols shown on cross sections

Acadian fault

Correlation of map units

Cretaceous — Devonian — Silurian — Ordovician — Cambrian — Late Proter. — Middle Proterozoic

Kfd
Intrusive

Dg Dp
Intrusive

DSwf DSw DSwg DSwg DSwc DSwvf DSwv DSwg DSwa DSwg DSwmg DSw DSng DSn DSng DSng
possible unconformity or disconformity

Spring Hill

Ochfs Ochs Ochmc Ochv Ochag Ocha Ochgs Ochc Ochg Ochg Ochs Ochra Ochbg Ochv
possible disconformity

Rockingham and Cambridgeport

Ochg Ochvg Ochg Och Ochf Ochb Ochc Ochg Ochgs Ochag Ochf Ochg Ochgs Ochhg Och Ochfg Ochv C
possible disconformity; C denotes coticule

Ontr
Intrusive

Ontr
?
Intrusive

Onrg
Intrusive in part

Omhs OmL Omgs Ombs Omd Ombg Omba OmL Oma Omd Omhs Omhgs Omhfg Oma C
C denotes coticule

Ont
?
Intrusive

OmL Omgs Omfg Omhg Oma OmL Oma Omfg C
C denotes coticule

OEsgt OEsa OEsg OEsa OEsgt

?

O2u O2t

?

Grgt Gra Gra Ers Gra Grcf Grch Grfb Grr Grgt Gra

?

Eph

Eog Eo Eoa

?

Ezhgab Ezhtm Ezh Ezhab Ezhc Ezhab
unconformity

Ezhgt Ezh Czhtm
unconformity

Chester and Athens dome

Ybh Ybhu

Yp
?

Ygg

Ya Ybg Yrs Ya Yrg Yg Ycs Ysp Ybg Ym

Green Mountain massif

Yfg Ybg Yt

?

Core of Buttemut Hill fold

Ymhu

Mount Holly Complex