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BEDROCK GEOLOGIC MAP OF THE MOUNT SNOW AND READSBORO QUADRANGLES, BENNINGTON AND WINDHAM COUNTIES, VERMONT

By Nicholas M. Ratcliffe

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INTRODUCTION

The Mount Snow and Readsboro quadrangles are located along the eastern margin of the Green Mountain massif in southern Vermont. Bedrock ranges from Middle Proterozoic basement gneisses of the massif, through Cambrian metasedimentary rocks that form an unconformable cover on the older basement. These rocks occur as tectonically juxtaposed, westward-directed, thrust slices. Middle Proterozoic gneisses reappear in the eastern part of the map area as basement within these thrust slices, and the gneisses form the core rocks of the Rayponda and Sadawga domes, which are located just east of this map in the West Dover and Jacksonville quadrangles. Dynamothermal metamorphism of middle Late Ordovician (Taconian) age and of Early Devonian to Middle Devonian (Acadian) age have affected cover and basement rocks variably. Effects of lower grade (biotite-grade) Taconian metamorphism are preserved in the western part of the area, but higher grade (garnet-grade) Acadian metamorphism was overprinted on the Taconian assemblages in eastern areas. Thrust faulting of Taconian age (approximately 455 Ma) and possibly also of Acadian age (390–370 Ma) may have affected the area, and this faulting may have truncated the older Taconian metamorphic zones. Thus, the structural geology and tectonic history involve two periods of imbricate thrust faulting, two periods of dynamothermal metamorphism, and repeated folding. As a result, the multiple generations of Acadian folding and metamorphism that were superposed on at least two generations of Taconian folds are preserved in the complexly faulted and folded terrane. Late brittle faults and accompanying quartz-feldspar-tourmaline veins of probable late Acadian age followed.

Lithotectonic Units

Throughout this report the first letters of Lithotectonic Units are capitalized to distinguish these from mapped units, which are shown by lower case letters. The term Lithotectonic Unit is used here to describe a fault-bounded sequence of rocks that differs from adjacent Units because of tectonic juxtaposition. The term does not necessarily signify great foreshortening, but only that Units differ in age, sequence, or character of the contained rock units. The term Lithotectonic Unit does not necessarily imply great lateral transport of regional extent, but merely identifies structural and stratigraphic entities.

The Middle Proterozoic through Cambrian metamorphic rocks are assigned to three Lithotectonic Units that are separated by two important thrust faults. Very similar Middle Proterozoic basement rocks form the lowest part of each Lithotectonic Unit; however, distinctive differences in stratigraphy of the cover sequence of Late Proterozoic and Cambrian age in each Lithotectonic Unit suggest that the Units are structurally as well as stratigraphically distinct. These three Lithotectonic Units are the Green Mountain, Mount Snow, and Wilmington Units.

The basement and cover rocks of the Green Mountain Lithotectonic Unit form the lowest and westernmost Unit. The structural base of this Unit is not exposed in the map area, as the Unit extends at least as far west as the western margin of the Green Mountain massif. The Champlain thrust or splays from this fault may underlie the Unit at depths of 10–15 km (Doll and others, 1961). The Searsburg fault system, a regional fault system having unknown displacement, forms the top of the Green Mountain Lithotectonic Unit and the base of the Mount Snow Lithotectonic Unit. The Mount Snow Lithotectonic Unit contains a stratigraphic succession of younger rocks that rest unconformably on the Middle Proterozoic basement. This basement appears near the eastern margin of the Lithotectonic Unit in the Mount Snow quadrangle and is found in a series of antiforms in the Readsboro quadrangle. These antiformal exposures constitute the western flank of the larger Rayponda and Sadawga domes to the east of the map. The eastern and upper boundary of the Mount Snow Lithotectonic Unit is delineated by the Wilmington fault system that overrides and truncates folds in the Mount Snow Lithotectonic Unit. Basement of the easternmost Wilmington Lithotectonic Unit consists of highly mylonitic Middle Proterozoic granite and gneiss that are overlain by a cover sequence similar to, but distinguishable from, either cover sequence in the western Units.

Stratigraphic Nomenclature and Previous Work

In previous studies of the Mount Snow area, Skehan (1961) defined various basement gneisses of the Mount Holly Complex as mapped by Doll and others (1961) within the Green Mountain massif. Many units shown on this map agree in general with Skehan's usage, although the distribution and grouping has been changed. Skehan suggested that biotite-quartz-plagioclase gneisses and microcline granite were unconformably overlain by the calc-silicate and graphitic quartzose gneiss unit, all of Middle Proterozoic age. The geology of the Rowe quadrangle immediately south of the Readsboro quadrangle (Chidester and others, 1967) consists largely of Hoosac Formation and Proterozoic gneiss. Reconnaissance mapping in the Readsboro-Rowe area by Ratcliffe in 1977–78 resulted in new interpretations presented in Zen and others (1983) and Ratcliffe (1979b). Subsequent detailed mapping for this report largely agrees with that shown in Zen and others (1983). Recent mapping in the Mount Snow and Readsboro quadrangles and in the nearby Woodford (Burton, 1991), Stamford, Pownal, and Stratton Mountain (Ratcliffe and Burton, 1989) quadrangles suggests that a fairly regular stratigraphic succession of Middle Proterozoic rocks can be mapped without the need for an unconformity beneath the calc-silicate gneisses. The most recent maps showing the regional setting of the Mount Snow-Readsboro area are in Ratcliffe and others (1992).

Ratcliffe and others (1988) propose that the rusty graphitic quartz gneiss and calc-silicate gneiss mapped by Skehan (1961) lie at or near the bottom of the paragneiss succession in the southern Green Mountains. North of the map area, a similar rusty paragneiss, quartzite, and calc-silicate sequence overlies older metadacitic and metatrondhjemitic gneisses that are as old as 1350 Ma (Ratcliffe and others, 1991). The paragneiss succession in the Mount Snow and Readsboro quadrangles is intruded by discontinuous biotite granite gneisses (map units Ybgr, Ygg) and aplites (Yap) that possess strong Middle Proterozoic deformation fabrics. Coarse-grained, biotite-microcline granite, rapakivi granite of the Cardinal Brook Intrusive Suite, and pegmatite (Ratcliffe, 1991) intrude the highly deformed basement and lack the strong folding and gneissosity present in other Middle Proterozoic intrusive rocks. Members of the Cardinal Brook Intrusive Suite in these quadrangles are the Somerset Reservoir (Ysr) and Harriman Reservoir (Yhr) Granites. The Somerset Reservoir Granite is found in the basement rocks of the Green Mountain and Mount Snow Lithotectonic Units. A similar, but highly mylonitic, biotite granite is found near the Harriman Reservoir, for which the unit is named. This granite is a part of the Wilmington Lithotectonic Unit. Basement rocks in the Mount Snow and Wilmington Lithotectonic Units, previously referred to as the Wilmington Gneiss of Middle Proterozoic age (Skehan, 1972), have been subdivided here into units that correlate with units present elsewhere in the Green Mountains (Ratcliffe and others, 1988; figs. 1 and 2).

Middle Proterozoic paragneiss and granitic gneiss units in all three Lithotectonic Units are distinguished as lithologic units and not formally named. Collectively, these units constitute the Mount Holly Complex as used by Doll and others (1961) and by Ratcliffe (1991). The Somerset Reservoir and Harriman Reservoir Granites of the Cardinal Brook Intrusive Suite are younger than the Mount Holly Complex as redefined by Ratcliffe (1991).

STRATIGRAPHY OF MIDDLE PROTEROZOIC ROCKS

Mount Holly Complex: Stratified and Intrusive Rocks

A series of well-layered gneisses that include biotite-plagioclase amphibolite, hornblende-plagioclase gneiss, calc-silicate rocks, quartz-ribbed gneiss, garnetiferous gneiss, and minor quartzite have been mapped within the Green Mountain, Mount Snow, and Wilmington Lithotectonic Units. These gneisses are interpreted as metasedimentary and, possibly, volcanogenic rocks. Granitic gneisses of several types, as well as migmatitic and aplitic gneiss, are interlayered with the well-layered gneisses and are in part intrusive. Collectively these gneisses, whether intrusive, extrusive, or metasedimentary, are assigned to the Mount Holly Complex (Ratcliffe, 1991). All units of the Mount Holly Complex were strongly deformed in the Middle Proterozoic when they developed high-grade, upper amphibolite-facies minerals. Two dynamothermal events, one at about 1250 Ma and another at about 1100 Ma, are now recognized on the basis of U-Pb zircon studies (Aleinikoff and others, 1990). Intrusive rocks younger than the Mount Holly Complex include late Middle Proterozoic post-tectonic granites of the Cardinal Brook Intrusive Suite (Ratcliffe, 1991) and pegmatite, which occurs as numerous pods and stringers. These intrusive rocks establish the upper limit for the Grenville orogeny in Vermont. Parts or all of the Mount Holly Complex also may have been affected by an older deformation at 1250 Ma, which corresponds to the Elzevirian orogeny (Ratcliffe and others, 1991).

The stratigraphic succession of the Mount Holly Complex is not well established. The oldest rocks are exposed in the Peru and Londonderry quadrangles, which are approximately 10 km north of the Mount Snow quadrangle. These rocks are trondhjemitic gneisses as much as 1350 Ma old that are intruded by biotite tonalite about 1320 Ma old (Ratcliffe and others, 1988; Aleinikoff and others, 1990; Ratcliffe and others, 1991). The trondhjemitic gneisses are overlain by paragneiss units that near the base consist of rusty, sulfidic, quartz-ribbed schists, coarse-grained garnet amphibolite, calc-silicate rock, and discontinuous quartzite. Granites, dated by a U-Pb zircon age at 1244 Ma (Aleinikoff and others, 1990) intrude the trondhjemite gneiss and paragneiss; therefore, the deposition age of the paragneiss is probably between 1350 and 1244 Ma. Subsequent remetamorphism at about 1100 Ma was determined by the U-Pb age of overgrowths on the zircons that were dated from the intrusive granite.

Dark-gray, rusty-weathered, graphitic quartz-ribbed gneiss (Yrr) is the oldest unit of the Mount Holly Complex exposed in the Mount Snow and Readsboro quadrangles. A belt of this unit enters the quadrangles from the west and forms prominent areas of outcrop at Searsburg and immediately south. Quartz-ribbing 2–5 cm thick, is produced by fine- to medium-grained beds of bluish quartzite or pebbly blue-quartz conglomerate that stand out in positive relief against layers of garnet-biotite-plagioclase-scapolite schist and gneiss. A discontinuous, sulfidic, calc-silicate gneiss and schist unit (Yrcs) locally marks the top of, or is interlayered with, unit Yrr. Rusty schists and gneiss (Yrr) and very localized calc-silicate gneiss (Yrcs) reappear to the east in the Harriman Reservoir area and form a discontinuous belt north of the reservoir in the hanging wall of the Wilmington fault system. The Yrr and Yrcs units are identical in appearance to the Washington Gneiss in the Berkshire massif of Massachusetts.

North of Searsburg, distinctive hornblende gneisses (Yhg), largely consisting of about equal amounts of hornblende and plagioclase, but containing minor layers of dark-green hornblende-diopside-spotted plagioclase gneiss, is in contact with the rusty, quartz-ribbed gneiss (Yrr). Minor unmapped beds of diopside-rich calc-silicate gneiss and spotted hornblende-diopside-plagioclase gneiss form discontinuous layers within the Yhg unit; they suggest a sedimentary origin for at least part of Yhg. South of the prominent Yrr belt at Searsburg, a poorly exposed, black, coarse-grained amphibolite (Ya) is locally in contact with Yrr, although a belt of granitic gneiss (Ybgr) intervenes locally. Elsewhere, Yrr is in direct contact with the younger layered bitoite gneisses (Ybg) or aplitic gneiss (Yap).

The biotite-rich well-layered gneiss (Ybg) forms a widely distributed map unit. It includes minor layers of amphibolite (Ya) that generally are too thin to map at this scale. The layering is largely due to alternating biotite-rich and biotite-poor layers, which are 1–3 cm thick. This layering may be entirely tectonic in origin, but distinctive layers of metasedimentary rocks, such as quartzite (Yq) and calc-silicate gneiss (Ycs), and minor beds of marble (Ym), garnet-biotite gneiss (Ybgt), and rusty, quartz gneiss (Ybrg) are also enclosed within unit Ybg. White-weathered, vitreous quartzite (Yq), either with or without garnet, locally forms narrow mappable belts that are commonly interlayered with dark-gray garnet-biotite gneiss (Ybgt) or occur within rusty quartz gneiss (Ybrg). Retrograde mylonization has transformed the more aluminous Ybgt and Ybrg units into lustrous, finely foliated, muscovitic or chloritic phyllonite or phyllitic gneiss. Outside these quadrangles, similar retrograde gneisses have been mistaken for aluminous members of the Hoosac Formation. However, in most cases, minor pegmatitic segregations or layers of Proterozoic gneiss are closely associated with the phyllonitic gneisses.

Large areas of light-gray- to white-weathering, locally migmatitic, biotite granite gneiss (Ybgr) occur within the paragneiss and is in contact with most units of the paragneiss succession in the Mount Holly Complex. Because unit Ybgr locally contains the same folds and coarse gneissosity that are also common to the paragneisses, this biotite granite gneiss is interpreted to be younger than 1300 Ma (the approximate age of the metasedimentary rocks), but older than about 1000 Ma (the approximate age of the last Proterozoic high-grade dynamothermal event). Rocks similar with unit Ybgr, which include granitic gneiss at College Hill and an associated migmatitic granite gneiss in the Jamaica and Stratton Mountain quadrangles (Ratcliffe and Burton, 1989) have been dated at approximately 1244 Ma (Aleinikoff and others, 1990).

A granitic gneiss unit mapped as Ygg occurs within the basement of the Mount Snow Lithotectonic Unit in the core of the small domal exposure at Readsboro and at Sadawga Lake. In the eastern part of the map where Taconian and Acadian metamorphism is intense, the gneiss is very strongly foliated and lacks the Proterozoic granitic texture present in Ybgr; nonetheless, correlation of Ygg with Ybgr is possible on the basis of similar modal composition and general appearance.

A white, aplitic to fine-grained migmatitic gneiss (Yap) forms lenticular masses within the paragneiss units and may be an aplitic phase of the granitic gneiss Ybgr. Alternatively, it may be a locally derived anatexite produced during the same dynamothermal event that involved intrusion of the unit Ybgr.

Post-Mount Holly Complex Intrusive Rocks

Very coarse grained, biotite rapakivi granites of the Cardinal Brook Intrusive Suite (Ratcliffe, 1991) intrude the Mount Holly Complex. The Somerset Reservoir Granite (Ysr) and Harriman Reservoir Granite (Yhr) are members of the Cardinal Brook Intrusive Suite. The type area of the Somerset Reservoir Granite is along the eastern shore of the Somerset Reservoir in the Stratton Mountain quadrangle (Ratcliffe and Burton, 1989). Zircons from the Somerset Reservoir Granite exposed in Wardsboro Brook in the Jamaica quadrangle to the northeast yield U-Pb upper intercept ages of approximately 960 Ma (Karabinos and Aleinikoff, 1988; 1990). The interior of the pluton contains nondeformed rapakivi granite. Large phenocrysts of plagioclase and (or) microcline perthite having complex resorption structures are common. At the margin of Somerset Reservoir pluton, the granite grades into a fine- to medium-grained white aplite or coarse-grained pegmatite in which microcline crystals are as much as 15 cm in diameter. A small sill-like intrusive mass of Somerset Reservoir Granite occurs along the contact between Ybg and Ybgr 0.75 km west of the reservoir. At this locality abundant float of mafic ferromonzonitic rock is associated with outcrops of the more typical rapakivi granite. Similar ferromonzonitic material forms dikes and irregular segregations within more abundant, normal rapakivi granite (the Stamford Granite) at the southern end of the Green Mountain massif (Ratcliffe and others, 1988).

One fairly large mass of pegmatite (Yp) has been mapped in Ybg due south of the Somerset Reservoir. This biotite- and (or) hornblende-bearing pegmatite has a strong Paleozoic foliation, but appears not to have been deformed in the Proterozoic. It is likely that this pegmatite is a local variant of the Somerset Reservoir Granite of the Cardinal Brook Intrusive Suite, which is very pegmatitic along the eastern shore of Somerset Reservoir.

The Harriman Reservoir Granite (Yhr) is a mylonitic gneiss and mylonite because of intense deformation associated with the Wilmington fault system. This granite is well exposed in the hanging wall of the Wilmington fault from the northern border of the map south to Wilmington. The type area is along the east shore of Harriman Reservoir at the east margin of the map, north of 42° 50′. Because of the intense deformation and highly foliated nature of the Harriman Reservoir Granite, no rapakivi texture is preserved. Chemical analyses of the Harriman Reservoir and Somerset Reservoir Granites are similar (Ratcliffe, 1991).

STRATIGRAPHY OF LATE PROTEROZOIC AND PALEOZOIC COVER ROCKS

Metasedimentary rocks of the Dalton and Hoosac Formations rest unconformably on the Middle Proterozoic Mount Holly Complex and the Cardinal Brook Intrusive Suite in the Green Mountain, Mount Snow, and Wilmington Lithotectonic Units. The age of these formations is poorly controlled, because no fossils are preserved in these rocks east of the Green Mountain massif. The *Olenellus*-bearing Lower Cambrian Cheshire Quartzite unconformably overlies the Dalton Formation on the western margin of the Green Mountain massif.

Dalton Formation

The Dalton Formation consists of two units, a lustrous dark-gray quartz schist member (ЄZdbs) and a feldspathic quartzite member (ЄZdfq). From the vicinity of the Searsburg Reservoir north, unit ЄZdbs is interpreted to unconformably overlie the basement gneiss of the Green Mountain massif. In the Deerfield River 300 m south of the Searsburg Reservoir, the basal beds of the Dalton Formation are dark-gray to black, fine-grained, biotite-rich quartzite and quartz schist as much as 12 m thick; the schist contains pebbly beds. The basal beds are discontinuous and cannot be mapped beyond these exposures. Skehan (1961) noted this occurrence and also thought they were unconformable basal units of the cover sequence. The feldspathic quartzite member (ЄZdfq) is mapped only at two localities, both just west of the Searsburg fault system, on the basis of concentrated float and limited exposure. Elsewhere, thin lenses, less than 1 m thick, of feldspathic quartzite similar to unit ЄZdfq occur within ЄZdbs. Excellent exposures of these quartzite lenses are in the bed of the southwesterly draining, unnamed stream 2 km north of Heartwellville at elevations between 690 and 762 m in the Readsboro quadrangle. In the lower parts of the stream, dark albitic and garnetiferous biotite schist (ЄZhbgt) of the Hoosac Formation is interpreted to overlie unit ЄZdbs on an inferred thrust fault; however, normal stratigraphic contact between the Hoosac Formation and the Dalton Formation may be possible.

Hoosac Formation

Complexly interfingered albitic granofels, biotite-rich dark-gray garnet schist, greenish aluminous schist, metaquartzite, dolomite marble, and several conglomeratic units form the complexly interfingered metasedimentary units of the Hoosac Formation. These rocks unconformably overlie the Middle Proterozoic Mount Holly Complex and the Cardinal Brook Intrusive Suite of the Green Mountain, Mount Snow, and Wilmington Lithotectonic Units. The Hoosac Formation is Late Proterozoic and Early Cambrian age and is coextensive with the type Hoosac, which is exposed in the Hoosac Range immediately southwest of the Readsboro quadrangle (Chidester and others, 1967; Ratcliffe, 1979b; Ratcliffe and others, 1993). In the Harriman Reservoir area, a discontinuous, lustrous gray schist member (ЄZhbs) mapped between the basal units ЄZhgt and ЄZhc of the Hoosac Formation is lithologically similar to unit €Zdbs of the Dalton Formation. Similarly, a feldspathic quartzite or quartz pebble conglomerate, unit €Zhq of the Hoosac Formation, closely resembles unit €Zdfq of the Dalton Formation in the Green Mountains. Both Dalton-like members of the Hoosac Formation are present in the Mount Snow Lithotectonic Unit and absent from the Wilmington Lithotectonic Unit to the east. Particularly good exposures of these rocks may be seen east of Haystack Mountain and south of Medburyville. Unit €Zhbs, which contains minor lenses of quartzite, can be seen along the slopes west of the Harriman Reservoir 2 km west of Whitingham.

Skehan (1961) and Doll and others (1961) proposed that two separate cover sequences exist in the Wilmington area (fig. 1). The older sequence, which included the Searsburg Conglomerate, Readsboro Schist, and Sherman Marble Member, was part of the Cavendish Formation of Late Proterozoic age (Doll and others, 1961). This older sequence is overlain unconformably by dolomite marble, quartzite, and conglomerate of the Tyson Formation that is overlain by the Hoosac and Pinney Hollow Formations (Skehan, 1961; Doll and others, 1961).

In more recent mapping in this area, Ratcliffe (1979a and this report) did not find evidence of the existence of the unconformity or overlying sequences. Instead the mapping supports a single, but laterally variable and interfingering, succession of rock units, all of which can be best assigned to the Hoosac Formation. All lithic units previously assigned by Skehan (1961) to the Readsboro-Heartwellville succession are present in the type section of the Hoosac Formation (Ratcliffe, 1979a; Zen and others, 1983); thus, separate names are not warranted. In general, albite-rich granofels and schist mapped by Skehan (1961) as the Readsboro Schist correspond to what is mapped here as the albite granofels member (€Zhab) of the Hoosac Formation. Rocks mapped by Skehan as Heartwellville Schist are included here in the black phyllite member (€Zhcb) and the chloritoid-bearing lustrous schist member (€Zhcgt) of the Hoosac. Skehan mapped as Hoosac Formation those albitic schists that contained greenstones, which included both his Turkey Mountain Member and other greenstones. The presence of greenstones was his criteria for distinguishing Hoosac from Readsboro. Remapping in this study, however, confirmed that greenstones are interlayered in the albitic granofels (€Zhab) of Skehan's Readsboro and that unit €Zhab is lithologically identical to and coextensive with belts of Readsboro mapped by Skehan. Therefore, the presence or absence of greenstones is not a valid marker to distinguish Readsboro from Hoosac rocks, and the Readsboro of Skehan is included as a part of the Hoosac Formation.

The name Tyson Formation, as proposed by Thompson (1950) and Chang and others (1965) in the Woodstock area of Vermont, has been applied to quartzite, dolomitic marble, and conglomeratic rocks that rest unconformably on Middle Proterozoic rocks along the eastern margin of the Green Mountain massif, but underlie albitic rocks of the Hoosac Formation. In the Mount Snow-Readsboro area and the Jamaica area to the northeast, albitic granofels of the Hoosac Formation both underlies and overlies quartzite and marble assigned to the Tyson Formation by Doll and others (1961). These relationships indicate that quartzite and marble characteristic of Tyson Formation to the north are contained here within units readily assigned to the Hoosac Formation. Therefore, quartzites (€Zhq) and marbles (€Zhm) are mapped as units of the Hoosac Formation in this area and not assigned to the separate Tyson Formation.

West to east facies variations in cover rocks occur across the three Lithotectonic Units (fig. 2). Cover rocks in the Green Mountain Lithotectonic Unit are primarily dark-gray, biotite feldspathic schists (€Zdbs) and feldspathic quartzite (€Zdfq) that are characteristic regionally of the Dalton Formation. Greenstones are absent from the Dalton Formation. In the Mount Snow Lithotectonic Unit, feldspathic quartzite (€Zhq) and silvery gray, flaggy biotite schist (€Zhbs), comparable to the €Zdbs and €Zdfq units of the Dalton Formation, are interbedded with the albite granofels member (€Zhab) of the Hoosac Formation. Farther east in the Wilmington Lithotectonic Unit, the Hoosac Formation contains few Dalton-like lithologies. Instead abundant greenstone (€Zhtm), interpreted as former basaltic lava flows, and dark-brown rusty-weathering albite schist (€Zhrab) replace the thick sections of white-albite granofels (€Zhab) that are characteristic of the Hoosac Formation of the Mount Snow Lithotectonic Unit. These lateral facies changes involve a decrease in quartzofeldspathic rock eastward, a thickening of a section of heterogeneous albitic schists and granofels in the middle (Mount Snow Lithotectonic Unit), and an increase in basaltic lava flows to the east. These lateral facies changes suggest that the base of the section is older to the east (fig. 2), because cover rocks of the Green Mountain Lithotectonic Unit lack greenstones but rest on basement rocks that contain diabasic dikes. The Hoosac Formation is viewed, therefore, as an eastern succession that is older than, contemporaneous with, and younger than the Dalton Formation (fig. 1).

In the Mount Snow and Wilmington Lithotectonic Units, heterogeneous conglomeratic or coarse albite granofels (€Zhabc, €Zhab) near the base of the Hoosac Formation grades upward into more aluminous schists. The uppermost unit of the Hoosac Formation in the Mount Snow and Wilmington Lithotectonic Units is a coarsely garnetiferous, fine-grained to silky-lustrous, green, ilmenite-chlorite-muscovite-quartz (±chloritoid±garnet) schist (€Zhcgt) that in part resembles the Pinney Hollow Formation as used by Doll and others (1961). Locally, this unit is in thrust contact with underlying rocks, as, for example, in the southwestern part of the map, where rocks of the Wilmington Lithotectonic Unit above the North Pond-Beaver Meadow fault (part of the Wilmington fault system) overlie rocks of the Mount Snow Lithotectonic Unit. This unit can be traced southward into interbedded garnet-chloritoid schists of the Hoosac Formation above the Hoosac summit thrust (Ratcliffe, 1979a, b). On the summit of Mount Snow and in a belt along the high ground extending southwest into the Readsboro quadrangle, lustrous green, ilmenite-chlorite-muscovite-quartz (±garnet±chloritoid) schist (€Zhcgt) overlies dark-gray schist units (€Zhcb or €Zhbgt). The contact with the underlying unit €Zhcb is either stratigraphic or an early synmetamorphic or premetamorphic fault. The Pinney Hollow Formation as used by Doll and others (1961) characteristically contains greenstones and abundant fine-grained chlorite-magnetite quartz phyllites; neither of these distinctive rocks are present here in unit €Zhcgt or in the type Hoosac Formation in the Hoosac Range (Ratcliffe, 1979b; Ratcliffe and others, 1993). Therefore, the €Zhcgt unit is mapped here as a member of the Hoosac Formation, although it may be allochthonous on an early, premetamorphic thrust.

The stratigraphy of the cover rocks in the Mount Snow-Readsboro area have been redefined so that the rocks previously assigned to the Cavendish and Tyson Formations by Doll and others (1961) are now in the Hoosac Formation (Ratcliffe, 1979a, b). The relationships shown in figures 1 and 2 suggest that repetition of rocks mapped as Tyson Formation and as Hoosac Formation (Doll and others, north of Jamaica, Vt., 1961) east of the Green Mountain massif may be facies equivalents that were repeated by folding and (or) faulting.

Turkey Mountain metabasalt member of the Hoosac Formation and other greenstones

Light-green to dark-green epidote-amphibole greenstones and amphibolite metabasalts that were originally discontinuous mafic volcanic flows are present in the Hoosac Formation. Within the Mount Snow-Readsboro area, most of these volcanic rocks occur as layers within the light-gray, albite-studded granofels member of the Hoosac Formation (€Zhab). Exposures in the Readsboro quadrangle occur west of the Harriman Reservoir in the lower half of the quadrangle. Metabasalt exposures in the Mount Snow quadrangle occur principally northeast of Mount Snow in the northern part of the map and east of the Aldrich fault about 2 km north of Wilmington.

The discontinuous lenses of metabasalt, informally referred to here as the Turkey Mountain metabasalt member of the Hoosac Formation, actually occur at different stratigraphic positions that extend through a stratigraphic distance of approximately 100–400 m above the base of the Hoosac Formation. In the West Dover and Jamaica quadrangles to the east and north, metabasalts within the Hoosac Formation occur from the base to as much as 800 m from the base. From the type area on Turkey Mountain in the Saxtons River quadrangle (Rosenfeld, 1954), south to the Massachusetts state line, the basalts form at least three relatively persistent units (Ratcliffe, 1991). The basalt unit mapped in the northeast corner of this map above the Wilmington thrust system correlates with the type Turkey Mountain. Therefore, the Turkey Mountain metabasalt member, used here, consists of several, laterally and vertically discontinuous, nonidentical flows and volcaniclastic deposits, including, but not restricted to, the type Turkey Mountain Member of the Hoosac Formation as used by Doll and others (1961) and by Skehan (1961). They mapped the lower basalts as unnamed greenstones in the Hoosac Formation.

The metabasalts vary from massive to very well layered within individual outcrops. Finely laminated, quartzose and epidotitic volcaniclastic beds several centimeters thick are interlayered with more massive, strongly foliated, black amphibolite. Where in contact with surrounding metasedimentary rocks, the layering within the metabasalt and volcaniclastic beds is concordant and gradational with the enclosing metasediment. Light-gray to yellowish-greenish-gray, well-laminated quartzite or, less commonly, gritty, pebbly conglomerate 0.5–5 m thick forms the contact between units €Zhab and €Zhtm. Two and one-half km southeast of the Heartwellville, a discontinuous quartzite (€Zhq) forms the upper contact of €Zhtm; this occurs elsewhere, but the quartzite is too thin to map at this scale. In the Wilmington Lithotectonic Unit the base of the Turkey Mountain metabasalt is in contact with rusty muscovite-albite-biotite schist (€Zhrab). The metabasalts probably originated as thin, composite basalt lava flows that contained intercalated basaltic volcaniclastic rocks. For example, in the northeastern corner of the map, the metabasalt forms a composite flow consisting of a lower, more massive, albite-studded metabasalt (€Zhtm) and an upper, very well laminated, epidotitic metabasalt and metabasaltic volcaniclastic unit (€Zhtme).

Chemical analyses of major and minor elements of the greenstones in the Hoosac Formation show a normal basalt composition range (SiO_2 weight percent is between 47 and 50) (table 1). However, other major element contents, such as MgO, total iron, and TiO_2, are quite variable. Within the Readsboro area, high and

Table 1. Major element chemistry, selected trace element characteristics, and normative olivine or quartz content using TiO_2-FeO allocation of Irvine and Baragar (1971) of metabasalts from the Hoosac Formation. Sample localitions shown on map. Analysis by rapid-rock techniques described in Shapiro (1975). Analysts J.E. Taggert, Jr., A.J. Bartel, and D.F. Siems

Constituent weight percent	Sample location			
	1	2	3	4
SiO_2	48.8	49.8	49.8	47.3
Al_2O_3	13.7	13.1	13.2	13.7
FeO	10.6	10.5	9.2	10.7
Fe_2O_3	2.27	3.45	2.47	3.68
MgO	7.70	6.44	7.39	6.15
CaO	8.99	10.50	9.75	8.67
Na_2O	3.17	1.84	3.49	3.78
K_2O	.23	.24	.27	.23
TiO_2	1.76	1.61	1.26	3.56
P_2O_5	.14	.15	.13	.62
MnO	.21	.22	.21	.27
H_2O^+	1.5	1.1	.61	.57
H_2O^-	.19	.18	.12	.21
CO_2	.01	.01	1.7	.05
Total	99.27	99.14	99.60	99.49
La+Sm+Yb	13.6 ppm	13.1 ppm	10.6 ppm	39.5 ppm
Sc	41. ppm	49. ppm	46.4 ppm	34.7 ppm
La/Yb	2.35	1.3	1.43	6.56
La rock/La chrondrite	21.	19.	14.	85.
Normative Ol, in percent	8.8	–	2.0	6.8
Normative Q, in percent	–	5.4	–	–

low TiO_2 basalts have moderately fractionated and nonfractionated rare-earth element patterns, respectively.

Turkey Mountain metabasalt samples from the Mount Snow Lithotectonic Unit, corresponding to the sample locations 1–3 in the Readsboro quadrangle are low in TiO_2 (1.26–1.76 weight percent), moderately high in MgO (6.44–7.7 weight percent), and characterized by low concentrations of lanthanum (La), samarium (Sm), and ytterbium (Yb) and low La to Yb ratios. These metabasalts have thorium-hafnium-tantalum (Th-Hf/$_3$-Ta) plots of tholeiitic within-plate or enriched-type mid-oceanic-ridge basalts (MORB). Metabasalt from the rusty albite schist member (€Zhrab) from the Wilmington Lithotectonic Unit north of Wilmington, location 4, is enriched in TiO_2 (3.56 weight percent), in rare-earth elements La, Sm, and Yb, and has a high La to Yb ratio (6.56). This metabasalt exhibits the light-rare-earth element enrichment that is characteristic of alkalic or transitional basalts. Metabasalts of the Mount Snow Lithotectonic Unit generally resemble those of the Underhill Formation of central Vermont, whereas the sample from location 4 resembles metabasalt that is more characteristic of the Tibbit Hill Formation (Coish and others, 1985). Similarly, chemical analyses from 15 other greenstones in the Hoosac Formation (Ratcliffe, 1991), including the type Turkey Mountain Member as used by Doll and others (1961), indicate that metabasalts occurring near the base of the Hoosac Formation in the Wilmington Lithotectonic Unit, tend to be more alkalic (more like Tibbit Hill) than those occurring higher in the formation (Ratcliffe, 1991). These data show that basaltic flows evolved into a more tholeiitic MORB-like composition during the deposition of the Hoosac Formation. Basalts within the albite granofels member (€Zhab) of the Hoosac Formation are markedly different from metabasalt in the (a) Taconic allochthons, (b) rift dikes of the Catoctin Formation of Virginia, (c) dikes in New Jersey and New York, and (d) rift basalts of the Tibbit Hill Formation of Vermont (Coish and others, 1985; Ratcliffe, 1987a, b). These data, in conjunction with the observation that the enclosing Hoosac strata do not resemble rocks of the allochthons, indicate that the root zone for the Taconic allochthon was east of the restored position of the Mount Snow and Wilmington Lithotectonic Units. This is consistent with the suggestion of Stanley and Ratcliffe (1985) that the root zone for the Taconic allochthon was east of the Hoosac Formation but west of the Whitcomb Summit thrust, which thrusts metapelites and metabasalt of the Rowe Formation over the Hoosac Formation. Thus, the Wilmington and Mount Snow Lithotectonic Units in this report form the hanging wall of the Whitcomb Summit thrust of Stanley and Ratcliffe (1985).

STRUCTURAL GEOLOGY

Faults

The Mount Snow-Readsboro area is characterized by the slab-like shingling of the Lithotectonic Units by moderately to gently east dipping thrust faults. Two important north-south-trending thrust systems, the Searsburg fault system and the Wilmington fault system, divide the area into three Lithotectonic Units. Minor, but persistent, shear zones that lack major displacement occur within the Green Mountain massif in the northwest. These shear zones constitute the Shep Meadow fault and Rake Branch fault systems. The age and movement history of the faults is uncertain, but slickenlines on fault and cleavage surfaces suggest that the largest, most complex of these faults, the Searsburg fault system, may have experienced both Taconian and Acadian motion. Each mapped fault system has its own distinctive fault fabric and localized folding. Within the Mount Snow Lithotectonic Unit, early folds and foliation surfaces are truncated by the two enclosing fault systems. In the southwestern part of the map, the North Pond-Beaver Meadow fault thrusts the Hoosac Formation over both younger and older rocks in the Mount Snow Lithotectonic Unit. This fault is believed to be a splay of the Wilmington fault system, which becomes the Hoosac summit thrust of Stanley and Ratcliffe (1985) to the south in the Stamford and North Adams quadrangles (Ratcliffe, 1979b). Northward, the Wilmington fault system becomes a complex zone of thrust faulting known as the Cobb Brook thrust fault east of the Jamaica anticline (Karabinos, 1984).

Shep Meadow-Rake Branch fault system

Semiductile deformation in narrow, closely spaced zones of concentrated strain is developed within the Green Mountain Lithotectonic Unit, along the Shep Meadow and Rake Branch fault systems. These systems mark an important Taconian deformational front that has been mapped from the southern end of the Green Mountain massif northward to near Londonderry, Vt. (Ratcliffe and others, 1988, fig. 9). Despite the regional persistence of these shear zones, actual displacement appears to be slight. However, east of these faults, foliations of Paleozoic age are dominant in Middle Proterozoic rocks, and all rocks are characterized by a penetrative foliation and down-dip lineation. Rocks at, or near, the shear zones exhibit strong retrograde diaphthoritic metamorphism to muscovite-chlorite-epidote mineral assemblages and have been transformed locally into phyllonite. Minor folds within the fault zones are sheath folds and complex interference folds, which both have hinge lines that generally plunge down dip in a reclined fashion. Although highly variable, well-developed quartz rodding and hinge lines of microfolds plunge about S. 65° E. This rodding and hinge-line lineation are interpreted as the regional direction of movement of these thrust faults (Ratcliffe and others, 1988). A Taconian age was determined by $^{40}Ar/^{39}Ar$ dating of second generation biotite from unit Ybg at the southwestern tip of Somerset Reservoir (location 5) and from unit Yrr exposed in road cuts at the intersection of State Routes 8 and 9 at Searsburg (location 6) (Sutter and others, 1985). Additional dating by Ratcliffe and others (1988) and Burton and others (1990) suggests that retrograde mineral assemblages formed at biotite to garnet grade associated with the Rake Brook and Shep Meadow fault systems are also Taconian in age. Therefore, the faults, as well as associated folding, lineations, and retrograde metamorphism are all considered Taconian.

Searsburg thrust-fault system

The Searsburg thrust-fault system, east of the Green Mountain massif, is responsible for imbrication of many units of the Hoosac Formation. Individual exposures at or near fault traces display intense plication and disruption of S_1 schistosity, which is of presumed Taconian age, and a strong S_2 foliation related to the faulting. In addition, crenulation cleavage and brittle fractures form still later features, which are not universally developed but do indicate late reactivation. Zones of brittle reactivation are shown on the map. The lack of lepidoblastic mineral fabrics and the presence of later, younger brittle fractures suggest that fault activity in some parts of the Searsburg fault system postdated all dynamothermal metamorphism. Elsewhere, as within the Rake Branch and Shep Meadow faults, semiductile fabrics are present, and coarse porphyroblasts of garnet are superimposed on lineated and strongly S_2-foliated tectonites. The lineation is comparable to that found in the Shep Meadow and Rake Branch fault systems. From these observations the Searsburg fault system experienced both Taconian and Acadian age thrust faulting. Abundant exposures showing late postmetamorphic faulting are in unit €Zhcb along State Route 9 at the Mount Snow and Readsboro quadrangle boundary and about 0.5 km east. Here, brittle fractures, quartz-feldspar veins, and slickensides are abundant. Although the quartz-feldspar veins experienced minor movement along their walls, breccia and fault gouge are absent. Field relations suggest that the brittle faulting and veining were contemporaneous. The Lamb Brook fault, which forms a splay to the south and east, has similar brittle fractures. This type of fracturing is more abundant to the south near Readsboro.

Wilmington thrust-fault system

The Wilmington fault system is characterized by very well developed mylonitic fabric (S_2) and southeast-plunging lineation, which are similar to, but much more intense than, those in either the Rake Branch-Shep Meadow fault system or the Searsburg fault system. Along the east side of Mount Snow, the Wilmington fault truncates all of the cover rocks, as well as the Paleozoic F_1 and F_2 folds (see fold section). Intense lineation and augen structure are present in the Harriman Reservoir Granite along the entire length of its fault contact with other rocks. The fault surface is broadly folded, especially in the Harriman Reservoir area. Mylonitic fabrics and tectonic lineations similar to those in the Wilmington fault also characterize the North Pond-Beaver Meadow fault. Thus, this fault is included in the Wilmington thrust-fault system.

Rocks near the Wilmington thrust-fault system display ductile deformation fabric while being transformed into mylonite schist, mylonite gneiss, and true mylonite. Dynamic recrystallization of quartz, muscovite, biotite, plagioclase, and microcline accompanied faulting. As in the Searsburg thrust-fault system, late coarse porphyroblasts of garnet are superimposed on lineated tectonites near the fault. Evidence of brittle faulting and reactivation of faulting was not seen. Thus, the Wilmington thrust-fault system probably was active in Taconian and possibly Acadian times. A thrust fault of premetamorphic age (early Taconian) may separate unit €Zhcgt from the other units of the Hoosac Formation in the Mount Snow area; however, no rock fabric or clear-cut map relations support this interpretation. Minor belts of unit €Zhcq are interbedded with €Zhcb and €Zhcgt along their contact suggesting a depositional contact.

High-angle faults

Five high-angle faults of uncertain age have been mapped. These faults have brittle fracture arrays and abundant quartz and feldspar veining. A component of both reverse and strike-slip movement is indicated by orientation of slickenlines. Four of these faults occur in a zone of concentrated brittle fracturing and abundant chlorite-quartz veining that extends in a northwest direction between Readsboro and Heartwellville. The southernmost fault forms the western boundary of the small complex interference dome of unit Ybg 2 km southwest of Readsboro. This fault is exposed in a small abandoned working for fuller's earth shown by the abandoned quarry symbol. Abundant fractures suggest that the fault dips 60° to the northeast. This fault and the one immediately north of Readsboro are probably high-angle reverse faults. Two brittle faults intersect at Lamb Brook and the West Branch of the Deerfield River 2 km southeast of Heartwellville. Subvertical fractures N. 20° E. and N. 20° W. and abundant subhorizontal slickensides are present in and around both faults. Micro-offsets associated with the N. 20° E.–trending fault indicate right-lateral motion. The fifth fault, the Aldrich fault, is just north of Wilmington. It may be a reverse fault. Motion up from the west and a component of right slip is indicated from slickenlines present in unit €Zhrab in the footwall.

The age and origin of these faults are unknown. The widespread occurrence of quartz veins as far north as Jamaica indicates a regionally important system of late brittle fracturing. No large faults of this kind are known. Similarly, true breccia or gouge are not known, although net-veined wall rocks are present. Additional vein minerals associated with these faults are magnetite, chlorite, plagioclase, and tourmaline. Quartz veins in this region most commonly trend between N. 25° E. and N. 45° E. The subvertical attitudes of many of the faults and veins and right-lateral strike-slip motion suggest generally northeast-southwest compression.

Folds

Axial traces of five fold sets are recognized. The oldest folds, of probable Middle Proterozoic age (YF), are recognized only in the Green Mountain Lithotectonic Unit. A coarse gneissosity is present in the Middle Proterozoic units and is subparallel to very tight isoclinal folds having steeply dipping axial surfaces. These folds cause small-scale symmetrical repetition of map units. Two generations of Middle Proterozoic folds are recognized in the Stratton Mountain area to the north (Ratcliffe and Burton, 1989). One fold set (YF_1) formed before the 1244-Ma intrusion of the College Hill Granite (Ratcliffe and Aleinikoff, 1990). A second dynamothermal event (YF_2) was completed before the intrusion of rapakivi granites of the Cardinal Brook Intrusive Suite at about 960 Ma (Ratcliffe and Aleinikoff, 1990). These latter YF_2 structures are ascribed to the Ottawan phase of the Grenville orogeny of Moore and Thompson (1980). The YF folds shown on this map probably represent the later Ottawan phase of folds. Middle Proterozoic folds are not recognized in the Mount Snow and Wilmington Lithotectonic Units because of intense Paleozoic folding.

Paleozoic folds F_1 and F_2 are believed to be Taconian (Late Ordovician), and the F_3 and F_4 folds are probably Acadian (Early Devonian). The earliest, F_1 folds, are deduced from map patterns that suggest that folds older than the F_2 folds existed, as well as from outcrop-scale folds in which the regional F_2 folds fold an older schistosity and also refold mesoscopic-scale folds of an older generation. The Mount Snow and Wilder Brook synclines represent two F_1 structures on the geologic map. Both of these synclines are internal to the Mount Snow Lithotectonic Unit. They have general northwest-southeast trends, are highly folded, and exhibit vergence both to the southwest and northeast. This change in vergence along the axial trace results from folding of the axial surface through the vertical. As a consequence, the F_1 limbs are also steeply dipping and subvertical in places, as shown in the cross sections.

F_2 folds are expressed by a penetrative schistosity (S_2) that crosscuts a still older schistosity (S_1). The axial traces of F_2 folds are subparallel to the major thrust faults and boundaries between the Lithotectonic Units. F_2 deformation is more intense near thrust faults, where lineated and foliated tectonite is present. Hinge lines of folded S_1 schistosity commonly plunge south-southeast. Mesoscopic sheath folds and partial sheath folds, both of which are recognized by their curvilinear hinge lines, are common. F_2 folds in the Readsboro and Atherton Meadow areas are arcuate, south-verging folds having gently north dipping axial surfaces and downdip plunges. Coarse porphyroblasts of garnet and albite are superimposed on the schistosity and lineation associated with the

F_2 folds, whereas biotite, muscovite, and ilmenite best define the F_2-related foliation.

Cross folding along northeast and northwest trends are assigned to the F_3 and F_4 folding events respectively. In the cross sections and on the map these folds are best expressed in folds of the S_2 surfaces because of the gentle, rather regular, sheetlike dip of F_2 faults and associated structures. The northwest-trending folds appear to be the latest, although this relationship is difficult to determine in outcrop. Commonly the F_3 and F_4 folds are expressed in outcrop by open folds, and the nearly upright axial surface of both is accentuated by a crenulation cleavage in schistose rocks or by a spaced cleavage in more brittle rocks. North of Wilder Brook in the Readsboro quadrangle and from there northward into Mount Snow quadrangle is a well-developed north- to slightly northeast striking crenulation cleavage. This crenulation cleavage is axial planar to a north-south set of late folds attributed to the F_3 event. If F_3 folds, they were rotated into a north-south orientation by the later F_4 folding event. Alternatively this set of north-south folds may represent a still younger F_5 fold set that is known to exist in quadrangles to the east (Ratcliffe, unpublished data).

METAMORPHISM

Proterozoic regional metamorphism of at least hornblende-granulite grade transformed rocks of the Mount Holly Complex prior to emplacement of the Cardinal Brook Intrusive Suite. Coarse hornblende, green diopside, coarse-grained graphite, and scapolite are among the common minerals surviving this old event. Beyond this area, the assemblage garnet-sillimanite-microcline–perthite-biotite-quartz is present in quartz-rich paragneiss, thus indicating that at least second sillimanite and probably hornblende-granulite facies conditions had once developed.

Paleozoic metamorphism increases from biotite grade in the northwest to garnet grade in the central and eastern part of the map; minerals become coarser eastward (Skehan, 1961). Garnet generally occurs east of and above the Searsburg thrust system, where 1–2-cm-sized euhedral garnets are common in units €Zhcgt and €Zhg. Most of the coarse garnets and coarser grained porphyroblasts formed after the F_2-folding event and characteristically exhibit static overgrowth textures of the S_1 schistosity and the S_2 foliation. Chloritoid is widespread in unit €Zhcgt and present locally in unit €Zhcb. Unusually coarse, 3–5-cm-diameter, inclusion-filled garnets having clear overgrowth rims are present in the aluminous schist unit €Zhcgt north of Whitingham. The coarse overgrowth rims indicate that the last metamorphic (static) event produced the high-grade mineral assemblages. An age of 376±5 Ma was determined on $^{40}Ar/^{39}Ar$ from hornblende from the Turkey Mountain metabasalt member just north of Wilmington and less than 1 km east in the West Dover quadrangle (Sutter and others, 1985). This indicates that rocks east of the Wilmington fault system underwent high-grade Acadian metamorphism, probably at temperatures above 500° C. Two biotite $^{40}Ar/^{39}Ar$ plateau ages of 446±4 Ma and 436±4 Ma were determined from two biotite samples from localities 5 and 6 in the Mount Holly Complex west of the Searsburg fault system (Sutter and others, 1985). They suggest that recrystallization of biotite was Taconian and not Acadian (389 Ma); the Taconian now is believed to be about 450 Ma (Hames and others, 1990). The foliated biotite that was sampled at each of these two localities was taken from zones of penetrative F_2 Paleozoic foliation similar to that which overprints rocks east of the Rake Brook and Shep Meadow fault zones. In thin section the dated biotites are green, lepidoblastic grains oriented in a strongly, dynamically recrystallized matrix of quartz, epidote, and albite; such textures are common to the F_2 shear zones within the Rake Branch-Shep Meadow fault system. Biotite from unit Ybg in the large road cut 1 km east of Medburyville on State Route 9 (location 7) yielded a plateau age of 363±3 Ma; thus, this biotite formed in the Acadian, or was reheated above 280° C (its retention temperature) in the Acadian (Sutter and others, 1985).

The argon ages cited above suggest that Acadian metamorphism of biotite grade and higher was overprinted on the area east of the Searsburg fault system. Brittle faults, which formed a postmetamorphic fault fabric and associated structures, in the Searsburg fault system suggest the possibility of telescoping of both the Taconian and Acadian metamorphic zones against the Green Mountain massif in the Acadian by reactivation of the Searsburg fault system.

Pressure and temperature estimates of Acadian metamorphism obtained by Armstrong from the Hoosac Formation (€Zhcgt) 0.5 km east of the Searsburg fault system were 6.5 kb (approximately 22 km deep) and 476° C (Ratcliffe and others, 1992). Ten km northeast of the Mount Snow-Readsboro quadrangles, similar rocks from the southern nose of the Athens dome were estimated to have had pressures of 9 kb (32 km deep) and temperatures of approximately 520° C. These estimates of Armstrong suggest that rocks now exposed east of the Green Mountain massif in southern Vermont experienced Acadian deformation and metamorphism in an eastward–thickening tectonic wedge. However, the argon age data suggest that rocks 5 km west of the Searsburg fault system did not experience Acadian reheating above 280° C.

TECTONIC SYNTHESIS

Paleozoic cover rocks of the Hoosac Formation along the eastern margin of the Green Mountain massif and Middle Proterozoic basement rocks in the southeast occur in imbricate Taconian fault slices that were later refolded during Acadian deformation. Reactivation of older (Taconian) thrust faults may have accommodated Acadian compression and produced disharmonic folding and cross folding (Ratcliffe, 1990). Major thrust faults are marked by mylonitic fold-thrust fabric and a prominent southeast-plunging extension lineation that formed during a second stage of Paleozoic deformation (F_2 event). Metamorphic F_1 folds, only preserved within the slices, were refolded during the F_2 thrust event. These older folds effected all units of the Hoosac Formation including aluminous schists (unit €Zhcgt) that have been emplaced on early metamorphic or premetamorphic thrust faults.

Acadian refolding along northeast, northwest, and possibly north axial traces produced interference folds, domes, and basins that produced the antiformal exposures of Middle Proterozoic rocks along the western margins of the Rayponda and Sadawga domes. These domal areas appear to result from interference of low amplitude flexures of thin imbricated slices of basement and cover rocks and not a diapiric rise—that is, by crustal shortening instead of vertical tectonics.

Late brittle faulting on subvertical faults and injection of abundant quartz, tourmaline-quartz, or feldspar-quartz veins are evident. Gentle plunges of slickenlines on the faults indicate a large component strike-slip movement, as well as reverse motion. The veins and faults probably are of late Acadian age, although a younger age is possible. Similar faults on College Hill in the

Jamaica area contain syngenetic muscovite that yielded an $^{40}Ar/^{39}Ar$, near-plateau age of 360 Ma, which suggests that the brittle faults may be 360 Ma and no younger (Ratcliffe and others, 1988).

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