Monson Rodgers Bedrock Compilation Sheet (paper)

Map

NOTICE!

Bedrock quadrangle 1:24,000 scale compilation sheets for the Bedrock Geological Map of Connecticut, John Rodgers, 1985, Connecticut Geological and Natural History Survey, Department of Environmental Protection, Hartford, Connecticut, in Cooperation with the U.S. Geological Survey, 1:125,000 scale, 2 sheets. [minimum 116 paper quad compilations with mylar overlays constituting the master file set for geologic lines and units compiled to the State map, some quads have multiple sheets depicting iterations of mapping]. Compilations drafted by Nancy Davis, Craig Dietsch, and Nat Gibbons under the direction of John Rodgers.

Geologic unit designation table translates earlier map unit nomenclature to the units ultimately used in the State publication.

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signed to rocks in the Merrimack synclinorium in southern New Hampshire Billings, 1956, Greene, 1970). The age of the regional metamorphism in this part of southern New England is thought to be Middle Devonian (Acadian), with overprinting by a later Pennsylvanian event (Thompson and Norton, 1968). Pelitic schists in the Bolton syncline (see map) contain kyanite and staurolite, which indicate that the middle grades of metamorphism were attained in the western third of the quadrangle. Pelitic schists of the Brimfield Group, however, contain the mineral pair sillimanite and potassium feldspar with no muscovite, thus indicating that these rocks reached the highest amphibolite or granulite facies. Two hypothetical isograds would exist in pelitic schists between the two areas. These are: (1) the first appearance of sillimanite with muscovite and (2) the appearance of sillimanite with potassium feldspar, but without muscovite. However, these isograds cannot be directly delineated because of the quartzofeldspathic composition of the Monson Gneiss.

BRONSON HILL ANTICLINORIUM SEQUENCE Layered rock units of the Bronson Hill anticlinorium sequence include, from oldest to youngest, the Monson Gneiss (exposed along a central belt of rocks showing steep dips) and the Ammonoosuc, Partridge, Clough, and Littleton Formations (exposed in the Bolton syncline). Rock units and contacts are well exposed on the east limb of the syncline and, in general,

poorly exposed on the west limb of the syncline. The Monson Gneiss underlies the Ammonoosuc on the east limb of the Bolton syncline, north of the Massachusetts-Connecticut State line. Layered Monson rocks would probably have been considered a lower felsic part of the Ammonoosuc in New Hampshire (Billings, 1956). The Monson layered gneiss probably originated as volcaniclastic sediment, and the massive Monson Gneiss probably originated as shallow sills that were emplaced during the volcanism. Some of the more massive gneisses and migmatitic lenses may have formed by partial mobilization of some Monson rocks

The Ammonoosuc Volcanics are divisible into upper felsic (Oaf) and lower mafic (Oaa) units. Contacts between the two units are gradational and intermixing occurs in both units. Most Ammonoosuc rocks are medium to fine grained and distinctly layered. They probably originated as accumulations of water-worked volcanic detritus. The thinly layered quartz-plagioclase-biotite-(garnet) gneiss of the felsic unit south of Peaked Mountain grades laterally into weakly layered to massive felsic gneiss with an aplitic texture in the Stafford Springs quadrangle (Pease, 1975) to the south. The massive amphibolite (Oama), mapped as inclusions in the Glastonbury Gneiss, is considered an Ammonoosuc unit. Similar massive amphibolite occurs with layered amphibolite as inclusions in the Glastonbury Gneiss of the Hampden quadrangle (Peper, 1977) to the west, and similar massive amphibolite also forms two very thin sills in the mafic unit: (1) about 4400 ft (1341 m) N. 13 E. of the north end of Bruie Pond, and (2) about 4200 ft (1280 m)

N. 38 W. of the intersection of Bumstead and May Hill roads. The Partridge Formation is exposed only in three thin lenses on the east limb of the Bolton syncline, but it is thick and continuous on the west limb. In most areas the unit consists of predominantly pelitic schist. Thin layers of calc-silicate-bearing gneiss and amphibolite are abundant only on the west limb of the syncline, south of the Massachusetts-Connecticut State line. The Clough Quartzite unconformably overlies the Partridge and the felsic unit of the Ammonoosuc. The locally angular nature of the unconformity at the base of the Clough is best evidenced in map pattern and outcrop on the northeast slope of West Hill, where the angular divergence of the strike of relict bedding in units above and below the unconformity is as great as 35 degrees. In addition, aerial photographs of the area extending for a distance of 3500 ft (1.1 km) southward from the unnamed fault trending northwest across Peaked Mountain display a consistent northeastward divergence of strike ridges of the Ammonoosuc upper felsic unit of as much as 20 degrees from the northward strike of rocks at the base of the Clough.

The Littleton Formation occupies the lower topographic elevations along the axial trace of the Bolton syncline, and this unit rests on the Clough Quartzite and Partridge Formation. Littleton schist is poorly exposed, and the distribution of this unit must be inferred from the distribution of the underlying units. The Glastonbury Gneiss forms the core of the Glastonbury dome—a major

elongate anticline west of the Bolton syncline. The dome extends southward from the southern part of the adjacent Palmer quadrangle to the vicinity of Middle Haddam, Conn. The Glastonbury also forms a sill near the base of the Ammonoosuc on the east limb of the Bolton syncline in the southern part of the Monson quadrangle. Exposed Ammonoosuc-Glastonbury contacts are chiefly concordant. Near the contact, however, small sills and dikes of Glastonbury cut Ammonoosuc rocks on the east limb of the syncline about 1500 feet (457 m) north of Crow Hill Road, and, on the west limb of the syncline, about 3500 feet (1069 m) S. 55 W. of Butler Cemetery. The Glastonbury is regionally foliated and is post-Ammonoosuc and pre-Acadian in age. The Glastonbury is not known to cut Silurian and Devonian rocks. A whole-rock rubidium-strontium age of 355 m.y. was obtained by Brookins and Hurley (1965) from Glastonbury Gneiss in the Middle Haddam and Glastonbury quadrangles of Connecticut. This age would require homogenization of strontium in the Glastonbury in the late Acadian (Leo and others, 1977) without necessarily melting it. A post-Ammonoosuc Ordovician primary magmatic age would be most consistent with the observed field relationships of the Glastonbury.

BOLTON SYNCLINE AND POSTSCHISTOCITY MODIFICATIONS The Bolton syncline, a major regional syncline, extends northward from Great Hill in the Middle Haddam quadrangle of Connecticut (Eaton and Rosenfeld, 1960) through Bolton Notch, Connecticut (Aitken, 1955), into northern Massachusetts. The syncline is recognized in the Monson quadrangle by the repetition of rock units on either side of the axial surface. Early minor folds with axial-plane schistosity plunge less than 45 degrees to the south and north, thus indicating that the synclinal axis remains chiefly subhorizontal through the quadrangle, with the largest axial depression at the latitude of the intersection of Wood Hill and Lower Hampden Roads. Postschistosity modifications of the syncline include refolding by folds with axial-plane cleavage, intrafolial thrust faulting, and oblique faulting. The sequence of structural events is well illustrated by minor folds and faults in the Clough Quartzite in the area north of Crow Hill Road. Although the outcrop pattern of the unit here is a simple band, the internal structure of the Clough is complex. Rocks in the eastern half of the band are folded by: (1) south-plunging early folds with axial-plane schistosity and refolded by (2) south-plunging folds with axial-plane cleavage that cuts schistosity and bedding on the limbs of the first folds. Rocks in the western half of the band form a steeply west-dipping homocline. A thrust fault, marked by a narrow zone of sheared rock, separates the folded rocks on the east from the homocline on the west. The thrust fault is offset by an oblique fault exposed in the narrow gully that crosses the ridge crest. To the north on Peaked Mountain, north-plunging dextral folds, having axial-plane cleavage that dips moderately to steeply west, thicken the outcrop width of the Clough band. n the vicinity of Hampden Road, the Clough is inferred to be repeated twice by thrust faulting. The westernmost thrust fault is marked by a narrow zone of crushed rock near the east base of the 930 foot-high hill east of Butler Road, as well as by an offset of foliation trends across the narrow gully containing the fault on the south slope of West Hill. Note also that both primary and secondary minor folds show the local map sense of offset of units along the east limb of the syncline, thus suggesting that the Clough was offset in part by folding before thrusting occurred; there need not be great displacement on the thrust faults to produce the present map configuration. The traces of two major oblique faults are marked by narrow gullys where they cross ridge crests on the east limb of the syncline across West Hill Road and southeast of Butler Cemetery. Small offsets of mapped unit contacts suggest that maximum apparent strike-slip movements along these faults are of the order of 200–800 feet (60–245 m). The trace of the small oblique fault on the southeast slope of the unnamed hill northwest of Butler Cemetery is marked by a closely spaced cleavage and retrograde chloritization of mafic Ammonoosuc rocks.

MERRIMACK SYNCLINORIUM SEQUENCE Lavered rock units of the Merrimack synclinorium sequence in the Monson quadrangle are the upper schist member of the Hamilton Reservoir Formation and the Mount Pisgah Formation. These metamorphosed sedimentary and volcanic rocks are intruded by sills and semiconco: dant bodies of late syntectonic igneous rocks similar, in style of intrusion, to bodies assigned to the New Hampshire Plutonic Series (Devonian) by Billings (1956). These rocks include: (1) foliated porphyritic quartz monzonite (Dfpg here; in part the Coys Hill Granite of Emerson, 1917); (2) foliated diorite and quartz diorite (Dfqd; in part the Hardwick Granite of Emerson, 1917, and equivalent to the diorite of Pomeroy, 1974, 1977); and (3) foliated granite

The upper schist member of the Hamilton Reservoir Formation is chiefly heterogeneous rusty-weathering schist and gneiss (hus) with minor lenses of

gray-weathering gneiss(husg, metasiltstone), fissile sulfidic schist

(huss, metamorphosed euxinic shale), and thin lenses of mafic and felsic gneiss (husa, metamorphosed volcanic or volcaniclastic debris). These rocks are assigned to the upper schist member, because they overlie a thick sequence of Hamilton Reservoir schist and gneiss to the east of the Hollow Brook fault (Peper and others, 1975). It is important to note that the Hamilton Reservoir Formation in the type area in the Wales quadrangle (Seiders, 1976) is complicated by numerous strike faults, so that its difficult to demonstrate the vertical relationships of the various members. Upper parts of the formation to the west could be lateral equivalents of rocks which are mapped as lower parts of the formation to the east.

The Mount Pisgah Formation overlies the Hamilton Reservoir Formation with structural conformity. Gradational contacts between the two units are well exposed at numerous localities such as Dearth Hill, Tupper Hill, the unnamed hill east of Moulton Hill, and the unnamed hills north and south of Munn Road. At these localities, well-layered, rusty-weathering Hamilton Reservoir gneiss, conspicuously lacking the heterogeneous components of thin calc-silicate, felsic, or mafic bands so characteristic of the lower parts of this unit, grades by interlayering over distances of 10-20 feet (3-6 m) into the cyclically layered, quartz-rich, gray-weathering ribbed gneiss of the Mount Pisgah.

FOLDING AND FAULTING EAST OF MONSON GNEISS

The fault-complicated area east of the Monson Gneiss contains three isoclinal synclines and two intervening anticlines, overturned to the southeast, that are modified or offset by later postschistosity folding, faulting, and cataclasis. The axial traces of the anticlines and synclines converge southward and are truncated or offset by faults at or near the Monson contact. Outcrop patterns suggest that fold axes are subhorizontal and plunge gently northeastward. The outcrop width of the Mount Pisgah bands narrows southwestward, and the outcrop width of Hamilton Reservoir bands narrows northeastwards. The easternmost syncline, the Mount Pisgah, is recognized chiefly by facing directions from relict bedding in the lower part of the unit in the area of the Norcross Ponds northeast of Tupper Hill. It has been traced from the Monson Gneiss border at the southern edge of the Stafford Springs quadrangle (Pease, 1977) to the northern part of the Warren quadrangle (Pomeroy, 1977), where the axial trace lies about 4.5 miles (7.2 km) east of the Monson. The syncline is offset and repeated along the Alden Brook fault in the Monson and Stafford Springs quadrangles. The axial trace of a second syncline trends northeast across South Nichols Mountain. Mount Pisgah rocks along the axial trace and west limb of this syncline are breached by sills of quartz monzonite and diorite. A third synclinal axis is inferred to plunge northeast in the area of no bedrock exposure along the Bonemill Brook fault near the northern border of the Monson quadrangle. This syncline has been mapped along the fault through the Palmer quadrangle. Minor folds in the eastern third of the quadrangle record mainly postschistosity shearing and crumpling. A common fold type is an open to tightly compressed dextral fold. These folds usually have an axial-plane marked by a thin zone or seam of protomylonite or blastomylonite oriented parallel, or subparallel to regional schistosity and relict bedding, and they also usually have a south or west-plunging axis. These folds indicate that early intrafolial movements were right lateral, with western blocks moving north relative to eastern blocks. In outcrops along Blanchard Road on the unnamed hills south of Conant Brook Reservoir, as well as in the spillway cut of the reservoir, later faults cut and displace the cataclastic seams. Clearly the sense of folding near faults may not be a reliable indicator of the latest movements on the faults.

Four major faults which parallel the regional strike are shown on the geologic map. The Hollow Brook fault, the easternmost strike fault, joins the Bonemill Brook fault in the Stafford Springs quadrangle and dies out to the northeast in the Warren quadrangle. The Alden Brook fault splays northward from the Hollow Brook fault in the Stafford Springs quadrangle, and it is marked by shear surfaces in outcrops along the upper reach of Alden Brook. The Alden Brook fault right laterally offsets the approximately located axial trace of the Mount Pisgah syncline a distance of 3.7 miles (6 km). The block Foskett Mill Stream fault produces shear surfaces in outcrops in the narrow gully west of Moulton Hill Cemetery and in the stream near South Nichols Mountain. It splays off the Bonemill Brook fault and probably does not extend far north of the vicinity of South Nichols Mountain, because the contacts between the map units mpg, Dfgd, and hus northeast of North Nichols Mountain, are not sheared in the Warren quadrangle (Pomeroy, 1977). The Bonemill Brook fault is evidenced by narrow zones (20 feet (6 m)) of cataclastic schist in outcrops east of the fault in the Stafford Springs, Monson, and Palmer quadrangles. The position of the trace of the fault through most of the Monson quadrangle is inferred from the positions of these outcrops and, more closely, from the position of the eastern edge of the magnetic terrane of high relief, which is associated with the Monson and is shown on aeromagnetic map of the quadrangle (U.S. Geological Survey,

ECONOMIC GEOLOGY

Quarrying of the Monson Gneiss for building stone is reported by Emerson (1917) at the old Flynt quarry. In addition, rock of the upper felsic unit (Oaf) of the Ammonoosuc Volcanics and the Clough Quartzite (Sc) were quarried, probably for hearthstone, on the east limb of the Bolton syncline near the southern edge of the quadrangle.

Recent sliding on joint and foliation surfaces is evidenced by small denuded areas on the southeast slope of Peaked Mountain. Although onsite investigations are needed to evaluate the stability of a particular area, the joint and foliation data shown on the map are a guide to planes of possible weakness in potential problem sites.

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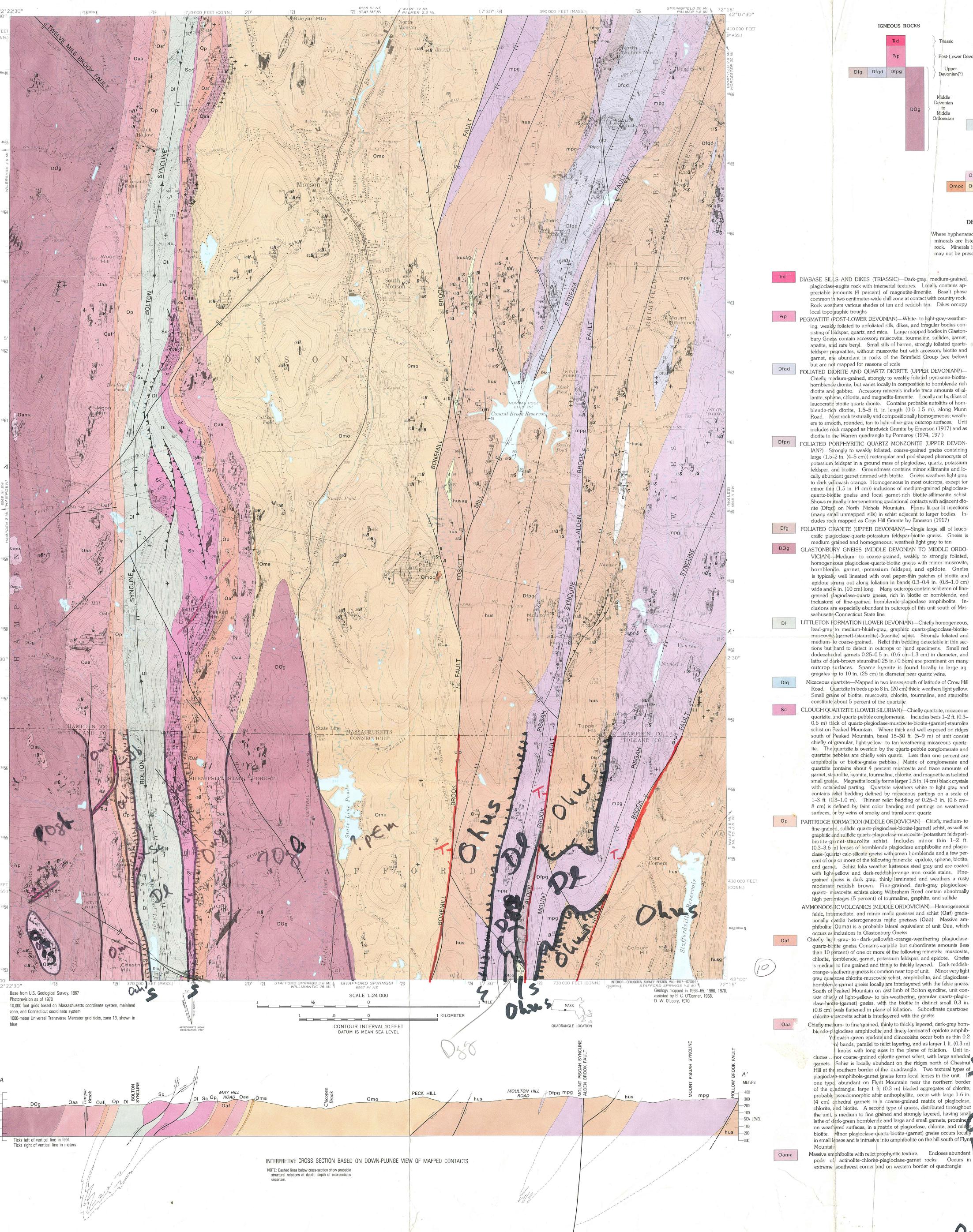
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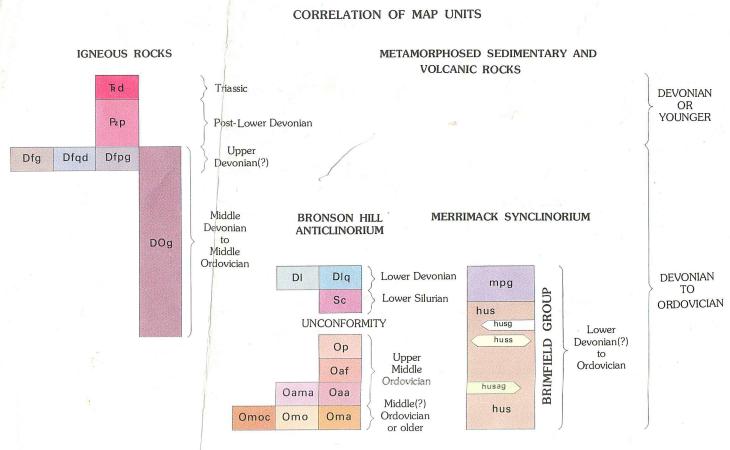
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GEOLOGIC QUADRANGLE MAP MONSON QUADRANGLE, MASSACHUSETTS-CONNECTICUT BEDROCK GEOLOGY GQ-1374

CORRELATION OF MAP UNITS



DESCRIPTION OF ROCK UNITS

Where hyphenated mineral names are used as adjectives in rocks names, minerals are listed generally in decreasing order of abundance in the rock. Minerals in parentheses show great variability in abundance and may not be present in every sample of the rock type

DIABASE SILLS AND DIKES (TRIASSIC)—Dark-gray, medium-grained, plagioclase-augite rock with intersertal textures. Locally contains appreciable amounts (4 percent) of magnetite-ilmenite. Basalt phase common in two centimeter-wide chill zone at contact with country rock. Rock weathers various shades of tan and reddish tan. Dikes occupy local topographic troughs PEGMATITE (POST-LOWER DEVONIAN)—White- to light-gray-weathering, weakly foliated to unfoliated sills, dikes, and irregular bodies con-

sisting of feldspar, quartz, and mica. Large mapped bodies in Glastonbury Gne'ss contain accessory muscovite, tourmaline, sulfides, garnet, apatite, and rare beryl. Small sills of barren, strongly foliated quartzfeldspar pegmatites, without muscovite but with accessory biotite and garnet, are abundant in rocks of the Brimfield Group (see below) but are not mapped for reasons of scale FOLIATED DIORITE AND QUARTZ DIORITE (UPPER DEVONIAN?)-Chiefly medium-grained, strongly to weakly foliated pyroxene-biotitehornblence diorite, but varies locally in composition to hornblende-rich diorite and gabbro. Accessory minerals include trace amounts of allanite, sphene, chlorite, and magnetite-ilmenite. Locally cut by dikes of leucocratic biotite quartz diorite. Contains probable autoliths of horn-

Road. Most rock texturally and compositionally homogeneous; weathers to smooth, rounded, tan to light-olive-gray outcrop surfaces. Unit includes rock mapped as Hardwick Granite by Emerson (1917) and as diorite in the Warren quadrangle by Pomeroy (1974, 197) FOLIATED PORPHYRITIC QUARTZ MONZONITE (UPPER DEVON-IAN?)—Strongly to weakly foliated, coarse-grained gneiss containing large (1.5-2 in. (4-5 cm)) rectangular and pod-shaped phenocrysts of potassium feldspar in a ground mass of plagioclase, quartz, potassium feldspar, and biotite. Groundmass contains minor sillimanite and locally abundant garnet rimmed with biotite. Greiss weathers light gray to dark yellowish orange. Homogeneous in most outcrops, except for minor thin (1.5 in. (4 cm)) inclusions of medium-grained plagioclasequartz-biotite gneiss and local garnet-rich biotite-sillimanite schist. Shows mutually interpenetrating gradational contacts with adjacent diorite (Dfqd) on North Nichols Mountain. Forms lit-par-lit injections (many small unmapped sills) in schist adjacent to larger bodies. In-

cludes rock mapped as Coys Hill Granite by Emerson (1917) FOLIATED GRANITE (UPPER DEVONIAN?)—Single large sill of leucocratic plagioclase-quartz-potassium feldspar-biotite gneiss. Gneiss is medium grained and homogeneous; weathers light gray to tan ASTONBURY GNEISS (MIDDLE DEVONIAN TO MIDDLE ORDO-VICIAN)-Medium- to coarse-grained, weakly to strongly foliated, homogeneous plagioclase-quartz-biotite gness with minor muscovite, hornblende, garnet, potassium feldspar, and epidote. Gneiss is typically well lineated with oval paper-thin patches of biotite and epidote strung out along foliation in bands 0.3-0.4 in. (0.8-1.0 cm) wide and 4 in. (10 cm) long. Many outcrops contain schlieren of finegrained plagioclase-quartz gneiss, rich in biotite or hornblende, and inclusions of fine-grained hornblende-plagioclase amphibolite. Inclusions are especially abundant in outcrops of this unit south of Mas-

LITTLETON FORMATION (LOWER DEVONIAN)—Chiefly homogeneous, lead-gray to medium-bluish-gray, graphitic quartz-plagioclase-biotitemuscovita-(garnet)-(staurolite)-(kyanite) schist. Strongly foliated and medium- to coarse-grained. Relict thin bedding detectable in thin sections but hard to detect in outcrops or hand specimens. Small red dodecahedral garnets 0.25-0.5 in. (0.6 cm-1.3 cm) in diameter, and laths of dark-brown staurolite 0.25 in. (0.6 cm) are prominent on many outcrop surfaces. Sparce kyanite is found locally in large aggregates up to 10 in. (25 cm) in diameter near quartz veins. Micaceous quartzite—Mapped in two lenses south of latitude of Crow Hill Road. Quartzite in beds up to 8 in. (20 cm) thick; weathers light yellow.

Small grains of biotite, muscovite, chlorite, tourmaline, and staurolite constitute about 5 percent of the quartzite CLOUGH QUARTZITE (LOWER SILURIAN)—Chiefly quartzite, micaceous quartzite, and quartz-pebble conglomerate. Includes beds 1–2 ft. (0.3– 0.6 m) thick of quartz-plagioclase-muscovite-biotite-(garnet)-staurolite schist on Peaked Mountain. Where thick and well exposed on ridges south of Peaked Mountain, basal 15-30 ft. (5-9 m) of unit consist chiefly of granular, light-yellow- to tan weathering micaceous quartzite. The quartzite is overlain by the quartz-pebble conglomerate and quartzite pebbles are chiefly vein quartz. Less than one percent are amphibolite or biotite-gneiss pebbles. Matrix of conglomerate and quartzite contains about 4 percent muscovite and trace amounts of garnet, staurolite, kyanite, tourmaline, chlorite, and magnetite as isolated small grains. Magnetite locally forms larger 1.5 in. (4 cm) black crystals with octahedral parting. Quartzite weathers white to light gray and contains relict bedding defined by micaceous partings on a scale of 1-3 ft. (0.3-1.0 m). Thinner relict bedding of 0.25-3 in. (0.6 cm-

8 cm) is defined by faint color banding and partings on weathered surfaces, or by veins of smoky and translucent quartz PARTRIDGE FORMATION (MIDDLE ORDOVICIAN)—Chiefly medium- to fine-grained, sulfidic quartz-plagioclase-biotite-(garnet) schist, as well as graphitic and sulfidic quartz-plagioclase-muscovite-(potassium feldspar)biotite-garnet-staurolite schist. Includes minor thin 1-2 ft. (0.3-3.6 m) lenses of hornblende plagioclase amphibolite and plagioclase-(quartz) calc-silicate gneiss with green hornblende and a few percent of one or more of the following minerals: epidote, sphene, biotite, and garnet. Schist folia weather lustreous steel gray and are coated with light yellow and dark-reddish orange iron oxide stains. Finegrained gneiss is dark gray, thinly laminated and weathers a rusty moderate reddish brown. Fine-grained, dark-gray plagioclasequartz- muscovite schists along Wilbraham Road contain abnormally high percentages (5 percent) of tourmaline, graphite, and sulfide AMMONOOS JC VOLCANICS (MIDDLE ORDOVICIAN)—Heterogeneous felsic, intermediate, and minor mafic gneisses and schist (Oaf) gradationally overlie heterogeneous mafic gneisses (Oaa). Massive amphibolite (Oama) is a probable lateral equivalent of unit Oaa, which

occurs as inclusions in Glastonbury Gneiss Chiefly light-gray- to - dark-yellowish-orange-weathering plagioclasequartz-biglitte gneiss. Contains variable but subordinate amounts (less than 10 percent) of one or more of the following minerals: muscovite, chlorite, hornblende, garnet, potassium feldspar, and epidote. Gneiss is medium to fine grained and thinly to thickly layered. Dark-reddishorange-weathering gneiss is common near top of unit. Minor very light gray quarzose chlorite-muscovite schist, amphibolite, and plagioclasenornblenge-garnet gneiss locally are interlayered with the felsic gneiss. South of Peaked Mountain on east limb of Bolton syncline, unit consists chiefly of light-yellow- to tan-weathering, granular quartz-plagioclase-biotite-(garnet) gneiss, with the biotite in distinct small 0.3 in. (0.8 cm) svals flattened in plane of foliation. Subordinate quartzose chlorite-muscovite schist is interlayered with the gneiss Chiefly medium- to fine-grained, thinly to thickly layered, dark-gray horn-

n) bands, parallel to relict layering, and as larger 1 ft. (0.3 m) knobs with long axes in the plane of foliation. Unit includes .. por coarse-grained chlorite-garnet schist, with large anhedral garnets. Schist is locally abundant on the ridges north of Chestnut Hill at the southern border of the quadrangle. Two textural types of plagioclase-amphibole-garnet gneiss form local lenses in the unit. In one type abundant on Flynt Mountain near the northern border of the quadrangle, large 1 ft (0.3 m) bladed aggregates of chlorite, probably pseudomorphic after anthophyllite, occur with large 1.6 in. (4 cm) anhedral garnets in a coarse-grained matrix of plagioclase, chlorite, and biotite. A second type of gneiss, distributed throughout the unit, is medium to fine grained and strongly layered, having small laths of clark-green hornblende and large and small garnets, promine on weathered surfaces, in a matrix of plagioclase, chlorite, and min biotite. Minor plagioclase-quartz-biotite-(garnet) gneiss occurs locally in small lenses and is intrusive into amphibolite on the hill south of Flynt

Massive amphibolite with relict prophyritic texture. Encloses abunc pods of actinolite-chlorite-plagioclase-garnet rocks. Occurs in extreme southwest corner and on western border of quadrangle

Omo MONSON GNEISS (MIDDLE? ORDOVICIAN OR OLDER)—Texturally diverse, layered and massive, leucocratic plagioclase-quartz-biotite-(hornblende)-(potassium feldspar)-(magnetite) gneiss interlayered with hornblende-plagioclase amphibolite at base of Ammonoosuc Volcanics. Most plagioclase [oligoclase-andesine]-quartz gneiss is medium to coarse grained and banded light to medium gray on a scale of 0.5-2 in. (1.3-5.1 cm), due to alternations in biotite content. Mafic minerals (biotite and hornblende) form less than 15 percent of the rock. About 50 percent of the gneiss samples contain biotite (average 5.7 percent) and no hornblende. Biotite/hornblende ratios vary from 1:1 to 3:1. The gneiss contains trace garnet, epidote, and magnetite. Some lightcolored gneiss is plagioclase-quartz-potassium feldspar-biotite gneiss with trace amounts of epidote, garnet, muscovite, and magnetite. Numerous thin (0.8-1.5 in. (2-4 cm)) veins and dikes of fine-grained plagioclase-quartz-magnetite-(biotite) gneiss cut the layered light gneisses in the quarry east of Flynt Mountain; coarser grained plagioclase-quartz-biotite gneiss shows intrusive contacts with layered gneiss on the hill northeast of the substation at South Monson. Hornblendeplagioclase amphibolite with minor epidote and quartz occurs in layers up to 50 feet (15 m) thick but is typically less than 3 feet (1 m) thick. Amphibolite makes up about 10 percent of the bedrock exposures and is most abundant near margins of Omo unit. Coarser-grained amphibolite abundant near center of unit forms topographic peaks such as Peck Hill and hills southwest of Monson Amphibolite—Identical to amphibolite in Omo. Mapped as a single lens

Very coarse-grained amphibolite—contains large 3-4 in. (8-10 cm) laths of hornblende in a matrix of coarse-grained plagioclase and abundant (20–30 percent) purple-gray cordierite. Mapped as a small pod east of

BRIMFIELD GROUP The age prefix has been omitted from the following letter symbols in order to keep them as short as possible mpg MOUNT PISGAH FORMATION (LOWER DEVONIAN? TO ORDO-VICIAN?)—Light-to medium-gray- and brownish-gray-weathering, medium- to coarse-grained quartz-plagioclase-(potassium feldspar)-biotite-garnet-sillimanite gneiss and subordinate schist of similar mineralogy. Gneiss is strongly layered on a scale of 1–3 in. (3–8 cm). Relict graded bedding, obscured by coarse recrystallization and dikes and veinlets of leucocratic plagioclase-quartz-potassium feldspar gneiss, is detectable at many localities. Relict beds grade from quartz-rich quartz-plagioclasebiotite gneiss, forming ridges on outcrop surfaces, upwards into gneiss richer in garnet and biotite. Coarsely recrystallized pelite, with large 1-1.5 in. (3-4 cm) anhedral garnets rimmed with potassium feldspar and with abundant fibrolitic sillimanite and coarse biotite folia in matrix, forms upper part of relict bed. Schist is very thickly layered. Unit

> relict beds of light-gray quartz-plagioclase-biotite-diopside-garnet granofels. Minor sulfidic schist UPPER SCHIST MEMBER OF THE HAMILTON RESERVOIR FORMA-TION (LOWER DEVONIAN TO ORDOVICIAN?)—Heterogeneous

includes thin 1.0-1.5 in. (3-4 cm) relict beds of white quartzite and thin

unit consisting chiefly of rusty-weathering schist and gneiss Rusty-weathering schist and gneiss—Chiefly quartz-plagioclase-potassium feldspar-biotite-garnet sillimanite schist and gneiss of similar mineralogy. Schist and gneiss are medium to coarse grained. Augen of potassium feldspar, 0.3–1.3 in. (0.8–3.3 cm), are common in the schist. Gneiss is well layered on a scale of 0.3-4 in. (0.8-10 cm), due chiefly to alternations in content of garnet, biotite, and sillimanite. Many outcrops contain one or more thick (8 in. (20 cm)) layers of fissile, sulfidic, and graphitic sillimanite-rich schist; also thin layers of dark-gray, finegrained, dense quartz-plagioclase granofels. Thin veins of leucocratic plagioclase-quartz-potassium feldspar-(garnet)-(biotite) rock occur in many outcrops parallel to compositional layering

Gray-weathering gneiss in minor lenses—Small lens in the southeast corner is not exposed in Monson quadrangle, but unit is exposed in adjacent Wales quadrangle (Seiders 1976) Fissile, graphitic, and sulfidic sillimanite schist

Amphibolite and plagioclase-quartz-(clinopyroxene)-(hornblende)-biotite-BEDROCK OUTCROPS—Closely ruled lines show areas of abundant

outcrops and thin drift. Solid color shows individual outcrops visited on field traverses. Many small outcrops shown only by structure symbol.

Note: Commonly used symbols are printed on the map jacket; a separately printed list is available on request from the U.S. Geological Survey intact—Approximately located; queried where probable; dotted under

Loose blocks of beds Abandoned rock qui

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BEDROCK GEOLOGIC MAP OF THE MONSON QUADRANGLE, MASSACHUSETTS AND CONNECTICUT