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GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGIC MAP OF THE EASTFORD QUADRANGLE WINDHAM AND TOLLAND COUNTIES, CONNECTICUT

By
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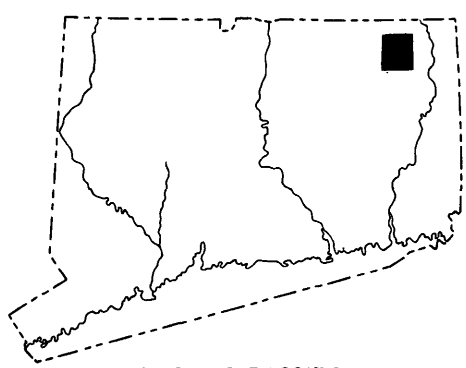

QUADRANGLE LOCATION

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GEOLOGIC MAP OF THE EASTFORD QUADRANGLE, WINDHAM AND TOLLAND COUNTIES, CONNECTICUT

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INTRODUCTION

The Eastford quadrangle, northeast Connecticut, is underlain by high-grade, regionally metamorphosed rocks of Paleozoic age covered in part by Pleistocene deposits. The bedrock formations strike northeast, although they trend more easterly toward the southwest. Bedding faces northwest and the dip gradually steepens from southeast to northwest. An older compact till as much as 75 feet thick forms about 140 drumlins and streamlined hills; a younger friable till blankets most of the upland areas, thinning on hill crests. Glaciofluvial deposits, mostly of ice-contact origin, occur in the principal stream valleys and in isolated upland patches.

A major northeast-trending fault, the Eastford fault, separates two distinct groups of rocks. To the northwest are rocks herein named the Bigelow Brook Formation and the Southbridge Formation that are on strike with but not entirely correlative with the Brimfield Schist and Paxton Quartz Schist. The Bigelow Brook Formation structurally overlies the Southbridge Formation and in the Eastford quadrangle, the Southbridge Formation is bounded on the southeast by the Eastford fault, and the Black Pond fault forms the contact between the two formations. The top of the Bigelow Brook Formation is not exposed. These formations predate the Acadian orogeny and are pre-Middle Devonian (Ordovician(?) to Silurian(?)) in age.

The Hebron Formation, Scotland Schist, and Eastford Gneiss southeast of the Eastford fault are overturned according to Dixon (in Dixon and Pessl, 1966). The Eastford Gneiss intrudes the Hebron Formation. The age of these rocks also appears to be pre-Middle Devonian.

Master faults trend northeast, subparallel to the regional strike, and cross faults trend N. 30° W. to N. 15° E. Thrust movement on both the Eastford and Black Pond faults has been southeastward. The Keach Pond fault coincides with the sillimanite-potassium feldspar isograd which marks the absence of prograde muscovite to the northwest (see Lundgren, 1966, p. 424).

STRATIGRAPHIC UNITS

All formations exposed in this quadrangle are of sedimentary or volcanoclastic origin. Most rocks are conspicuously layered and locally have cross laminations and gradational changes in grain size and composition that are believed to be relic sedimentary structures defining top-facing directions.

The dark- and light-gray biotite gneisses and schists and less common amphibolite lenses of the Southbridge Formation were mostly waterlain pyroclastic rocks of rhyolitic to basaltic composition; their sporadic calc-silicate mineral content was derived from calcareous cement and lime mud. The sillimanitic garnetiferous biotite schist and gneiss of the Bigelow Brook Formation were originally aluminous and iron-rich mudstones derived perhaps from a lateritic source; an abundance of sulfide and graphite in these schists and gneisses suggests deposition in an euxinic environment. The gray granular schists and gneisses which predominate in this formation were less aluminous sandstones and siltstones and the less common greenish-gray calc-silicate layers were lime-rich mudstones. The uniformly thin-layered, fine-grained, biotite schist of the Hebron was a thin-bedded sequence of calcareous-cemented sandstone and siltstone that contained reworked pyroclastic debris.

Details of lithology and thickness of the stratigraphic units are given in figures 1–3. Figure 1 diagrammatically illustrates the minimum amounts of stratigraphic section cut out along faults and includes only rocks of the Southbridge and Bigelow Brook Formations. Figures 2 and 3 show a composite columnar section with lithologic description of the Bigelow Brook and Southbridge Formations and rocks southeast of the Eastford fault, respectively.

Southbridge Formation.—The Southbridge Formation consists of a lower and upper member. The lower member is characterized by an alternation of dark-gray biotite gneiss and schist with lighter gray quartz-feldspar gneiss, and by the presence of ¼ to ¾ inch subhedral feldspar crystals commonly askew to foliation and layering. Exposures southeast of Kenyonville are generally more homogeneous and contain fewer felsic layers than equivalent strata in the northeast corner of the quadrangle. In both areas, the base of the formation is cut out by the Eastford fault.

The upper member, mostly medium- to dark-gray schist and gneiss, is more heterogeneous than the lower member. It includes interlayers closely resembling the overlying Bigelow Brook Formation and a few lenses of amphibolite. The contact between the upper and lower members is immediately beneath the lowest garnetiferous or sulfidic layer of the upper member and therefore may not be at the same stratigraphic position in the two widely separated areas of outcrop. In both areas the contact is poorly exposed and isolated by faults.

Biotite-muscovite-garnet-sillimanite gneiss (SOsug), near the base of the upper member in the northeast corner of the quadrangle resembles rocks of the Bigelow Brook Formation but has more quartz and less sillimanite. The biotite-sulfide-graphite schist (SOsus), in the same area resembles sulfidic schist of the Bigelow Brook but lacks sillimanite, potassium feldspar, and garnet.

The two layered amphibolites ($SOsua_1$ and $SOsua_2$) of the upper member are exposed only in the southwestern part of the quadrangle where they are separated by about 3,600 feet of stratigraphic section. Rocks exposed above the upper amphibolite ($SOsua_2$), south of the west-trending part of the Black Pond fault, are extrapolated as slightly higher in the section than rocks exposed northeast of Chamberlain Pond (fig. 1, columns III and X); they are lithologically similar to rocks exposed near the northern border of the quadrangle in the narrow fault ridge on the east side of the Black Pond fault, but stratigraphic correlation is not possible. The top of the Southbridge Formation is truncated by the Black Pond fault.

Bigelow Brook Formation.—The Bigelow Brook Formation is mostly brownish-gray, biotite-sillimanite-garnet gneiss and schist, interlayered with which are calc-silicate- and sulfide-graphite-bearing units. The formation is distinguished from the Southbridge by its browner color and greater abundance of sillimanite and garnet. Biotite is generally reddish-brown rather than olive brown as in the Southbridge. The base of the Bigelow Brook Formation is cut out by the Black Pond fault.

Rocks exposed between the Black Pond and Keach Pond faults and northeast of Crystal Pond Brook are considered the oldest rocks in the Bigelow Brook Formation; they are described in figure 2 as mica-garnet-sillimanite gneiss and include the poorly exposed rusty schist unit ($SObr_1$). Overlying these rocks and southwest of Crystal Pond Brook in the same fault block are rocks described in figure 2 as biotite-muscovite-garnet-sillimanite gneiss. Prograde muscovite is present in the rocks of this fault block.

Thin units of calc-silicate schist and rusty-weathering, graphitic, sulfidic, biotite schist and gneiss are widely distributed within the formation, but only the most conspicuous of these units have been mapped. Two calc-silicate units (SObdb and SObsb), form excellent marker units northwest of the Keach Pond fault; they can be traced in faulted segments across the northwest corner of the quadrangle. Rusty schist and gneiss units are most common above the scapolitic biotite schist marker unit (SObsb); calc-silicate schist is most common below this marker unit. The top of the Bigelow Brook Formation is not exposed in the quadrangle.

Hebron Formation.—The Hebron Formation is a homogeneous sequence of dark-gray to olive-gray fine-grained, thinly layered biotite schist with accessory hornblende, pyroxene, muscovite, and garnet. The Hebron is truncated on the northwest by the Eastford fault. Dixon (in Dixon and Pessl, 1966) mapped the Hebron Formation as overturned in the Hampton quadrangle to the south and some overturning is evident near the southern edge of the Eastford quadrangle west of Phoenixville. Rocks west of the trace of the overturned anticline in Bigelow Brook, however, are right-side-up. The overturned contact between the Hebron and younger Scotland Schist in the extreme southeast corner of the quadrangle is projected from the Hampton quadrangle (Dixon and Pessl, 1966).

Scotland Schist.—The Scotland Schist is not exposed in the Eastford quadrangle. Dixon (in Dixon and Pessl, 1966) described it as a biotite-muscovite schist; the lower part, which projects into this quadrangle in the subsurface, is muscovite poor.

INTRUSIVE ROCKS

The Eastford Gneiss is a gently northward-plunging sill-like body of gneissoid quartz monzonite that intrudes the Hebron Formation. The metamorphic foliation in this gneiss strikes generally north-northeast and dips westward approximately parallel to the regional foliation. North of Nightingale Pond crinkled biotite foliation, masked by the regional foliation may represent an early igneous foliation. The diverse attitudes of this foliation suggest that the gneiss was folded, possibly during the overturning of the Hebron. Gneissoid pegmatite, interleaved with the layered rocks, increases in abundance to the northwest. Sparse gneissoid quartz diorite and gabbro intertongue locally with the pegmatite. Thin two-mica granite dikes cross-cut the regional foliation.

STRUCTURE

Folds with wavelengths of 100 to 1,000 feet, locally overturned, are common in the upper member of the Southbridge Formation. Asymmetric folds with wavelengths mostly less than a foot occur in all formations; most show a consistent west-over-east sense of movement. Axes of most small-scale folds plunge gently north-northwest approximately parallel to the regional mineral lineation, and axial planes dip northwest parallel to the regional foliation.

The traces of most faults in the Eastford quadrangle are along narrow, linear, shallow troughs where bedrock is covered by glacial debris. Recognition of the faults is based mainly on offset of stratigraphic units, changes in lithology and metamorphic grade, and abrupt variations in the attitude of foliation and bedding. Fault surfaces and zones containing cataclastic rock and ultramylonite are rarely exposed. Small faults, joints, and microfractures are more closely spaced near faults. Potassium feldspar is common in the microfractures. Dips may steepen near faults, and the sense of movement is commonly shown by the alinement of quartz-feldspar rodding and sillimanite needles normal to the axes of plunging asymmetric folds.

The type of movement on master faults is uncertain because their traces are so nearly parallel to the regional foliation that stratigraphic displacement is difficult to detect. Most thin stratigraphic units traced into northeast-trending fault troughs are not found in opposite fault blocks. The units evidently were truncated by faulting. The apparent displacement was large, but along strike, facies changes may account for their total absence across fault traces. The sense and amount of displacement of cross faults commonly can be measured, however, by offset of stratigraphic units.

The attitude and sense of movement on the Eastford fault is indicated locally by minor structural features such as asymmetric folds and down-dip mineral rodding. Stratigraphic displacement with upward movement of the northwest block is indicated by juxtaposition of the older Southbridge Formation with the younger Hebron Formation. Upward displacement of the northwest block in conjunction with northeastward strike slip is also indicated by the angular relation of the faults bounding the triangular-shaped horst surrounding Kenyonville.

The magnitude of displacement is sufficiently great that rock units on opposite sides cannot be correlated within the quadrangle, a distance of at least 9 miles. By projection of the contact between the upper and lower members of the Southbridge Formation from Kenyonville northeastward to the northern border of the quadrangle, the apparent minimum stratigraphic displacement is approximately 8,000 feet. Loss of section on the Eastford fault, as shown in figure 1, is of the same order of magnitude, and the absence of the Eastford Gneiss on the northwest also suggests large-scale movement.

The Black Pond fault is an east-trending low-angle thrust near the western border of the quadrangle. In this area, axial planes of crinkle drag folds in the upper plate (loc. 16) strike easterly and dip 20° to 40° north. These folds are asymmetric in a right-handed west over east sense and their crests are commonly ruptured by minor thrusts with the same sense of movement. Quartz and feldspar rods and sillimanite lineation plunge down the dip of these drag folds. Similarly oriented but less deformed drag folds are exposed beneath the fault surface. About one half mile east of the quadrangle border (loc. 13) the fault trace swings abruptly northward and the dip appears to steepen. Highly sheared rusty schist of the Bigelow Brook Formation in the upper plate dips steeply westward, and dark-gray amphibolite gneiss of the Southbridge Formation in the footwall contains closely-spaced, U-shaped folds with almost horizontal axes and axial planes that strike about N. 20° E. and dip 45° SW to vertical.

An apparent stratigraphic displacement of 4,700 feet is estimated for the southern part of the Black Pond fault as shown in figure 2 by the stratigraphic interval between locality 13 below and locality 16 above the fault. Stratigraphic displacement diminishes unevenly northward, and near the northern border of the quadrangle the section lost as measured from figure 1, column X, is only 500 feet.

Minor structural features indicate that the Keach Pond fault is a reverse fault dipping steeply northwest. It probably is within the upper plate of the Black Pond fault. Northward truncation of stratigraphic units on the west side of the Keach Pond fault and intense shearing, and retrograde metamorphism at its north end suggest that displacement on the fault increases northward. The largest apparent stratigraphic displacement on the Keach Pond fault, measured in figure 1, column VIII, is about 4,500 feet, assuming zero displacement where the Keach Pond joins the Black Pond fault (fig. 1, column III).

No fossils have been found nor radiometric ages determined for rocks in the Eastford quadrangle. Dixon and Lundgren (1968) consider the stratified metamorphic rocks in the Eastford quadrangle to be the Brimfield, Hebron, and Scotland Formations of pre-Silurian to Devonian age overturned on the upper limb of a folded recumbent syncline. Present mapping has not confirmed this interpretation. The contact between the formations they presumed to be Hebron and Brimfield approximates the trace of the Eastford fault; rocks northwest of the fault are in a homoclinal but faulted sequence in which relic sedimentary structures, such as crossbedding and channelling, indicate tops to the northwest. This thick west-facing sequence, detailed in figure 2, has not been described elsewhere in New England, and on strike to the southwest the geology is not yet understood.

Emerson (1917, p. 77-78) correlated the Paxton and Brimfield with the Oakdale Quartzite and fossiliferous Worcester Phyllite respectively, and on this basis assigned them a Carboniferous age. The Brimfield Schist in southeastern Connecticut is now assigned a Middle(?) Ordovician or older age on the basis of a tentative correlation (see summary by Rodgers and others, 1959, p. 19, 25) with the Partridge Formation exposed in the Bronson Hill anticlinorium in western New Hampshire and in central Massachusetts, but the Partridge Formation is much thinner than the Brimfield.

A more reasonable interpretation would be that the Paleozoic succession on the Bronson Hill anticlinorium represents the thin western margin of the Merrimack synclinorium, a broad geosynclinal basin that extends from Connecticut through Maine (Dixon and Lundgren, 1968; Osberg and others, 1968), and that the Bigelow Brook and Southbridge Formations are a thick sequence of rocks deposited east of the anticlinorium in the center of a broad geosyncline and not completely represented elsewhere in New England. Their age is unknown, but these rocks show broad lithologic similarities to much of the Ordovician to Lower Devonian sequence in central Maine and New Hampshire.

According to Dixon (in Dixon and Pessl, 1966; in Dixon and Lundgren, 1968) the Hebron is probably Devonian or older in age, overlying the Tatnic Hill Formation and underlying the Scotland Schist in southeastern Connecticut. Because the Hebron is separated from the Southbridge and Bigelow Brook Formations by the Eastford fault, its age relative to these formations is not known. The Scotland Schist according to Dixon (in Dixon and Pessl, 1966; in Dixon and Lundgren, 1968) is overturned and structurally underlies the Hebron. The Scotland is Early Devonian or older in age.

The Eastford Gneiss has structural and textural features that suggest crystallization during regional metamorphism. It is correlated with the syntectonic New Hampshire Plutonic Series of Devonian age by Page (1968). Pegmatites and other orthogneiss exposed in the quadrangle also appear to be syntectonic and similar in age. The granite dikes are not foliated and therefore are post-regional metamorphism and post-Early Devonian.

ECONOMIC GEOLOGY

Metallic mineral deposits.—Finely divided pyrite and pyrrhotite are important accessory minerals in several stratigraphic intervals of the Southbridge Formation; graphite associated with the sulfides has been mined in adjacent quadrangles. There is no evidence in the Eastford quadrangle, however, of local concentrations of metallic minerals. Spectrographic analyses of 50 samples collected from stream sediments show no significantly anomalous values for the 32 elements reported. Silver was not detected, mercury occurs in amounts less than 0.15 ppm, and all but 3 samples contain less than 0.1 ppm of gold with a maximum of 0.2 ppm. Copper, even in the sulfide-rich rocks of the Southbridge Formation was no more than 15 ppm.

Nonmetallic minerals.—The glaciofluvial and younger fluvial deposits are interstratified, poorly-sorted gravel and sand. These supplies are ample for the present rural community, but are inadequate for future housing development or highway construction. Kame-delta deposits near the confluence of Still River and Bungee Brook are the principal source of well-sorted sand; extensive sand deposits also occur east of Harakleys Pond, near the confluence of Mashamoquet and Lyon Brooks, and along English Neighborhood Brook. Most gravel deposits are bony and rusty and require washing and sieving for use as concrete aggregate. Clay deposits underlying many swamp deposits deserve further investigation as a source of brick clay.

The Eastford Gneiss was once quarried for dimension stone and several of the small quarries are still recognizable between Angel Brook and Quarry Road. Pegmatite and sillimanite gneiss are abundant in the Bigelow Brook Formation but are not in sufficient concentration to be of present commercial value.

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