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Reconnaissance Bedrock Geologic Map of the South Royalton Quadrangle, Vermont

by

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INTRODUCTION

The purpose of this map is to provide data in support of some new ideas on the stratigraphy of the rocks in the Connecticut Valley trough of east-central Vermont (fig. 1) (Hatch, 1988). The recognition of locally widespread graded beds in recent detailed and reconnaissance mapping has compelled a rethinking of the stratigraphic relationships between some of the major units of the trough.

The earliest mapping in the area was done by Hitchcock (1861). In the early 1900s Richardson (1927; Richardson and Cabeen, 1923) studied the rocks of eastern Vermont. The granitic rocks of the quadrangle were studied by Dale (1909, 1923) and by Balk (1927). In the late 1950s, Ern (1963) mapped the Randolph 15'quadrangle, of which the South Royalton 7 1/2' quadrangle forms the southeast quarter. Ern's (1963) mapping, with only minor changes, was included in Doll and others' (1961) Centennial geologic map of the state. In 1980 Fisher and Karabinos published a report on a study of the previously unreported graded beds in the Townshend-Brownington syncline belt of Gile Mountain Formation well exposed along and near the White River.

RESULTS OF NEW WORK

Reconnaissance remapping of the Connecticut Valley trough north of 43° 30' in the mid 1980s has indicated that the graded beds reported by Fisher and Karabinos (1980) are present in the Townshend-Brownington syncline belt of Gile Mountain at least as far north as 44° 40'. These graded beds indicate that the Gile Mountain Formation stratigraphically overlies the Waits River Formation throughout the belt.

In addition, identical graded beds are present, locally, in the Northfield. These graded beds, where they are exposed near the Northfield-Waits River contact north of the South Royalton Quadrangle, indicate that the Northfield is stratigraphically above, rather than below (Doll and others, 1961), the Waits River Formation. If this interpretation is correct, the Northfield occupies the same stratigraphic position as the Gile Mountain Formation (Hatch, 1988), and is reasonably intprpreted as a more distal facies of the western belt of the Gile Mountain Formation. Therefore it is here proposed that the Northfield be changed from a separate formation at the bottom of the trough sequence to a formal member at the top of the Gile Mountain Formation along the west edge of the trough. This relationship requires that the west margin of the trough, commonly known as the R.M.C., be a fault, in agreement with the conclusions of Westerman (1987) on the basis of field textural data. Westerman

(1987) has named this fault the Dog River fault zone. The stratigraphic relationships discussed above have been more thoroughly documented by Hatch (1988).

The belt of Northfield shown here is significantly wider (as wide as 3 km) than shown by Ern (about 0.4 km) (1963) and Doll and others (1961). This wider belt is mapped on the basis of several factors. First, highway cuts along Interstate Route 89 made after Ern's mapping was complete have provided some excellent fresh exposures. Second, the presence of Northfield/Gile Mountain-like graded beds in the eastern (previously mapped as Waits River Formation) part of the area here mapped as Northfield strongly suggests a close affinity to Northfield/Gile Mountain. And third, because the Northfield has long been recognized as containing some thin beds of calcite-quartz-mica granofels, and the Waits River Formation has not been reported to contain any graded quartzite beds, it seems more appropriate to map Northfield-like phyllites interbedded with calcite-quartz-mica granofels in beds as much as a few meters thick as Northfield Member of the Gile Mountain Formation rather than Waits River Formation.

STRUCTURE

The rocks of the South Royalton quadrangle have been folded at least twice, and metamorphosed to as high as kyanite grade (Ern, 1963). The first stage of folding produced tight to isoclinal folds with a well-developed axial surface schistosity. Although these isoclinal folds are relatively common in outcrop scale, particularly in the rhythmically graded member of the Gile Mountain Formation, only locally are reversals in topping direction noted which are interpreted as due to isoclinal folding. The schistosity that commonly parallels bedding is attributed to this first stage of isoclinal folding.

The second stage of folding produced somewhat more open folds observable small examples of which are present throughout the quadrangle. They are indicated on the map by the symbol for folds that fold schistosity, and they have axial surfaces that most commonly strike northeast and dip northwest They generally develop an axial surface cleavage which, particularly in the southern part of the quadrangle, is quite widespread. This cleavage commonly becomes sufficiently well developed that it becomes a schistosity. On the map, no attempt is made to distinguish first from second stage schistosity; the map symbol is purely descriptive with no interpretation, as is also true for fabrics mapped as cleavage. However, schistosity that strikes generally north and dips steeply and/or is parallel to bedding is almost certainly first generation, and schistosity that strikes northeast and dips northwest, whether or not it can be seen to cut an earlier schistosity, is probably second generation. The large folds that produce the present distribution of map units are interpreted to have formed by a combination of these two fold generations.

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EXPLANATION

| 9 | <u>"Bethel granite"</u> (Middle (?) Devonian)

Exposed in one body about 1400 m north-south and 200 m east-west in the northwest corner of the quadrangle, and in one outcrop to the east on U.S. Interstate Route 89. Well exposed in two quarries within the main body. Locally known as the "Bethel white granite". The bulk of the rock is medium to coarse grained, very light colored, and is composed, in approximate decreasing order of abundance, of quartz, oligoclase, potash feldspar (predominantly orthoclase), muscovite, and minor biotite. Concentrations of biotite in orbicules are particularly common in the west wall of the southern of the two quarries. No isotopic age on the Bethel is known, but the body is thought to be late syn- to post-tectonic

Gile Mountain Formation (Lower Devonian)

Dgn Northfield Member

Underlies approximately the western 1/4 of the quadrangle. Consists predominantly of massive, dark-gray, fine-grained muscovite-quartz-chlorite-garnet-biotite graphitic phyllite. Locally includes beds as much as a meter thick of light-gray, medium- grained calcite-quartz-mica granofels. This granofels is characterized by a variably thick (locally as much as 4 or 5 cm) punky-brown weathering rind. These punky-brown weathering granofels beds are characteristic of the underlying Waits River Formation into which the Northfield is gradational. The two units are distinguished by the much higher percentage of punky-brown granofels in the Waits River. Also locally present in the Northfield are beds, generally 10 to 25 cm thick, which grade from light-gray, fine-grained micaceous quartzite into increasingly dark-gray aluminous phyllite identical to the phyllites just described. These graded beds are indistinguishable in appearance from the graded beds of the rhythmically graded member of the Gile Mountain Formation a few km to the east. They are mapped as part of the Northfield on the basis of a higher percentage of interbedded dark-gray phyllite and the presence of the beds of punky brown-weathering granulite

Dgr Rhythmically graded member

Underlies a north-south belt, the Townshend-Brownington syncline, 2 to 5 km wide through the central part of the quadrangle. Rhythmically graded beds generally 10 to 25 cm thick grading from light- to medium-gray, fine-grained micaceous quartzite to dark-gray muscovite-quartz-biotite-(garnet)-(chlorite) graphitic phyllite. Beds are almost universally graded particularly in the eastern part of the belt. In the western part of the belt are local exposures of faintly bedded to unbedded dark-gray graphitic phyllite identical to that in the Northfield Member

Dgq Thick-bedded micaceous quartzite member

Mapped only in the extreme southeast corner of the quadrangle. Consists of beds as much as 2 m thick of gray-brown, medium- to coarse-grained micaceous quartzite consisting primarily of quartz and biotite with minor chlorite, plagioclase, garnet, and accessories. Muscovite is rare or absent. Not seen in this quadrangle in the course of present mapping. Contact with DSv drawn on the basis of data from adjoining quadrangles and from Ern (1963).

DSv Metavolcanic rocks (Lower Silurian (?) to Lower Devonian)

Mapped only in the southeast corner of the quadrangle. Previously mapped (Ern, 1963; Doll and others, 1961) as Standing Pond Volcanic Member of the Waits River Formation. Rocks are chiefly dark-green amphibolite, garnet amphibolite, greenstone, and feldspar-chlorite-actinolite schist. Not seen in this quadrangle during current mapping; contacts drawn on the basis of data from adjoining quadrangles and from Ern (1963).

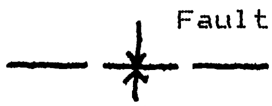
DSw <u>Waits River Formation</u> (Lower Silurian to Lower Devonian)

Forms two north-south belts across the quadrangle, one on each side of the belt of the rhythmically graded member of the Gile Mountain Formation. Formation consists predominantly of dark-gray phyllite, indistinguishable from the phyllite of the Gile Mountain Formation, and punky brown-weathering, medium- to light-gray, fine- to medium-grained calcite-quartz-mica granofels. Beds generally range from about 25 cm to as much as 10 m in thickness. The Waits River is distinguished from the overlying Gile Mountain Formation by the much greater thickness and abundance of beds of calcite-quartz-mica granofels and the near absence of beds of micaceous quartzite in the Waits River. The phyllites in the eastern belt of Waits River appear to have more quartz veins and to be somewhat less aluminous in composition than the phyllites in the western belt. Furthermore, the percentage of calcite-quartz-mica granofels appears to be higher in the eastern belt than in the western.

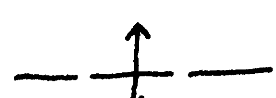
pt <u>Pre-trough rocks undifferentiated</u> (Missisquoi Formation of Doll and others (1961)). Mapped only in the southwest corner of the quadrangle. Consists predominantly of green and gray slate and phyllite and chlorite schist, feldspathic schist and gneiss, biotite gneiss and amphibolite.

Contact, approximately located.

Fault, approximately located



syncline

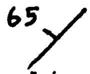


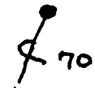
anticline

Approximate location of the trace of the axial surface of a large fold

PLANAR FEATURES

Where two symbols for planar or linear features are combined, their intersection marks the point of observation. Where two symbols for planar features are combined with one or more symbols for linear features, the point of observation is the intersection of the symbols for planar features.

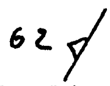




Inclined Vertical Overturned

Strike and dip of bedding

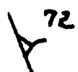
Ball indicates top of beds known from sedimentary structures.
Position of 90 on vertical bed indicates top



Inclined Vertical

Strike and dip of schistosity

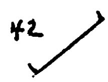
Relation to bedding not apparent in outcrop



Inclined Vertical Overturned

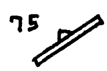
Strike and dip of parallel bedding and schistosity

Ball indicates top of bedding known from sedimentary structures. Position of 90 on vertical bedding indicates top

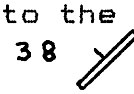


Inclined

Strike and dip of cleavage



Strike and dip of axial surface of small fold that folds bedding; schistosity is parallel to the axial surface

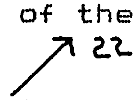


Strike and dip of axial surface of fold that folds schistosity (bedding either parallel to schistosity or not apparent in outcrop); no cleavage observed

Strike and dip of axial surface of fold that folds schistosity (bedding either parallel to schistosity or not apparent in outcrop); cleavage is parallel to axial surface

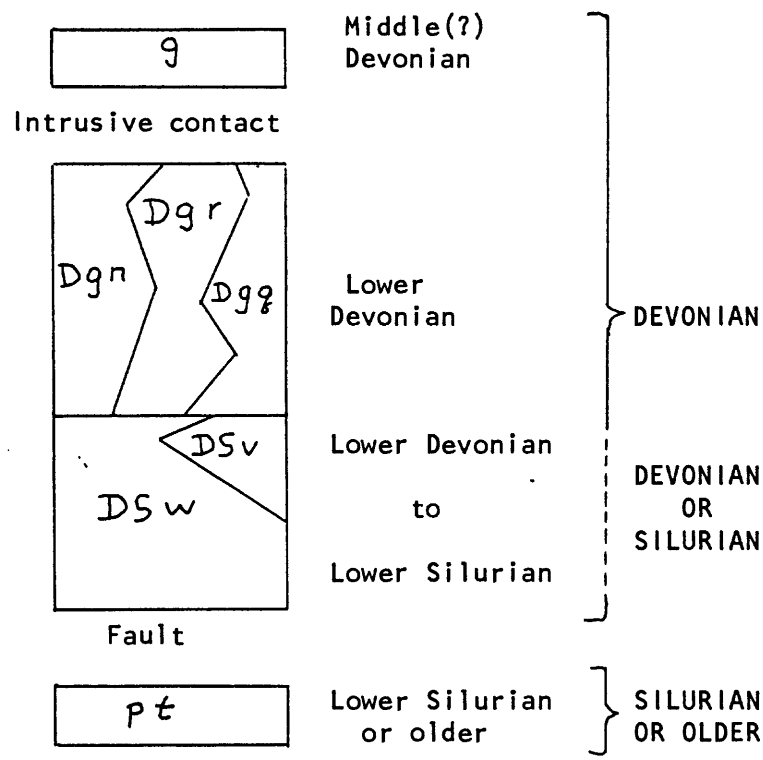
LINEAR FEATURES

May be combined with any of the above planar features



Bearing and plunge of axis of small fold or crinkle.
Where combined with the symbol for the axial surface of a fold, indicates the bearing and plunge of the axis of that fold

CORRELATION OF MAP UNITS



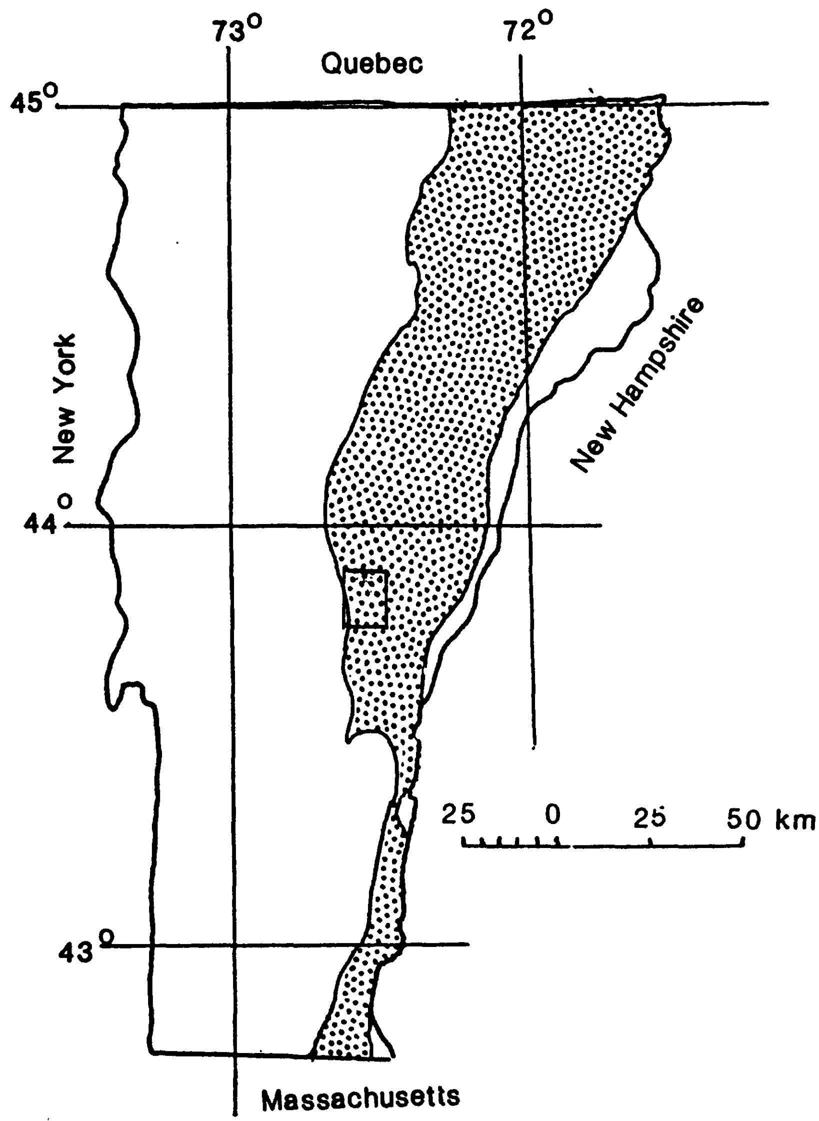


Figure 1. Outline map of Vermont showing the area of the Connecticut Valley trough (patterned) and the location of of the South Royalton quadrangle (rectangular outline).