

STRATIGRAPHY AND METAMORPHISM NEAR THE TOWNSEND RESERVOIR,
SOUTHEASTERN VERMONT

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The remarkable exposure of bedrock in the spillway of the Townsend Reservoir in southeastern Vermont provides an excellent opportunity to examine the lithologic sequence and metamorphic history of the rocks present. The study area flanks both the western side of the Athens Dome and the eastern side of the Green Mountain massif. The Green Mountains and Athens Dome are cored by Precambrian Grenville rocks; the units separating them are late Proterozoic to Paleozoic in age.

According to Doll et al. (1961), the rock units in the study area follow the stratigraphic sequence, whereas Stanley and Ratcliffe (1985) argue that thrust faults have eliminated some of the units.

In the field a detailed survey was taken of the rocks in the reservoir spillway. Abundant outcrops both upstream and downstream of the reservoir also were mapped and examined.

A cross section of the Townsend reservoir spillway, a map of rocks upstream of the reservoir, and studies of thirty thin sections of the units were used to compare the lithologic sequence found in the field with that of Doll et al. (1961). These units were also compared among themselves for evidence of the repetition of layers and thrust faulting.

FIELD OBSERVATIONS

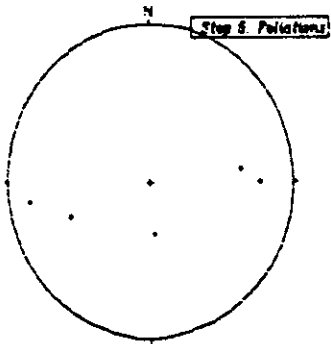
Most of the field work for this study was in the spillway of the Townsend reservoir. The outcrop was divided into seven units based on composition. The units are the following: pelitic albite schist; thinly layered (1-2m); pelitic schist (some mafic layers); fine grained Mafic Schist; rusty pelitic garnet schist; fine grained mafic schist; graphitic pelitic garnet schist; fine grained mafic schist; and pelitic schist. Although the nature of the pelitic schists, many of which contain large (>1cm) garnet porphyroblasts, varies substantially, the fine grained mafic schists are indistinguishable from each other. Predominantly, the beds in each unit dip nearly vertical and strike at 030. Complex and small scale folds are common, as are boudinaged layers.

Southeast of the spillway the albite schist outcrops for nearly a third of a kilometer, to where a quartz rich pelitic schist with interbedded mafic layers occurs. Further down, almost a kilometer past the spillway, the Bull Hill gneiss outcrops.

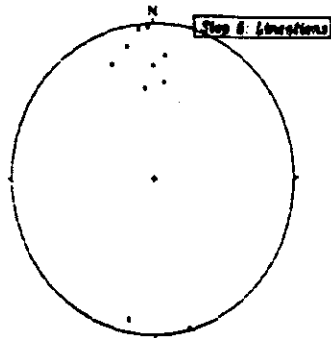
Northwest of the reservoir, along the West River, the rocks are similar to those found in the spillway. They are loosely divided into three units: a pelitic schist of varying composition; a mafic schist; and a pelitic garnet schist.

PETROGRAPHIC OBSERVATIONS

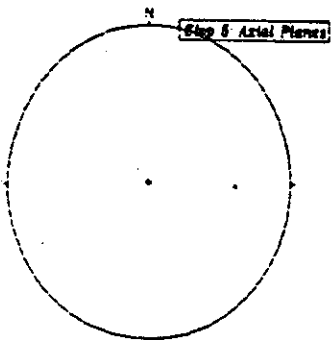
The metamorphism in the study area is garnet grade. Garnet occurs in almost every unit present and porphyroblasts are common. In many of the units, the garnet grew relatively late and overprinted the micaceous fabrics of the rocks. The size of some of the garnets provide an opportunity to look for evidence of two metamorphic episodes as done by Cook (1988). Some apparently late muscovite and chlorite also may show two prograde metamorphic events. Occasionally, quartz and chlorite are zoned.



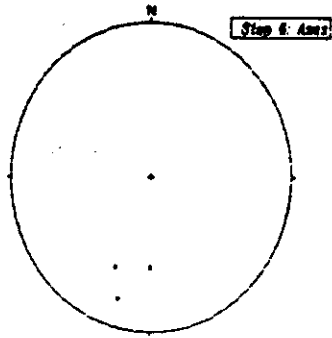
$N = 5$
Poles to Planes



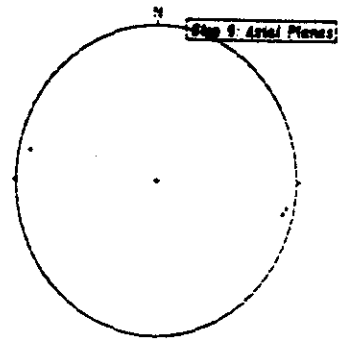
$N = 10$
Locations



$N = 2$
Poles to Planes



$N = 3$
Locations



$N = 2$
Poles to Planes

2e Houghtonville

2f William's River

Retrograde textures are present in some rocks.

DISCUSSION

The stratigraphic sequence mapped by Doll et al. (1961) is not present in its entirety at the Townsend Reservoir. There are no units resembling the Pinney Hollow formation. However, units resembling the Moretown member of the Missisquoi formation and various elements of the Hoosac formation are present. The similarity among the thin mafic layers found in pelitic units indicate that there may be repetition of units.

It is possible that this is due to thrust faulting, but the evidence is not sufficient to prove it. The mafic layers in the spillway may be one repeating layer displaced by Taconic faulting, but this cannot be seen due to the Acadian overprinting. The thrust faulting proposed by Ratcliffe et al. (1988) is reasonable in light of the large thrusts that are found in southern Vermont and western Massachusetts. However, the discrepancy between field observations and the state geologic map is not that units repeat, as would be expected were there thrust faults, but that several units are eliminated. Boudinaged layers in the spillway also indicate extensional tectonic conditions.

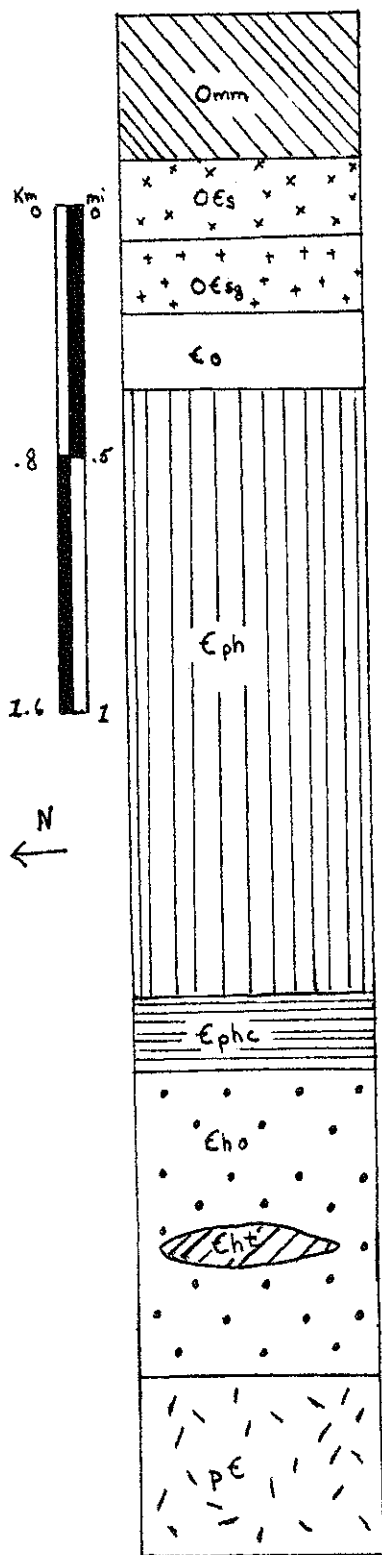
This evidence of stretching is not incompatible with the thrust fault theory. If nappe folds are thrust while folding continues, units may be pulled apart in a line parallel to the fault to the extent that they are discontinuous. The spillway, though a complete cross section, is a small territory in which layers may not have enough space to reoccur.

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Lithographic Sequence
 Townsend Reservoir Area
Centennial Geologic Map of Vermont
 Doll et al. 1961

Figure 1



Omm Missisquoi fm: Moretown Member
 Schist and phyllite commonly contain biotite, garnet porphyroblasts; qtzite and qtz-plag-granulite layers separated by "pinstripe" partings that contain musc, chlt, epidote, biotite, and locally garnet.

OE_s Stowe fm
 Qtz-sericite (musc-parag)-chlt phyllite and schist, local porphyroblasts.

OE_{sg} Stowe fm: Greenstone Amphibolite Member
 Greenstone and amphibolite; epidote-albite-chlt rocks contain actinolite and hornblende where more metamorphosed.

E_o Ottauquechee fm
 Black carbonaceous phyllite or schist containing interbeds of massive qtzite commonly criss-crossed by veins of white qtz

E_{ph} Pinney Hollow fm
 Pale green qtz-sericite (musc-parag)-chlt phyllite and schist with abundant magnetite, chloritoid; garnet porphyroblasts common.

E_{phc} Pinney Hollow fm: Chester Amphibolite M.
 Thin layered, ligniform amphibolite and hornblende schist.

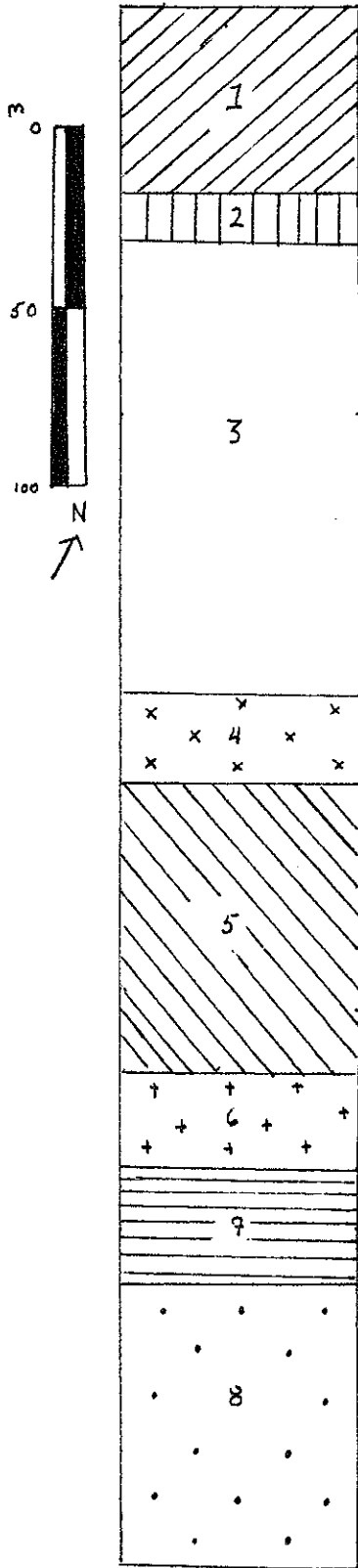
E_{ho} Hoosac fm
 Qtz-sericite-albite-biotite-chlt schist characterized by albite porphyroblasts, biotite and garnet porphyroblasts common.

E_{ht} Hoosac fm: Turkey Mountain Member
 Amphibolite and actinolite greenstone characterized by oval (<lin) spots, chiefly epidote.

pE Precambrian Basement

Lithographic Sequence
Townsend Reservoir Spillway

Figure 2



Unit 1: Pelitic Schist
Banded light grey; qtz, hornblende, biotite, muscovite.

Unit 2: Mafic Schist
Dark green and fine grained; amphibole, qtz, epidote.

Unit 3: Pelitic Garnet Schist
Rusty to dark (graphitic) grey; qtz, biotite, muscovite, garnet, graphite, sulfides, chlorite; garnet porphyroblasts >1cm.

Unit 4: Mafic Schist
Dark green and fine grained; amphibole, qtz, epidote.

Unit 5: Pelitic Garnet Schist
Rusty to grey; qtz, sulfides, muscovite, biotite, garnet; extremely rusty; garnet porphyroblasts >1cm.

Unit 6: Mafic Schist
Dark green and fine grained; hornblende, qtz, epidote.

Unit 7: Pelitic Schist
Light to dark grey (varies); qtz, musc, biotite; composition varies greatly; amphibole sprays >3cm; garnet porphyroblasts >1cm.

Unit 8: Pelitic Albite Schist
Banded dark grey; albite, qtz, biotite, musc, (chlt, pyrite, garnet).

