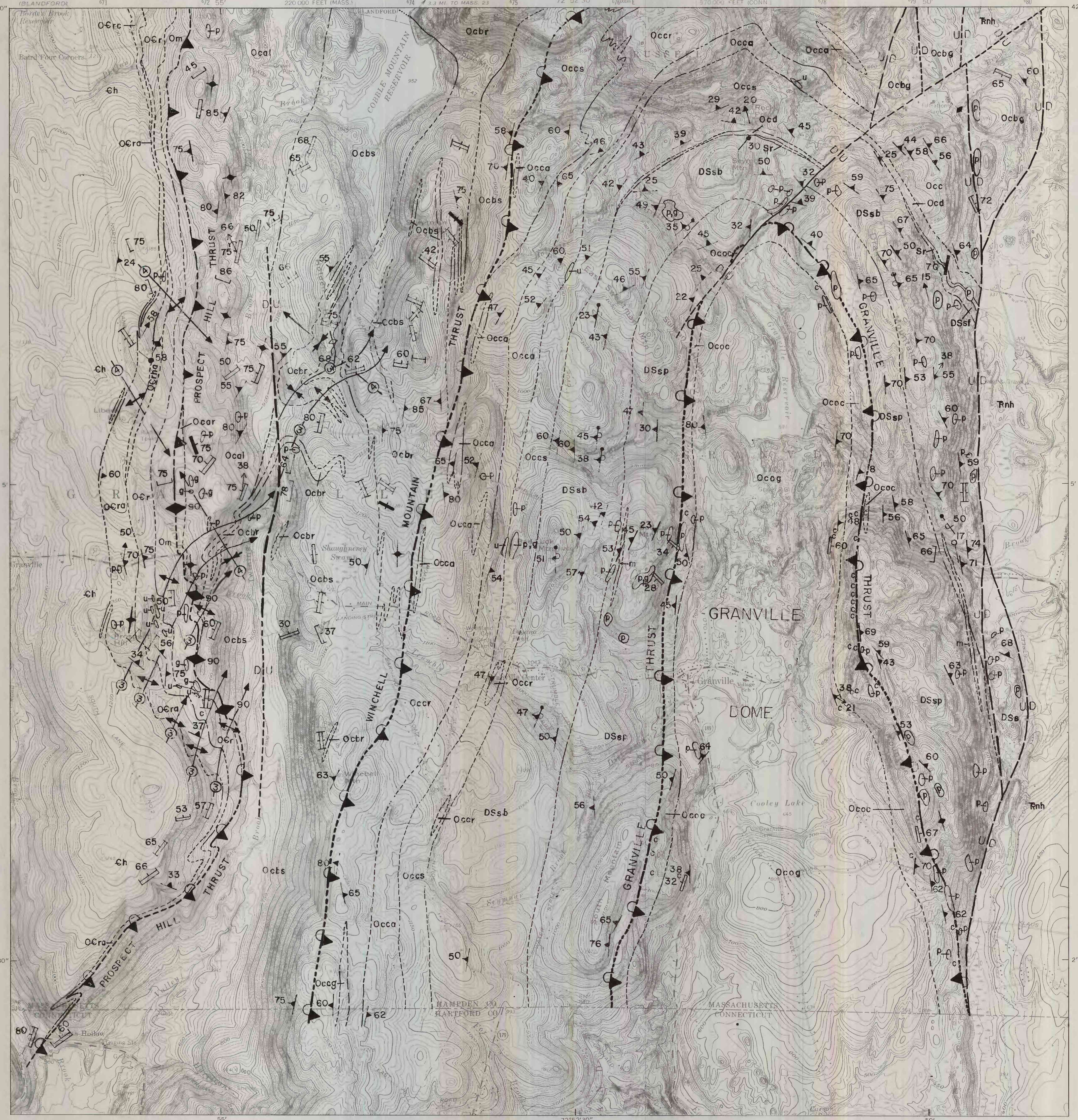
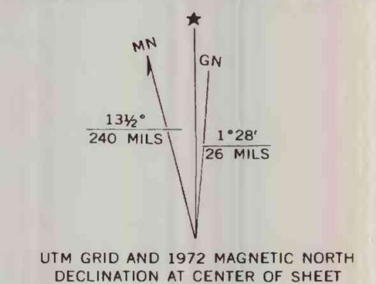
78-271



QUADRANGLE LOCATION



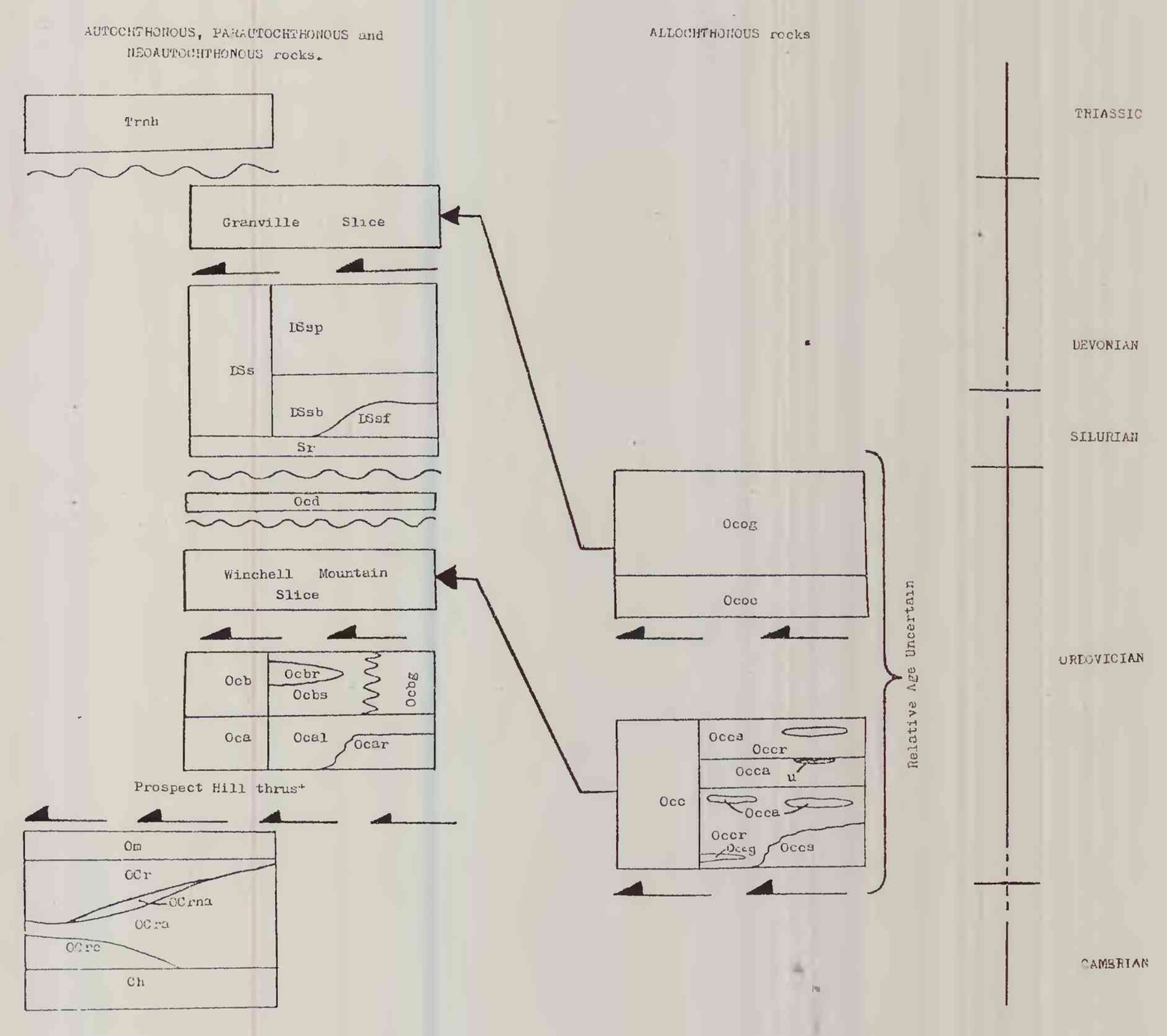
UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

U.S. Geological Survey
OPEN FILE MAP
This map is preliminary and has not been edited for conformity with Geological Survey standards or nomenclature.

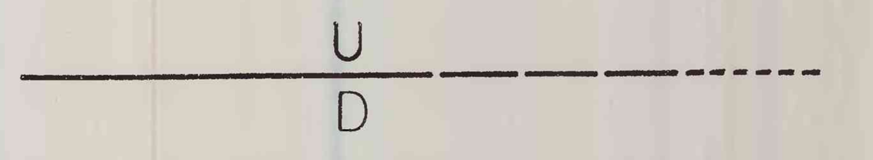
Introduction

The present study was undertaken in an effort to resolve the differences between the interpretation of the geology on the east side of the Berkshire Massif in southern Massachusetts presented by Hatch and Stanley (1973, 1976) and that presented by Schnabel (1973, 1974). The interested reader is referred to these reports for further discussion on the geology of this area.

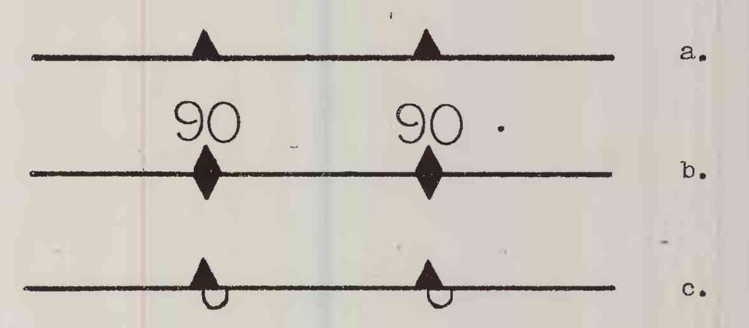


EXPLANATION

Contact: long dash where approximate, short dash where inferred, based upon proximity to outcrop.



Fault: long dash where approximate, short dash where inferred, based upon proximity to outcrop; U = upthrown side; D = downthrown side.

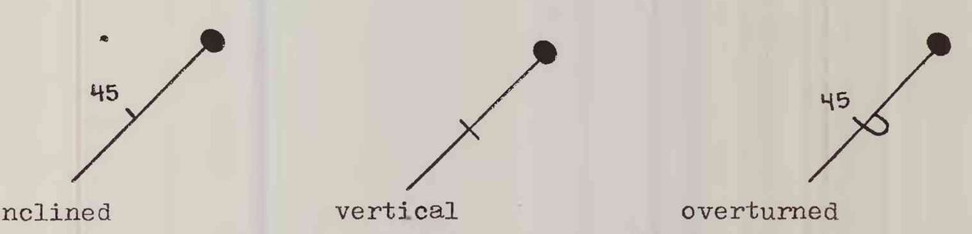


Thrust fault: teeth on tectonically higher plate; long dash where approximate, short dash where inferred, based upon proximity to outcrop: (a.), inclined, tectonically higher plate is upper plate; (b.), vertical, position of 90 indicates the tectonically higher plate; (c.), inclined, tectonically higher plate is overturned.

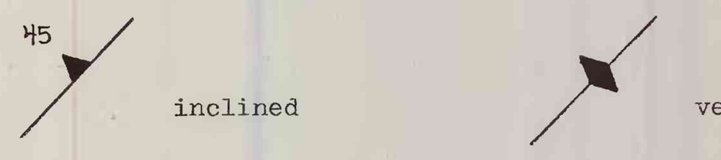
Planar Features

Where two symbols for planar features are combined, their intersection marks the point of observation. Fn refers to a folding event and Sn any planar feature formed during that folding event. The letter n represents the oldest recognized folding event and n+1, n+2, n+3 represent successively younger folding events. In this description, n is taken to be 1.

Strike and dip of bedding.



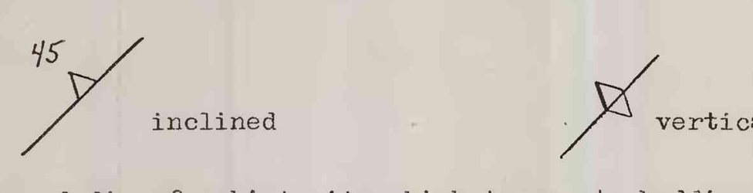
Strike and dip of bedding where top of bed is known from sedimentary structures. The position of 90 on the symbol for a vertical bed indicates the top direction.



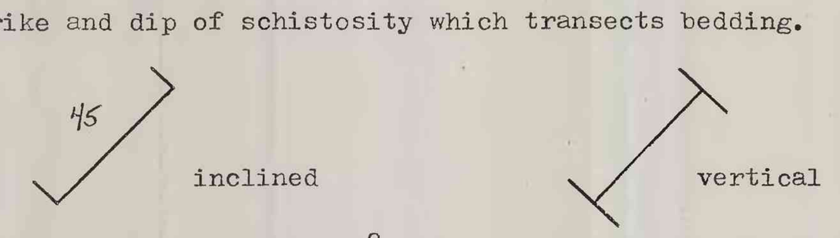
Strike and dip of schistosity[1]; includes only S2 surfaces.

[1] Schistosity, as used here, refers to a penetrative planar surface formed by the parallel alignment of all platy and inequant minerals.

Strike and dip of schistosity which is coplanar to bedding.



Strike and dip of schistosity which transects bedding.



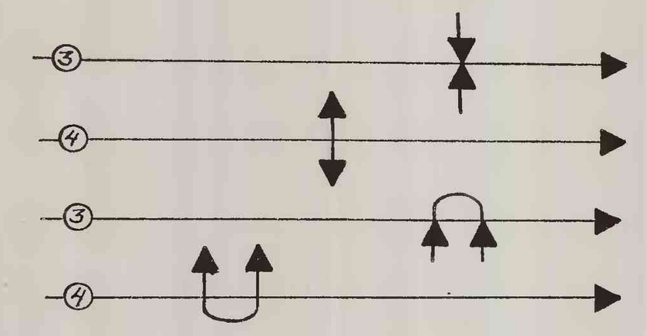
Strike and dip of cleavage[2]. This cleavage may vary from a weak crenulate cleavage to a well developed strain-slip cleavage; includes S3 and S4 surfaces.

Strike and dip of axial surface of minor fold that deforms bedding; schistosity is parallel to the axial plane; includes only F2 folds.

[2] Cleavage, as used here, refers to nonpenetrative, discrete, planar zones of intense strain alternating with zones of far less strain.

Strike and dip of minor fold that deforms schistosity and bedding; includes all F3 and some F4 folds.

Strike and dip of minor fold that deforms cleavage, schistosity and bedding; includes only F4 folds.



Approximate location of trace of axial surface of major fold based on minor fold data and contacts. 2, 3, 4 indicate the generation (F2, F3, F4) assigned to the major fold. The arrow indicates the general trend of the plunge of the major fold axis.

Linear Features

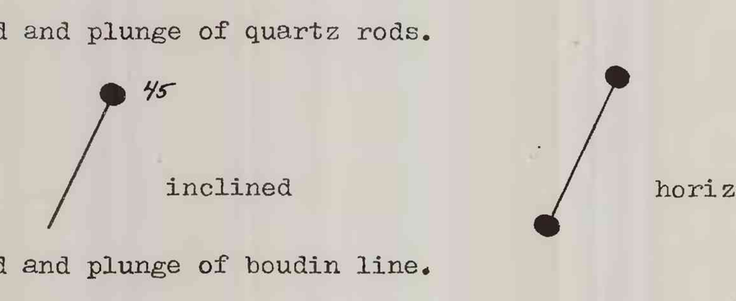
The following linear features may be combined with any of the above planar features. The inclination is always placed at the downplunge end of the symbol.

Trend and plunge of axis of minor fold or crenulation. The fold or crenulation is either symmetrical or the sense of rotation is indeterminate.

Trend and plunge of axis of asymmetrical minor fold showing sense of rotation as viewed down plunge. Where combined with the symbol for the axial surface of a fold, the above symbol indicates the trend and plunge of the axis of that fold. Where combined with a bedding, schistosity or cleavage symbol, the above symbol indicates the trend and plunge of crinkles or tiny folds on that surface.

Trend and plunge of long axis of acicular minerals.

Trend and plunge of quartz rods.



Trend and plunge of boudin line.

STRUCTURE

Minor Structural Features

Four fold generations are recognized in the Blandford and Woronoco quadrangles immediately north of the study area (Stanley 1975). Three fold generations are recognized in the study area, and correlate with F2, F3 and F4 of Stanley (1975).

Folds of F2 age are tight to isoclinal and axial planar to the regional schistosity, S2. The regional schistosity, which varies in strain level from a crenulation cleavage to a spaced schistosity, is deformed by a slip cleavage, S3. Folds of F3 age, axial planar to this slip cleavage, are chevron to open in style. A second slip cleavage, S4, is axial planar to F4 folds. Although these folds are similar in style to folds of F3 age, F4 folds and cleavage deform F3 and S3 structures.

The regional schistosity, S2, forms the dominant fabric in both pre-Silurian and Silurian-Devonian rocks and is accordingly assigned a Devonian age corresponding to the Acadian Orogeny. F3 and F4 folds are also considered Acadian in age.

Thrust Surfaces

Three thrust surfaces are recognized in the study area, the Prospect Hill thrust, the Winchell Mountain thrust and the Granville thrust. The Prospect Hill thrust is delineated by truncation of stratigraphic units in both upper and lower plates. Relative age of movement along the Prospect Hill thrust is syn- or post-F2 and pre-F3 on the basis of minor fold data (Knapp 1977).

The Winchell Mountain thrust is also defined by truncation of stratigraphic units in both upper and lower plates. Rocks of the upper plate of the Winchell Mountain thrust are unconformably overlain by the uppermost member of the Cobble Mountain Formation, Ocd (described below). This unit is unconformably overlain by Silurian rocks; thus a pre-Silurian age is assigned to the Winchell Mountain thrust.

A third thrust surface, the Granville thrust, is defined by stratigraphic evidence. The Straits Schist is correlative with the Silurian-Devonian Goshen Formation (Hatch and Stanley 1973) and is therefore equivalent in age, but is both overlain and underlain by older rocks. This has been interpreted to be a tight isoclinal synform (Stanley 1975). However, a lack of stratigraphic symmetry across the axial surface of this proposed fold suggests that the synformal configuration of Straits Schist results from both folding and thrusting or simply thrusting. Rocks that stratigraphically overlie the Straits Schist are considered allochthonous and to be in thrust contact with the Straits Schist. This thrust is designated the Granville thrust. Dislocation along the Granville thrust pre-dates overturning of the section to the east which is possibly related to F3 folding and formation of the Granville dome between F3 and F4 deformational events.

Rocks west of the Prospect Hill thrust are autochthonous relative to the overlying section. The section bounded by the Prospect Hill thrust and the Winchell Mountain thrust is considered parautochthonous. Rocks that overlie the Winchell Mountain thrust and underlie the unconformity at the base of the uppermost member of the Cobble Mountain Formation are considered allochthonous. The section that stratigraphically overlies this allochthonous sequence is interpreted to be neoautochthonous.

Thrust slices are named after the respective thrust fault located at the stratigraphic base of the allochthonous rocks which compose the slice. The Winchell Mountain slice refers to allochthonous rocks immediately above the Winchell Mountain thrust mapped as member-C of the Cobble Mountain Formation. The Granville slice is composed of the Collinsville Formation that stratigraphically overlies the Granville thrust.

DESCRIPTION OF MAP UNITS

Major minerals are listed in order of decreasing abundance. Thickness of units is based on map pattern after correcting for inclination of bedding and recognized folds and faults. This value is probably greater than the true thickness due to unrecognizable isoclinal folding and/or faulting and is therefore an apparent thickness.

Meta-Igneous and Igneous Rocks

p,g Fine- to medium-grained granodiorite and diorite (g) and coarse-grained pegmatite (p).

m Tan-weathering, medium-grained microcline-plagioclase-quartz-hornblende-sphene orthogneiss.

u Coarse-grained rocks of ultramafic composition composed of serpentine, talc, calcite and magnetite in varying proportions. Pods of pale-green tremolite up to 1 m in length are locally associated with the ultramafic rocks.

Autochthonous, Parautochthonous and Neoautochthonous Rocks

Trnh NEW HAVEN ARKOSE (TRIASSIC)
Reddish-brown, fine- to very coarse-grained arkosic siltstone, sandstone and conglomerate.

DSs STRAITS SCHIST (SILURIAN - DEVONIAN)
Brown to brownish-gray, medium- to coarse-grained quartz-plagioclase-muscovite-biotite-(garnet)-(sillimanite) schist interbedded with brown to brownish-gray quartz-plagioclase-mica gneiss near the base of the formation. The Straits Schist is divided into three members in the study area. The uppermost unit is a brown to brownish-gray, medium- to coarse-grained quartz-plagioclase-muscovite-biotite-(garnet)-(sillimanite) schist (DSsp). Garnets range in size up to 1 cm. Locally sillimanite, pseudomorphic after kyanite, constitutes up to 10 percent of the rock. Coarse flakes of muscovite, coated with a film of graphite, give a distinct graphitic sheen to foliation surfaces. Strongly boudinaged layers or lenses of dark-gray to greenish-gray, medium- to coarse-grained calc-silicate composed of varying amounts of quartz, plagioclase, hornblende, diopside, tremolite, garnet, zoisite and sphene are present locally. Calc-silicate is more abundant in DSsp than in the rest of the Straits Schist. Apparent thickness of DSsp varies from 380 to 820 meters. DSsp overlies brown to brownish-gray, medium- to coarse-grained quartz-plagioclase-muscovite-biotite-(garnet)-(sillimanite) schist interbedded with medium-grained, brown to brownish-gray quartz-plagioclase-mica gneiss (DSsb). Beds range from 1 to 20 cm thick and are locally graded. Small "BB" sized garnets are distinctive. Schistose beds are characterized by large flakes of muscovite with a distinct graphitic sheen on foliation surfaces. This member is distinguished from DSsp by the presence of beds of gneiss. Apparent thickness ranges from 380 to 750 meters. Dark-brown to dark-gray, fine-grained quartz-plagioclase-mica gneiss (DSsf) is locally present along the base of DSsb. A thin (10 m) bed of brown, coarse-grained quartz-plagioclase-muscovite-biotite schist with large (1-2 cm) porphyroblasts of plagioclase is present along the upper contact of DSsf. DSsf is recognized only along the northeast limb of the Granville dome. Maximum thickness is 70 meters.

Sr RUSSELL MOUNTAIN FORMATION (SILURIAN)
Greenish-gray, medium-grained calc-silicate and schistose quartzite. The calc-silicate consists of quartz, feldspar, garnet, zoisite, tremolite, diopside and carbonate minerals in varying proportions. Maximum thickness of Sr is 30 meters.

Oc COBBLE MOUNTAIN FORMATION (MIDDLE ORDOVICIAN)
Light- to dark-brown and silvery-gray, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-(garnet) schist and fine- to medium-grained plagioclase-quartz-mica gneiss. The Cobble Mountain Formation is divided into four members. The uppermost member is composed of dark-brown, fine- to medium-grained quartz-plagioclase-muscovite-biotite schist interbedded with plagioclase-quartz-mica gneiss (Ocd). Individual beds range up to 20 cm in thickness. Maximum thickness of Ocd is 124 meters. Occ constitutes the Winchell Mountain thrust slice and is discussed further under the section "Allochthonous Rocks". Ocb, which forms the lower plate of the Winchell Mountain thrust, is composed of medium- to coarse-grained plagioclase-quartz-muscovite-biotite-(garnet) schist interbedded with fine- to medium-grained plagioclase-quartz-mica gneiss. Massive, dark-gray to black, medium-grained hornblende-plagioclase amphibolite is present throughout Ocb. Ocb is divided into three units: silvery-gray, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-(garnet) schist interbedded with gray to light-gray, medium-grained plagioclase-quartz-mica gneiss (Ocbs); light to dark-brown, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-(garnet) schist interbedded with light- to dark-brown, medium-grained plagioclase-quartz-mica gneiss (Ocbr); and slabby, light-gray, fine- to medium-grained plagioclase-quartz-mica gneiss (Ocbg). Ocbg is recognized only in downdropped fault blocks of presumed Triassic age along the eastern edge of the study area and is correlated with gneissic rocks in Ocbs. The lowermost member, Oca, is composed of brown quartz-plagioclase-mica gneiss interbedded with light-brown, fine- to medium-grained plagioclase-quartz- muscovite-biotite schist. Massive, medium-grained, dark-gray to black hornblende-plagioclase amphibolite is present throughout Oca. Oca is divided into two units: reddish-brown, fine- to medium-grained quartz-muscovite-biotite-plagioclase-(garnet) schist (Ocar), present only as a thin (10-15 m) bed at the base of Oca; and light-brown, fine-grained quartz-plagioclase-mica gneiss interbedded with quartz-plagioclase-muscovite-biotite schist (Ocal) which makes up 95 percent of Oca.

Om MORETOWN FORMATION(MIDDLE ORDOVICIAN or older)
Light-brown and light-gray, fine-grained quartz-plagioclase-muscovite gneiss characterized by a "pinstriped" appearance resulting from paper-thin partings of mica alternating with quartz-plagioclase rich layers. This gneiss is interbedded along the basal contact with quartz-muscovite-plagioclase-staurolite schist indistinguishable from staurolite-bearing schists of the underlying Rowe Schist. Maximum thickness of Om is 150 meters.

OCr ROWE SCHIST (CAMBRIAN to LOWER ORDOVICIAN)
Light-brown, fine- to medium-grained quartz-muscovite-plagioclase schist with conspicuous porphyroblasts of staurolite and pseudomorphs of sillimanite after kyanite (OCr); greenish-black, medium-grained, hornblende-plagioclase-epidote amphibolite (OCra); black to dark-brown, medium- to coarse-grained, hornblende-anthophyllite-plagioclase amphibolite (OCrha) recognized only as a lens along the upper contact of OCra; brown, medium-grained, slightly-carbonaceous quartz-muscovite-plagioclase-biotite-(garnet) schist (OCrc). Ultramafic rocks are locally present throughout the Rowe Schist as pods or lenses up to 100 m in length. Maximum thickness of the Rowe Schist is 230 meters.

Ch HOOSAC FORMATION (LOWER CAMBRIAN)
Gray-brown, medium-grained quartz-plagioclase-mica gneiss and light-brown, medium-grained quartz-muscovite-plagioclase-biotite schist. Minimum thickness is 500 meters. Maximum thickness was not determined as the base of the section is not exposed in the study area.

Allochthonous Rocks

Granville Slice

Oco COLLINSVILLE FORMATION (MIDDLE ORDOVICIAN)
Quartz-plagioclase-mica gneiss interbedded with quartz-plagioclase-muscovite-biotite schist at the top of the formation. The Collinsville Formation is correlative with the Cobble Mountain Formation (Hatch and Stanley 1973). The Collinsville Formation is divided into two members. The uppermost member is composed of brown to reddish-brown, medium-grained quartz-plagioclase-muscovite-biotite schist (Ococ). Abundant thin (.5 to 5 cm) layers of light-pink, fine-grained quartz-garnet gneiss (coticule) characterize the upper section. Massive hornblende-plagioclase amphibolite is present near the base of the member interbedded with brown schist lithically indistinguishable from schist in the upper part of the section except lacking coticule. The apparent thickness of Ococ is 180 meters. Underlying Ococ are light-gray, medium-grained quartz-plagioclase-mica gneisses interbedded with black to dark-gray, medium-grained hornblende-plagioclase amphibolite in beds 0.1 to 3 m thick (Ocog). Amphibolite is more abundant near the top of this member and locally constitutes up to 90 percent of the section. A distinct, laterally persistent horizon (several meters thick) of medium-grained quartz-garnet-magnetite-hornblende gneiss is present near the upper contact of this member. Minimum thickness of Ococ is 700 meters. Maximum thickness is unknown as the base of the section is not exposed.

Winchell Mountain Slice

Occ COBBLE MOUNTAIN FORMATION Member C (MIDDLE ORDOVICIAN)
Dark-brown and silvery-gray, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-(sillimanite)-(garnet)-(magnetite) schist. Beds of gneiss and massive hornblende-plagioclase amphibolite are generally absent. Apparent thickness of this member is 740 meters. Occ is divided into four units: silvery-gray, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-garnet-(sillimanite) schist (Occs); dark-brown, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-garnet-(sillimanite) schist (Occr); light-gray, medium- to coarse-grained plagioclase-quartz-muscovite-biotite-sillimanite-magnetite schist (Occa) with conspicuous porphyroblasts of plagioclase and pseudomorphs of sillimanite after kyanite; and light-gray, medium-grained plagioclase-quartz-mica gneiss (Occg). Ultramafic rocks and dark-green to black, thinly-laminated plagioclase-hornblende amphibolites are locally present along the Occa-Occs contact. Occa is present as lenses near the base of Occ and as a continuous bed or layer in the central part of Occ. Occg is recognized as a thin (100 m) bed or layer that extends for about 1 km along strike in the basal section of Occ at the latitude of the Massachusetts-Connecticut state line. Occg is the only unit in Occ that contains gneisses and is therefore unusual in this section and more typical of rocks in the underlying Ocb. Occg may prove to be a fault-bounded slice or a tight fold of Ocb when the unit is mapped more completely to the south.

Origin of Occa

Aluminous schist, ultramafic rocks and thinly-laminated, epidote-bearing amphibolites are present in Occa and also in the Rowe Schist but are not recognized elsewhere in the study area. On the basis of lithic similarity and rock association, Occa is a probable equivalent to rocks of the Rowe Schist. This implies that Occr and Occs, which appear similar to Ocb except for a lack of gneiss and amphibolite, are intercalated with older Rowe-equivalent rock types. Occ may have formed as an olistostrome during tectonic transport of a thrust sheet. The central layer of Occa in Occ could thus represent a thrust sheet that overrode a highly mixed zone formed in part from detritus derived from the leading edge of the thrust sheet and in part from tectonic mixing of lithic types during emplacement.

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GEOLOGIC MAP OF THE GRANVILLE AREA, HAMPDEN COUNTY, MASSACHUSETTS

By
Douglas A. Knapp

1978