U.S. DEPARTMENT OF THE INTERIOR
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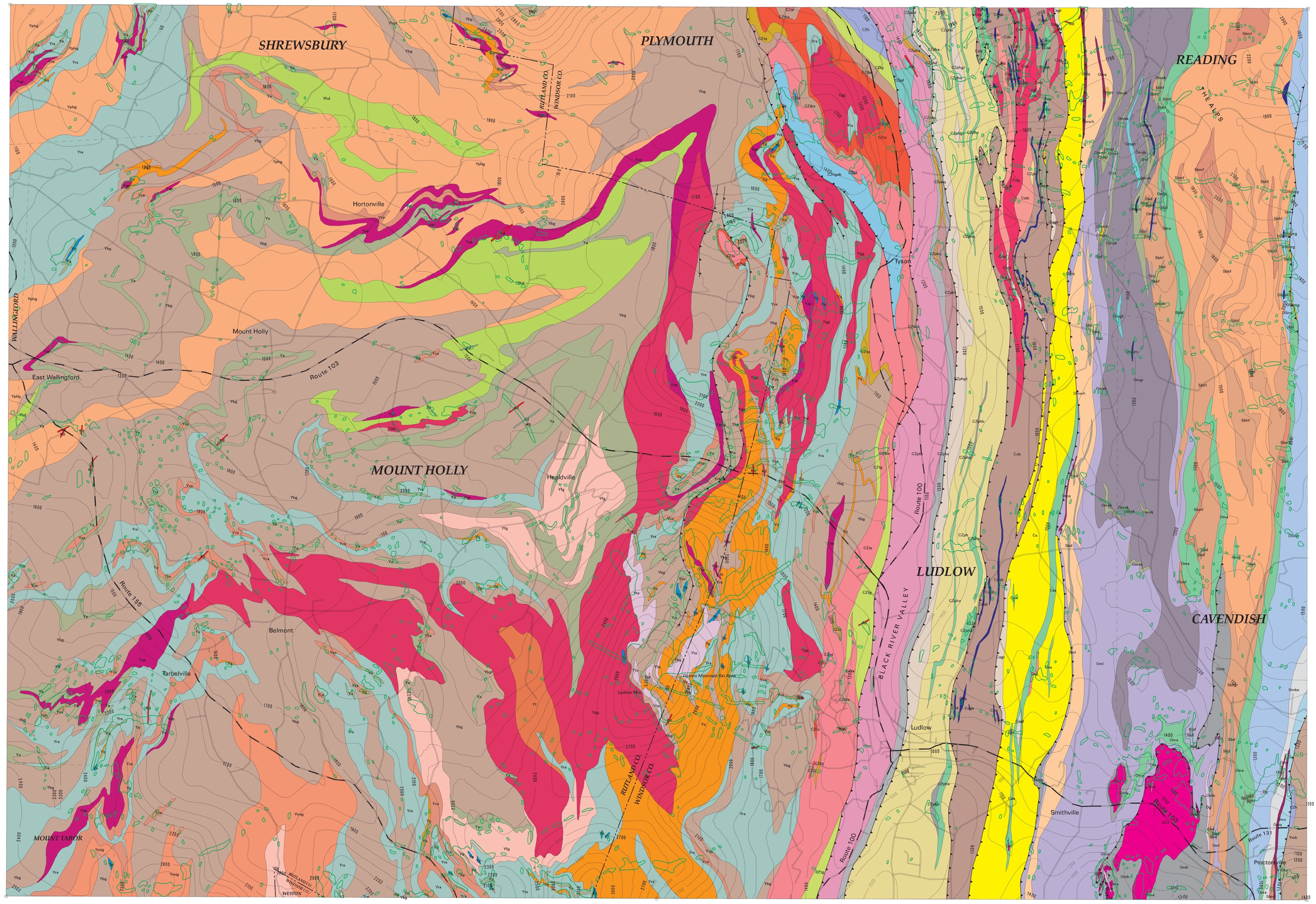
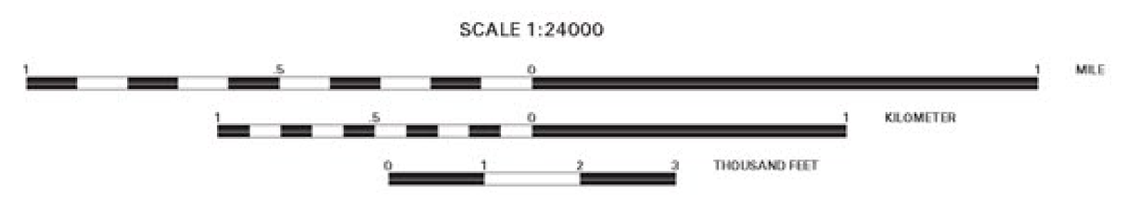
OPEN-FILE REPORT 94-229-A
GEOLOGIC UNITS AND OUTCROP MAP
Plate 1 of 3



Topography modelled from USGS 7.5' DEM data
Contour Interval 100 feet
National Geodetic Vertical Datum of 1929
Digital map units in State Plane Coordinate System
National Geodetic Horizontal Datum of 1927
Roads and town boundaries from the Vermont Center for Geographic Information, Inc.



Digital Bedrock Geologic Map of the Mount Holly and Ludlow Quadrangles, Vermont and Explanation of the Bedrock Geology Database in the Vermont Geographic Information System

By
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1994

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Waterbury, Vermont 05671

Approximate Mean Declination
15°00' West, 1986

Geology mapped by Ratcliffe in 1990 and 1991, assisted by Leon Sawyko in 1990; and by Ratcliffe and Walsh in 1992. Digitized by Merrifield and Walsh.

LOCATION OF MAP

Description of Map Units

(Not necessarily in stratigraphic order; minerals listed in order of increasing abundance)

CRETACEOUS DIKES

- Kd — Lamprophyre

DEVONIAN DIKES

- Dg — Rhyodacite
- Dbg — Biotite granite

UNDIFFERENTIATED SILURIAN TO DEVONIAN NORTHFIELD AND WAITS RIVER FORMATIONS

- DSnw — Dark-gray garnetiferous biotite-quartz-muscovite phyllite
- DSnwc — Gray quartzite and quartz pebble conglomerate
- DSnwg — Gray garnetiferous quartz-rich schist with coticule

SILURIAN BARNARD GNEISS

- Sbd — Metadiorite dike or sill
- Sbbf — Biotite metatrondhjemite gneiss
- Sbhf — Hornblende metatrondhjemite gneiss
- Sbmf — Mixed metatrondhjemite with mafic schist and amphibolite

UNDIFFERENTIATED LATE PROTEROZOIC TO ORDOVICIAN ULTRAMAFIC ROCKS

- OZu — Serpentinite and talc-carbonate schist

ORDOVICIAN MORETOWN FORMATION

- Omu — Undifferentiated Oml and Omgr
- Oml — Laminated gray-green quartz-plagioclase schist
- Omgr — Light-green phyllitic quartzite and silvery-green plagioclase-biotite-muscovite-chlorite-quartz phyllite
- Omwh — Gray small-garnet biotite-quartz-muscovite phyllite, and dark-gray to black graphitic biotite-quartz-muscovite phyllite
- Oma — Dark-green amphibolite
- Omak — Green ankeritic greenstone
- Omgrc — Green small-pebble plagioclase-quartz conglomerate
- Omgt — Gray garnetiferous plagioclase-biotite-muscovite-quartz schist
- Omq — Tan feldspathic quartzite
- Omgq — Gray garnetiferous quartzite
- Ombb — Black cross-biotite quartz-muscovite schist
- Omb — Black sulfidic carbonaceous quartz-muscovite schist
- Ombs — Black carbonaceous metasiltstone

CAMBRIAN STOWE FORMATION

- Cs — Silvery-green biotite-chlorite-quartz-muscovite schist
- Csa — Amphibolite and greenstone
- Csgt — Silvery-green garnetiferous biotite-muscovite-quartz schist
- Csg — Gray feldspathic cross-biotite schist
- Cst — Talc schist

CAMBRIAN OTTAUQUECHEE FORMATION

- Cob — Dark-gray to black sulfidic graphitic quartz-muscovite phyllite
- Coqb — Dark-gray to black quartzite
- Coq — Tan quartzite
- Cobi — Green cross-biotite chlorite-quartz schist
- Cog — Gray feldspathic cross-biotite gneiss to schist
- Coa — Amphibolite and greenstone
- Cocr — White to green chromium-mica carbonate schist to quartzite

CAMBRIAN TO LATE PROTEROZOIC PINNEY HOLLOW FORMATION

- CZph — Silvery-green magnetite-chlorite-quartz-muscovite +/-chloritoid schist
- CZpha — Amphibolite and greenstone
- CZphgt — Silvery-green garnetiferous muscovite-quartz schist
- CZphb — Dark-gray to black sulfidic carbonaceous quartz-muscovite schist

CAMBRIAN TO LATE PROTEROZOIC PLYMOUTH FORMATION

- CZpbs — Dark gray carbonaceous quartz phyllite with thin blue-gray dolostone
- CZpbq — Gray vitreous quartzite
- CZpbf — Gray-tan biotite feldspathic quartzite
- CZpfq — Feldspathic quartz schist
- CZpbd — Orange-brown to beige weathering dolostone
- CZpd — Dark blue-gray and white mottled dolostone

CAMBRIAN TO LATE PROTEROZOIC TYSON FORMATION

- CZts — Lustrous chlorite schist to gray biotite-albite schist
- CZtbs — Dark-gray carbonaceous sulfidic quartz phyllite
- CZtg — Lustrous chlorite schist
- CZtd — White to beige dolostone
- CZtq — White quartzite
- CZtc — Quartz-pebble and gneiss-pebble conglomerate

CAMBRIAN TO LATE PROTEROZOIC HOOSAC FORMATION

- CZh — Gray albitic schist
- CZhgab — Gray magnetite-rich albitic granofels

LATE PROTEROZOIC DIKES

- Zd — Metadiabase dike

MIDDLE PROTEROZOIC MOUNT HOLLY COMPLEX

- Yp — Granite pegmatite
- Yta — Tourmaline aplite
- Ygg — Biotite granite gneiss
- Yap — White feldspar-rich aplite and gneissic aplite
- Yphg — Biotiote-rich granodiorite gneiss
- Yhd — Hornblende-plagioclase gneiss
- Ya — Amphibolite
- Ybg — Biotite-quartz-plagioclase gneiss
- Yrs — Rusty aluminous quartz schist
- Ycs — Calc-silicate rocks including diopside gneiss, hornblende-diopside gneiss, diopside quartzite, and calcite marble
- Yq — White vitreous quartzite
- Ym — Calcite marble
- Yd — Dolomite marble
- Ybgt — Garnet-biotite-quartz-plagioclase schist to gneiss
- Yt — Trondhjemite gneiss
- Ymig — Migmatite gneiss
- Yfg — Felsic magnetite gneiss
- Ymh — Undifferentiated gneiss, quartzite, and calc-silicate rocks
- Ymha — Amphibolite

Explanation of Map Symbols

- Contacts
- Outcrops (areas of exposed bedrock examined in this study)
- Thrust fault, teeth on upper plate

1.0 Introduction

The U.S. Geological Survey (USGS) and the State of Vermont have agreed to jointly produce a new bedrock geologic map of the State at a scale of 1:100,000. A major goal of the project is not only to produce the 1:100,000 scale map, but to build a State-wide digital database that contains much of the detailed baseline data from which the State map is made. Too often, State geologic maps are produced based on unpublished and nonavailable field data. This kind of unpublished document provides less than the full value to users such as towns, counties, states, and industry. Recognizing this need, the USGS and the State of Vermont have jointly developed a method for handling newly collected geologic data at 1:24,000 or larger scales. Preliminary detailed geologic data is submitted for digitizing by geologists within approximately six months of the completion of field work. The data are digitally compiled and final products are published as Open-File Reports within approximately one year from the completion of the field work, greatly speeding the release of detailed information while the 1:100,000 State map is being prepared. The Open-File Reports are available in paper and digital formats.

The plates in this report are a paper representation of the digital bedrock geologic information for the Mount Holly and Ludlow 7.5 minute quadrangles located in Rutland and Windsor counties, Vermont. The paper maps are part A and the database is part B of this Open-File Report. The maps were developed from a digital database compiled in cooperation with the State of Vermont, Geological Survey, and serve as a guide to the geologic information available in the database. This report is the first of a series of cooperative U.S.Geological Survey (USGS) and Vermont Geological Survey (VGS) digital bedrock geologic maps of Vermont, and thus constitutes a prototype for the series.

The bedrock geology of Vermont is complex and its portrayal on maps is complicated and time consuming. The goals of this study, therefore, are twofold: (1) compile a digital map from complex geologic information in a time efficient manner, and (2) provide a database of the bedrock geology to users of a statewide geographic information system (GIS). In order to achieve these goals, the fundamental idea behind this report is that the digital map should provide the essential bedrock geologic information in a manner consistent with the applications of a GIS. While the paper maps in this publication contain a significant amount geological information, they were not designed to take the place of standard paper maps such as USGS Geologic Quadrangle maps or Miscellaneous Investigations Series maps which contain more complete geologic information such as cross sections, detailed descriptions of map units, and detailed discussions of stratigraphy, structure, metamorphism, age of units, geochemistry, tectonic interpretations, etc.. Although this report is designed for geologists and non-geologists alike, some readers or users of the GIS database may be unfamiliar with some of the terminology. Readers unfamiliar with some of the terminology are referred to Bates and Jackson (1987).

2.0 Map Preparation

The geology of the Mount Holly and Ludlow quadrangles was mapped on U.S. Geological Survey 7.5 minute series topographic maps at a scale of 1:24,000 (1 inch = 2000 feet). The geology was digitally compiled at the same scale in order to preserve the detail of the original maps, and to maintain compatibility with the majority of existing Vermont GIS data layers compiled at the same or larger scale (VCGI, 1991). Additionally, smaller scale maps do not contain the same level of detail, and extrapolation of small-scale data to larger scales often oversimplifies or misrepresents the original mapping. The bedrock geology data were drawn with pen and ink on scale-stable mylar separates from the bedrock geologic maps of the Mount Holly and Ludlow quadrangles (Ratcliffe, 1992; Ratcliffe and Walsh, unpub. data). The term "separate" applies to a unique type of geologic information portrayed on an individual map. A typical paper geologic map contains multiple types of information that must be separated in order to compile the data digitally. The following eight separates were used in this compilation:

Contacts -- lines for geologic unit polygons
Lithic Designators -- labels for geologic unit polygons
Ductile Faults -- lines for faults and labels for strike and dip points
Outcrops -- lines for outcrop polygons
Schistosity -- lines for form-lines and labels for strike and dip points
Gneissosity -- lines for form-lines and labels for strike and dip points
Cleavage -- lines for cleavage symbols and labels for strike and dip points
Brittle joints and faults -- lines for joint and fault symbols and labels for strike and dip points

The separates were scanned on a Vemco Multiscan 4000 scanner. Raster images were converted to vector files with Envision It 2.0 by Envisions Solutions Technology, Inc., a PC-based raster-to-vector conversion software package. Envision It 2.0 produced vector files in an AUTOCAD DXF format, which were then imported into ARC/INFO software with the "dxfarc" command. The GIS database was developed on a personal computer system using PC ARC/INFO version 3.4D by Environmental Systems Research Institute, Inc.. For the purpose of printing the solid color fills on Plate 1, the PC ARC/INFO database was exported to UNIX-based ARC/INFO version 6.1 running on Data General AViiON workstations. There, Plate 1 was generated as an ARC/INFO display-type graphics file (1040). Plate 2 required no solid color fills, therefore, the plate was generated as a PC ARC/INFO display-type graphics file (1039). Both graphics files were then converted to a VCGL (Versatec Color Graphics Language) format in ARC/INFO version 6.1 and plotted on a Versatec Series 8900 electrostatic plotter. The topographic base was developed from USGS 7.5 minute digital elevation model (DEM) data by contouring the grid-based data (National Geodetic Vertical Datum of 1929 in metric units). The contour interval is 100 feet. The contours in this report have been processed by several digital methods, all of which involved considerable interpolation. The methods include rasterizing the published topographic map contours into a cell- or grid-based format (DEM data by the USGS), resampling into an ARC/INFO grid system, and recontouring to produce the contour lines used in this report. The topographic base, therefore, is only an approximation of the original topography as depicted on the Mount Holly and Ludlow 7.5 minute quadrangles. The map projection is Vermont State Plane Coordinate System (National Geodetic Horizontal Datum of 1927). The roads and town boundaries were obtained from the Vermont Center for Geographic Information, Inc. (VCGI).

3.0 Coverages

The mylar separates of the original geologic data were organized into digital categories called coverages in ARC/INFO terminology. The coverages were combined to produce the bedrock geologic map of the Mount Holly and Ludlow quadrangles. The coverages were plotted on the Geologic Units and Outcrop Map (Plate 1) and Structure Map (Plate 2) as follows:

Plate 1:

Feature	Coverage Name	Coverage Type
Geologic Units	CONTACTS	polygon
Outcrops	OUTCROP	polygon
Ductile Faults	DUCFLTCL	line

Plate 2:

Feature	Coverage Name	Coverage Type
Ductile Faults	DUCFLTCL	line
Ductile Faults	DUCFLTPT	point
Schistosity	SCHISTCL	line
Schistosity	SCHISTPT	point
Gneissosity	GNEISSCL	line
Gneissosity	GNEISSPT	point
Cleavage	CRENCL	line
Cleavage	CRENPT	point
Joints & Faults	BRITCL	line
Joints & Faults	BRITPT	point

Figure 1 on Plate 3 illustrates the individual coverages by feature type at a scale of 1:100,000.

4.0 Plate 1 - Geologic Units and Outcrop Map

4.1 Contacts

The contacts coverage was created by combining two geology separates, contacts and lithic designators, into a single polygon coverage. The contacts separate contains the line work representing the geologic contacts, or boundaries, between different geologic map units, and the lithic designators separate contains the labels for each map unit (i.e. CZph, Co, etc.). A total of 74 map units have been designated in the Mount Holly and Ludlow quadrangles; three of which are unmetamorphosed igneous rocks (Cretaceous and Devonian dikes: Kd, Dg, and Dgb), and the remaining 71 units are metamorphic rocks. There are no unmetamorphosed sedimentary rocks in the map area. Quaternary glacial sediments are present in the area, but were not mapped. The map units are listed in the Description of Map Units on Plate 1.

The contacts between the map units are shown as solid lines on the map. On conventional geologic maps contacts are shown as solid (indicating a high degree of certainty about the location of the contact), dashed (less certain), and dotted (inferred or concealed by water). The contacts on these maps are drawn as solid lines because editing time is reduced by not revising the original scanned solid lines, and the GIS user (typically not a geologist) will likely accept a contact's location on the map regardless of line style. The positional control of contacts can be determined by comparing the Plocation of the contact with the distribution of outcrops shown on Plate 1.

4.2 Outcrops

The outcrops coverage indicates most, but not all, of the exposed bedrock (natural and man made) in the area. The coverage only includes exposures visited during the preparation of the bedrock geologic map. Some of the larger polygons may indicate areas of virtually contiguous, but not entirely exposed bedrock. In the database, the outcrop data are contained in a single polygon coverage. Area calculations indicate that bedrock exposures occupy 5 percent of the total area of the two quadrangles (14.1 of 281 square kilometers).

4.3 Ductile Faults

The ductile faults are thrust faults produced during deformation and metamorphism. No distinction was made between different ages of ductile faults. The faults are characterized by metamorphic fault fabrics such as mylonite and phyllonite. In some cases, however, such fabrics may be partially or completely annealed by later metamorphism. The faults are shown on both Plates 1 and 2; Plate 1 shows the location of the faults, and Plate 2 shows their locations and their orientations (strike and dip). In the database, the fault data are contained in two coverages: a line coverage and a point coverage. The line coverage shows the location of the faults, and the point coverage contains information on the strike and dip of the faults. The strike and dip symbols are drawn from the point coverage. The value of the dip is drawn from the point coverage.

5.0 Plate 2 - Structure Map

The representation of structural data is the most complex and time consuming task in the compilation of digital bedrock geologic maps. In order to present these data more clearly (or simply), form-lines and structure symbols are used to represent the prominent structural features in the Mount Holly and Ludlow quadrangles. Only a fraction of the structural data from the mapping are used to depict the structural geology; Plate 2, therefore, is a simplified structure map. In the PC ARC/INFO database each structure type (schistosity, gneissosity, etc.) is comprised of a line coverage, where the lines are graphic images, and a point coverage, where the points contain the strike and dip data. The structure symbols shown on Plate 2 were drawn from line and point coverages.

5.1 Schistosity and Gneissosity

Schistosity and gneissosity are types of foliation in metamorphic rocks. The orientation of a foliation is often shown on geologic maps with individual strike and dip symbols. On this map, the orientation is generalized and is illustrated with form-lines. Form-lines are interpretive, and are drawn by along-strike interpolation between individual strike and dip symbols. Essentially, form-lines are a graphical abstract of a geologic map's planar structural data. The form-lines represent the most prominent planar fabric in a given rock type, however, they do not distinguish between the multiple ages of foliations in the rocks. Additionally, we believe a reader unfamiliar with individual strike and dip symbols (a GIS user, for example) may find form-lines easier to understand than a collection of "stick" symbols. Less prominent planar structural features (cleavage, joints, etc.) are illustrated with individual strike and dip symbols. In the metamorphic rocks of the Mount Holly and Ludlow quadrangles the compositional layering is largely parallel to the foliation. Gneissosity form-lines depict the layering in the gneissic rocks of the Mount Holly Complex and the Barnard Gneiss, and schistosity form-lines depict the layering in all the other metamorphic rocks. Due to the limited number of bedding measurements and the fact that bedding is virtually parallel to the foliation, a bedding coverage is not included in this report.

In the database, the schistosity and gneissosity data are each contained in two coverages: a line coverage and a point coverage. The line coverage shows the general trend of the metamorphic foliation across the map, and the point coverage contains information on the orientation (strike and dip) of the foliation at a particular point on the map. The strike and dip symbols are drawn from the point coverages. The value of the dip is drawn from the point coverage.

5.2 Cleavage

Strike and dip symbols illustrate the cleavage present in the area. Cleavage is a planar break in the rocks that is less pervasive than the schistosity or gneissosity. The point of measurement is the center of the symbol. Like the form-lines, the cleavage symbols represent only a fraction of the cleavage data from the original mapping. Symbols are located to illustrate the most common orientation of the cleavage in a given area. For example, in an area where many cleavage symbols indicated approximately the same orientation in the original mapping only one or two symbols were drawn for the simplified cleavage coverage.

In the database, the cleavage data are contained in two coverages: a line coverage and a point coverage. The line coverage contains the strike and dip symbol as it was originally drawn on the mylar separates, and the point coverage contains information on the orientation (strike and dip) of the cleavage. The value of the dip is drawn from the point coverage.

5.3 Brittle Features

Brittle features include brittle faults and joints. These features are the youngest structures in the bedrock and record a period of brittle deformation. Such fractures, or cracks, may significantly influence the flow of groundwater, and other fluids or gases, in the otherwise low-permeability bedrock of the Mount Holly and Ludlow quadrangles. Strike and dip symbols indicate the location of such features on the map. All brittle faults and joints that have been mapped are shown on Plate 2; these data have not been simplified from a larger data set. The brittle faults are drawn with arrows indicating the direction of relative lateral displacement and the letters "U" and "D" indicating up and down relative vertical displacement. Joints and joint sets were only measured in the vicinity of the Cretaceous dikes or on prominent cliff faces. Where the intersection point of two or more symbols coincides with the end of the strike and dip symbols, the intersection indicates the location of the measurement. In the database, the brittle fault and joint data are contained in two coverages: a line coverage and a point coverage. The line coverage shows the linear trend of the fault or joint, and the point coverage contains information on the orientation (strike and dip) of the fault or joint at a particular location on the map. The brittle fault point data also contain information on the relative horizontal or vertical displacement. The strike and dip symbols and the relative displacement symbols are drawn from the point coverages. The value of the dip is drawn from the point coverage.

6.0 Discussion

The Vermont Geographic Information System (VGIS) contains over 75 data layers ranging in scale from 1:5,000 to 1:250,000 (VCGI, 1991). The digital bedrock geologic map is a new addition to the VGIS, offering a new tool for evaluating the natural environment. Although the type of possible uses of these data will vary with the user, a few examples follow.

The data could be used for a preliminary evaluation of the radon potential in the Mount Holly and Ludlow quadrangles. Radon is a radioactive gas produced during the natural decay of uranium. Radioactivity studies show that certain map units in the Mount Holly Complex contain elevated levels of uranium (Skyline Labs, Inc., 1979; McHone and Wagener,1982). Rocks with the highest levels of uranium include tourmaline-bearing aplites and pegmatites (Yta and Yp), rusty aluminous quartz schist (Yrs), and quartzites (Yq). Grauch and Zarinski (1976) report anomalously high radioactivity from ultramafic rocks (OZu) in the Ludlow area. Gundersen and others (1993) and Gundersen and Schumann (1993) rate a number of rock types in Vermont with potentially high radon levels, many of which are found in the Mount Holly and Ludlow area. Faults and shear zones may also be areas of high radon potential (Gundersen and others, 1992). A radon potential map derived from the map units, ductile faults, and brittle features coverages could provide preliminary information for assessing the potential health risks associated with radon gas in the Mount Holly and Ludlow area.

The bedrock geologic data can be combined with the other VGIS data layers to derive maps for many other purposes. The bedrock geology could be combined with the source protection areas (SPAs) data layers to help communities and regulatory agencies better manage public and domestic water supplies. For example, an analysis of well location versus rock type may provide insight to factors affecting groundwater quality, especially in carbonate rocks, sulfidic rocks, or rocks containing elevated levels of uranium. The outcrops coverage used in conjunction with U.S. Soil Conservation Service soils data layers would provide the most comprehensive evaluation of exposed bedrock and shallow soils available. Such information would be useful for indicating areas that might require blasting and ledge removal during road construction. It would also be useful for preliminary evaluation of potential solid waste or subsurface wastewater disposal sites by indicating potential exclusion areas based on shallow depth to bedrock. By combining the hazardous waste sites (HWA) and pollution source inventory (PSI) data layers with the bedrock geology data layer, one could determine if any sites were located over areas susceptible to rapid contaminant migration such as carbonate rocks, faults, or brittle fractures. Figure 2 on Plate 3 illustrates how the geologic units can be combined with the DEM topography to provide new perspectives on how the bedrock geology influences the topography.

The addition of the bedrock geology database to the VGIS creates opportunities to develop a myriad of derivative maps not previously available, and it will enable Vermonters to make accurate assessments of factors which affect or are affected by the bedrock geology.

7.0 References

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STRUCTURE MAP
Plate 2 of 3

Schistosity
- Strike and dip of inclined schistosity
- Strike and dip of vertical schistosity

Gneissosity
- Strike and dip of inclined gneissosity
- Strike and dip of vertical gneissosity

Brittle Features
- Relative lateral displacement of brittle fault
- Relative vertical displacement of brittle fault, U = up and D = down
- Strike and dip of inclined brittle fault
- Strike and dip of vertical brittle fault
- Strike and dip of inclined joint
- Strike and dip of vertical joint

Cleavage
- Strike and dip of inclined cleavage
- Strike and dip of vertical cleavage

Ductile Faults
- Strike and dip of ductile fault

Topography modelled from USGS 7.5' DEM data
Contour Interval 100 feet
National Geodetic Vertical Datum of 1929
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SCALE 1:24000

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MN N

Approximate Mean Declination
15°00' West, 1986

VERMONT

LOCATION OF MAP

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FIGURES 1 AND 2
Plate 3 of 3

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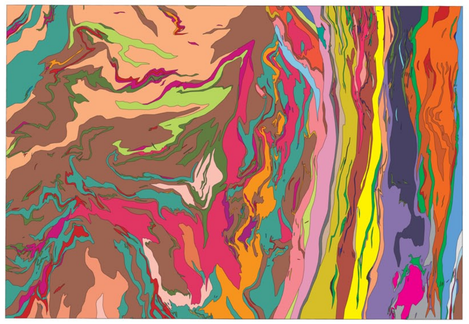
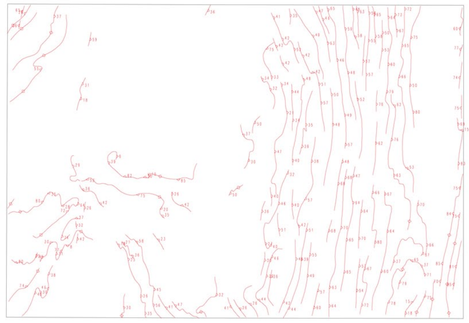
FIGURE 1.

The eight maps shown below illustrate the data layers in the bedrock geology database of the Vermont Geographic Information System. The bedrock geology of the Mount Holly and Ludlow quadrangles was mapped at a scale of 1:24,000 and is shown here at a scale of 1:100,000 -- the scale of the new State bedrock geologic map. These maps show the level of detail that can be preserved in the transfer from large-scale to small-scale maps. The geologic units, thrust faults, outcrops, and joints and brittle faults represent complete datasets from the original geologic mapping. The schistosity, gneissosity, and cleavage layers represent derivative datasets developed by the authors of the geology from a subset of the total structural data. See Plates 1 and 2 for a complete explanation of map units and symbols.

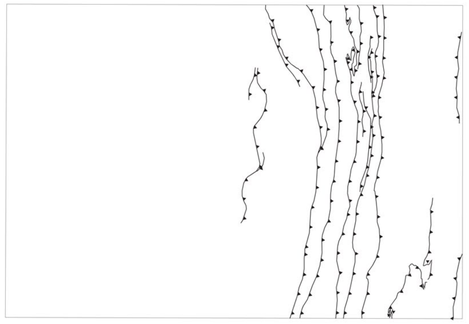
GEOLOGIC UNITS



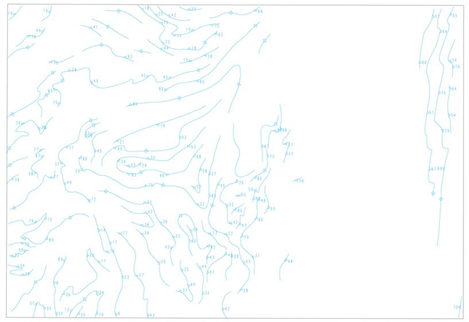
SCHISTOSITY FORM LINES



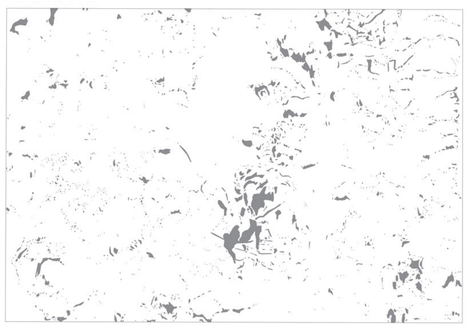
THRUST FAULTS



GNEISSOSITY FORM LINES

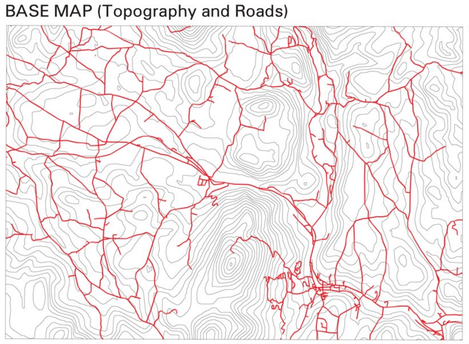


OUTCROPS



CLEAVAGE

BASE MAP (Topography and Roads)



JOINTS and BRITTLE FAULTS

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SCALE 1:100000

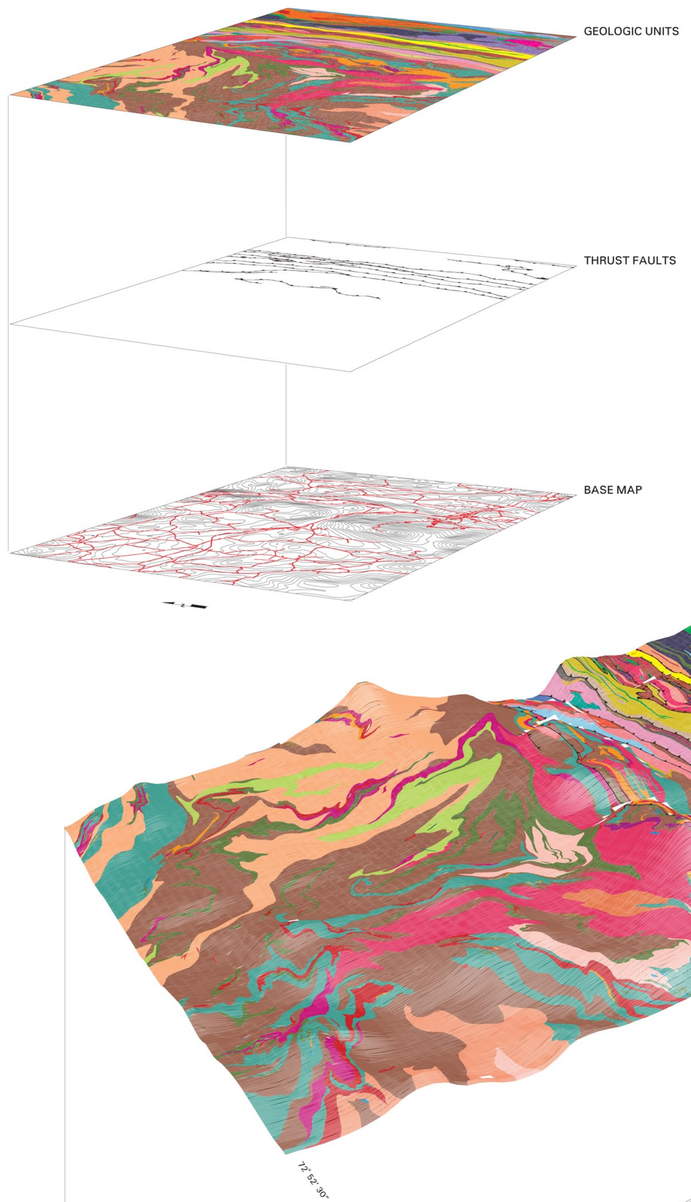

FIGURE 2.

The diagrams in figure 2 illustrate visual perspectives of three of the data layers from the Mount Holly and Ludlow quadrangles as viewed from the southwest. The topography data layer is based on USGS Digital Elevation Model (DEM) data and was used to generate the three-dimensional topography to produce the diagram shown below. The combination of these three layers shows how the digital database can be used to provide a unique look at how bedrock geology influences topography. Resistant gneisses and quartzites of the Middle Proterozoic Mount Holly Complex in magenta and gold underly much of Ludlow Mountain (Okemo Mountain Ski Area). Less resistant black schists and interlayered carbonate rocks of the Plymouth Formation in gray, pink, and blue underly the Black River Valley. Just to the east, however, the resistant muscovite-quartz schists of the Pinney Hollow Formation in greenish yellow support a prominent ridge where they have been thrust over the Plymouth Formation rocks. Still farther east, resistant rocks of the Barnard Gneiss in red and orange form the ridge know as "The Alps" between the villages of Tyson and Felchville.

View is from the southwest, no vertical exaggeration.
Approximate east-west dimension is 12.6 miles (20.2 kilometers).

These plates are part A and the database is part B of this Open-File Report. Both parts are available from the Vermont Geological Survey, telephone (802) 241-3608.

For more info: http://geology.er.usgs.gov/gmapeast/vtp/vermont.html