WATER-RESOURCES INVESTIGATIONS REPORT 99-4000
PLATE 1 OF 2

Abstract

This data layer shows the generalized lithologic and geochemical (lithogeochemical) character of near-surface bedrock in the Connecticut, Housatonic, and Thames River Basins and several other small basins that drain into Long Island Sound from Connecticut. The area includes most of Connecticut, western Massachusetts, eastern Vermont, western New Hampshire, and small parts of Rhode Island, New York, and Quebec, Canada.

Bedrock geologic rock units are classified into 29 lithogeochemical rock units, on the basis of the relative reactivity of their constituent minerals to dissolution and other weathering reactions and the presence of carbonate or sulfide minerals. The 29 lithogeochemical units (28 of which can be found in the study area) can be grouped into 6 major categories: (1) carbonate-rich rocks, (2) carbonate-poor, clastic sedimentary rocks restricted to distinct depositional basins, (3) metamorphosed, clastic sedimentary rocks (primarily noncalcareous), (4) mafic igneous rocks and their metamorphic equivalents, (5) ultramafic rocks, and (6) felsic igneous and plutonic rocks and their metamorphic equivalents. The lithogeochemical rock units also are grouped into nine lithologic and physiographic provinces (lithophysiographic domains), which can be further grouped into three major regions: (1) western highlands and lowlands, (2) central lowlands, and (3) eastern highlands.

INTRODUCTION

The goals of the National Water Quality Assessment (NAWQA) program are to describe the status and trends of a large representative part of the Nation's surface- and ground-water resources and to identify the natural and human factors that affect the quality of these resources (Leahy and others, 1990). The data set presented here was intended to characterize the bedrock geologic units in the Connecticut, Housatonic, and Thames River Basins study area in terms of mineralogic and chemical characteristics relevant to water quality, such that the geologic data were in digital form and could be used in a Geographic Information System (GIS) to analyze and interpret water-quality and ecosystem conditions.

HOW THIS DATA LAYER WAS CREATED

The data layer was compiled from State and regional geologic maps. The geologic units shown on the State and regional maps were classified using a lithogeochemical classification scheme that reflects geochemical principles and previous studies of the relations among rock types, water quality, and ecosystem characteristics. The classification of specific geologic units was based primarily on descriptions of the lithology, mineralogy, and weathering characteristics (for example, "rusty- weathering" as an indicator of sulfidic character) provided on the maps. Additional information for the Mesozoic Basin of Connecticut and Massachusetts from Smoot (1991) was used to modify the contacts and descriptions shown on the State geologic maps. The lithogeochemical units were further grouped into lithophysiographic domains. The lithophysiographic domains are based on tectonic and lithologic characteristics as well as physiography and are similar to the physiographic provinces of Denny (1982). The digital data layer was created using coded mylar overlays, registered to the State geologic maps, which were digitized at a scale of 1:125,000, attributed with the appropriate lithogeochemical code and other information, and edgematched.

LIMITATIONS OF THE DATA SET

This data layer has several limitations that originate from the procedures used in its compilation. About 95 percent of the data layer was compiled at a scale of 1:125,000 from published maps from various States and years. Thus, the data layer should not be used at scales larger than those of the source materials and should be expected to incorporate any limitations associated with the base materials of the source maps. Compilation of the lithogeochemical map from State geologic maps resulted in some discontinuities at State borders. The lithogeochemical code assigned to a rock unit was based primarily on its description on the appropriate State geologic map. Because the information contained on the individual State maps was interpreted and assembled by different groups of geologists during a 40-year period, the maps do not always represent a coherent or consistent data set when combined. In addition, the chemical and mineral-assemblage characteristics of the rock groups and formations within each State are generalized in the geologic map descriptions; thus regional trends in lithology or metamorphic grade may have resulted in different generalized descriptions of the same geologic unit in adjacent States. Discrepancies across State borders in the lithogeochemical coverage reflect these and other inconsistencies among the State geologic maps that could not be resolved with the existing information. However, the lithogeochemical coding of geologic units is internally consistent within each State, and discrepancies across State boundaries are minor in most cases. Use of the State geologic maps as source materials also left small parts of the study area along the coast of Connecticut unmapped, which reflects the extent of geologic information on the source map.

The 29-unit lithogeochemical classification scheme presented here has not been tested using actual water-quality data. The classification scheme and associated expected water-quality and ecosystem characteristics are based on geologic and geochemical principles and previous studies of the relations of rock types and these characteristics. Comparison with actual water-quality data likely would result in refinement of the classification scheme and a better understanding of the relations among rock types, water quality, and ecosystem characteristics. Finally, the data layer primarily depicts the lithogeochemical character of bedrock units, not the surficial deposits such as glacial till, glacial outwash, or recent alluvium. Where surficial deposits are derived from the local bedrock, the data layer also might be used to describe the lithogeochemical character of these materials. Chemical characteristics of natural waters associated with surficial deposits may differ from that suggested by the lithogeochemical character of bedrock units to the extent that the surficial deposits consist of or are mixed with materials transported from source areas with differing lithogeochemical characteristics.

ABOUT THE FILES AND PRODUCTS IN THIS DIGITAL PUBLICATION

Several files and products are included in this digital publication. The primary product is an ARC/INFO coverage, which is attributed with lithogeochemical codes and other information and includes documentation or metadata. The metadata describes the data layer and provides information on data quality, spatial data organization, spatial reference, spatial entities and attributes, and other aspects of the data layer; the metadata follows the "Contents Standards for Digital Geospatial Metadata," devised by the Federal Geographic Data Committee (FGDC) as part of the National Spatial Data Infrastructure. A spatial data transfer format (SDTF) version of the ARC/INFO coverage also is included, which conforms to FDGC standards for spatial data transferability across hardware and software boundaries. An ARCVIEW shape file also is included as an option. The data layer may be viewed on-line as map compositions showing the lithogeochemical units or lithophysiographic domains in the entire study area. The map compositions are available in several digital formats.

SOURCES OF MAP AND GEOLOGIC DATA

Billings, M.P., 1955, Geologic Map of New Hampshire: Reston, VA, U.S. Geological Survey, 1:250,000.

Denny, C.S., 1982, Geomorphology of New England: U.S. Geological Survey Professional Paper 1208, 18 p

Doll, C.G., Cady, W.M., Thompson, J.B., Jr., and Billings, MP., eds. and compilers, 1961, Centennial Geology Map of Vermont: Montpelier, VT, U.S. Geological Survey, 1:250,000, 1 sheet (transverse mercator projection).

Fisher, D.W., Isachsen, Y.W., Rickard, L.V., eds., 1970, Geologic Map of New York, Lower Hudson Sheet: New York State Museum and Science Service, Map and Chart Series No. 5, 1:250,000 (UTM projection).

Hermes, O.D., Gromet, L.P., Murray, D.P., 1994, Bedrock Geologic Map of Rhode Island: Kingston, RI, Office of the Rhode Island State Geologist, Rhode Island Map Series No:1, scale 1:100,000, 1 sheet (transverse mercator projection, zone 19).

Leahy, P.P., Rosenshein, J.S., and Knopman, D.S., 1990, Implementation plan for the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 90-174, 10 p.

Lyons, J.B., Bothner, W.A., Moench, R.H., and Thompson, J.B., Jr., 1986, Interim Geologic Map of New Hampshire: Reston, VA, U.S. Geological Survey, 1:250,000, 1 sheet (Lambert conformal conic projection, standard parallels 33 and 45 degrees).

Moench, R.H., ed., 1984, Geologic maps of the Sherbrooke-Lewiston Area, Maine, New Hampshire, and Vermont: U.S. Geological Survey Open-File Report 84-0650, 1:250,000 (transverse mercator projection).

Moench, R.H., Boone, G.M., Bothner, W.A., Boudette, E.L., Hatch, N.L., Jr., Hussey II, A.M., and Marvinney, R.G., 1995, Geologic map of the Sherbrooke-Lewiston Area, Maine, New Hampshire, and Vermont, United States, and Quebec, Canada: U.S. Geological Survey Miscellaneous Investigations-Series Map I-1898-D, 1:250,000, 2 sheets (transverse mercator projection).

Rogers, J., 1985, Bedrock geological map of Connecticut: Hartford, Conn., Connecticut Geologic and Natural History Survey, 1:125,000, 2 sheets (polyconic projection, zones 18 and 19).

Smoot, J.P., 1991, Sedimentary facies and depositional environments of early Mesozoic Newark Supergroup basins, eastern North America: Paleogeography, Paleoclimatology, Paleoecology, v. 84, p. 369-423.

Zen, E-an, Goldsmith, G.R., Ratcliffe, N.L., Robinson, P., and Stanley, R.S., 1983, Bedrock geologic map of Massachusetts: Washington, D.C., U.S. Geological Survey, 1:250,000, 3 sheets.

ABOUT THIS MAP COMPOSITION

The map composition depicted in this plot shows the lithogeochemical rock types (see table below) as depicted in the data layer; the lithophysiographic domains are depicted in a separate plot file. Additional information about the lithogeochemical classification scheme, the lithogeochemical coding of specific geologic map units, the procedures used to create and review the data layer, and spatial and digital characteristics of the data layer are provided in the documentation (metadata) associated with the ARC/INFO coverage. The ARC/INFO coverage and associated digital products can be obtained from the World Wide Web at http://water.usgs.gov/lookup/get?wrir994000.

Lithogeochemical rock types and expected unit characteristics

[Unit code is attribute "litho_unit" in ARC/INFO coverage. Various shades of gray represent areas outside the study unit and unmapped areas near the coast of Connecticut]

Lithogeochemical Unit		Chemical Character of Natural Waters	Sensitivity to Acid Deposition and Other Habitat Characteristics	Soil Characteristics	Topographic Expression
Unit code	Description				
Carbonate-rich Rocks					
11 Not in study area	limestone, dolomite, and carbonate-rich clastic sediments	high alkalinity, calcium, and bicarbonate concentrations; high pH; may have high concentrations of sulfate and solutes complexed by bicarbonate ion, such as arsenic and uranium	low sensitivity to acid deposition; flora favoring alkaline, high-calcium soils may occur; productive aquatic faunas	generally thin alkaline clay soils; high calcium, low potassium availability; may form iron-gossan in weathered sulfide-rich facies	generally lowlands and topographic depressions; may be sites of stream and river channels, ponds, lakes, and ground-water discharge
12	marble, including dolomitic marble; may include some calc-silicate rock				
12s	sulfidic marble; may include some calc-silicate rock				
13	calcareous clastic and metaclastic rocks containing approximately 15 to 45% carbonate minerals				
Carbonate-poor Clastic Sedimentary Rocks Restricted to Distinct Depositional Basins (bedded lithologies below biotite-grade of regional metamorphism)					
21	tan and red mudstone and shale; may include sandstone; locally contains minor carbonate and(or) sulfate (gypsum) minerals	generally high sodium and sometimes high calcium and sulfate; ground water may have moderate to high solute concentrations where acidic or high sulfate concentrations exist; iron may be high in ground water where Eh and pH are low; distinct groundwater types may be localized within the area of the depositional basin	low to moderate sensitivity to acid deposition	clay soils; variably neutral to acidic	variable; generally lowlands with subdued topography in the study area
21cs	calcareous, locally sulfidic, gray mudstone and shale				
22	interbedded mudstone, shale and siltstone; may contain sandstone				
23	sandstone and interbedded sandstone and conglomerate; may contain siltstone, shale, and mudstone				
Metamorphosed Clastic Sedimentary Rocks (primarily non-calcareous; may include felsic and mafic metavolcanic rocks; rocks may be foliated, recrystallized, highly deformed; highly variable rock types may be exposed in individual watersheds)					
31	slate and graywacke	low to moderate solute concentrations; generally low calcium-to-sodium ratios; variable potassium-to-sodium ratios; higher calcium concentrations when slightly calcareous	moderate to high sensitivity to acid deposition	rocky soils	uplands and ridges
32	pelitic schist and phyllite; may include granofels			clay soils	moderate hills
32c	pelitic schist and phyllite; may include granofels; calcareous				
33	mixed schist, granofels, and gneiss			clay to sandy soils	low to moderate rolling hills
33c	mixed schist and granofels; calcareous				
34	quartzose metasandstone, quartzite, quartz granofels, and quartzose gneiss	generally low solute concentrations; low pH; high potassium-to-sodium ratios		sandy to rocky soils	uplands and ridges
34c	quartzose metasandstone, quartzite, quartz granofels, and quartzose gneiss; locally includes schistose or calcareous units				
31s	graphitic and sulfidic slate and graywacke	low to moderate solute concentrations; iron may be higher in ground water where Eh and pH are low; sulfate may be high	moderately sensitive to acid deposition; endemic floras may occur in acidic metal-rich soils over sulfide-rich horizons	rocky acidic soils; acidic metal-rich soils may occur	uplands and ridges
32s	sulfidic schist; may include sulfidic granofels			clay soils; acidic metal-rich soils may occur	low to moderate hills
32cs	pelitic schist and phyllite; may include granofels; calcareous and sulfidic				
33s	sulfide-bearing schistose granofels and mixed schist and gneiss (sulfidic character may be local)			clay to sandy soils; acidic metal-rich soils may occur	low hills
35	interlayered granitic gneiss, schist, mafic gneiss, and amphibolite	low to moderate solute concentrations; variable calcium- and magnesium-to sodium ratios	variable sensitivity to acid deposition	clay to sandy soils	low to moderate rolling hills, upland, and highland
Mafic Igneous Rocks and their Metamorphic Equivalents					
41	basalt	high calcium- and magnesium-to-sodium ratios; variable silica concentrations (sometimes high due to dissolution of reactive silicates); where Eh and pH are low, iron and manganese are high	low sensitivity to acid deposition; may have endemic flora favoring alkaline, high-magnesium and low-potassium soils; productive aquatic faunas where calcium is high in surface waters	thin, rocky smectite clay soils; high in magnesium, low in potassium	moderate ridges and hills
42	amphibolite, greenstone, greenschist-facies metavolcanics, and schistose mafic rock with minor dispersed carbonate				
43	mafic gneiss and mafic lithologies mixed with felsic volcanics and(or) metaclastic lithologies			iron-rich smectite clay soils, with poor drainage; neutral to basic; high magnesium	moderate rolling topography
44	mafic plutonic rocks, including gabbro, diorite, monzodiorite, and diabase				lowlands or uplands, depending upon adjacent lithologies
Ultramafic Rocks					
50	ultramafic rocks, including serpentinites, dunites, peridotites, and talc schists	high magnesium-to-calcium ratios; relatively high silica concentrations due to dissolution of reactive silicates; ground water may have low Eh values and high metal concentrations	low sensitivity to acid deposition; frequently has endemic flora favoring high-magnesium, low-potassium, alkaline soils	thin, rock, iron-rich soils; high-magnesium, low-potassium, alkaline soils may occur	upland hills, knobs or ridges
50 c	ultramafic rocks, including serpentinites, dunites, peridotites, and talc schists; carbonate present				
Felsic Igneous and Plutonic Rocks and their Metamorphic Equivalents					
61	granitoid plutonic rocks, including granite, quartz monzonite, granodiorite, tonalite, trondhjemite, and equivalent gneiss	generally low solute concentrations; relatively high sodium, bicarbonate, and silica concentrations and relatively low pH; fluoride, uranium, and radon concentrations may be high; calcium and magnesium concentrations generally are low	high sensitivity to acid deposition	sandy soils	uplands and highlands; uplands may have little internal relief and steep slopes along borders
61v	fine-grained felsic rocks of volcanic to subvolcanic origin; includes feldspathic hypabyssal dikes and flows				
62	quartz-poor plutonic rocks, including syenite, nepheline syenite, quartz syenite, monzonite, and anorthosite			thin clay soils	

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LITHOGEOCHEMICAL CHARACTER OF NEAR-SURFACE BEDROCK IN THE CONNECTICUT, HOUSATONIC, AND THAMES RIVER BASINS

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