Minute Man National Historical Park

Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory Digital Geologic Data for Minute Man National Historical Park

mima_geology.pdf

Version: 3/15/2017
Geologic Resources Inventory Map Document for Minute Man National Historical Park

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This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Minute Man National Historical Park, Massachusetts (MIMA).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: http://irma.nps.gov/App/Reference/Search. To find GRI data for a specific park or parks select the appropriate park.
(s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: http://www.nature.nps.gov/geology/inventory, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.
GRI Digital Maps and Source Map Citations

The GRI digital geologic maps for Minute Man National Historical Park, Massachusetts (MIMA) are listed below. The source maps used to produce each map is also listed.

GRI Digital Surficial Geologic Map of Minute Man National Historical Park and Vicinity, Massachusetts (GRI MapCode MMSR)


** Only data within the extent of the 7.5' Concord quadrangle, and a 2.5' by 2.5 area in the northeastern corner of the Maynard 7.5' quadrangle was used.

GRI Digital Bedrock Geologic Map of Minute Man National Historical Park and Vicinity, Massachusetts (GRI MapCode MIMA)


** Only a 2.5' by 2.5 area in the northeastern corner of the Maynard Quadrangle was used.

Additional information pertaining to each source map is also presented in the Source Map Information (MIMAMAP) table included with the GRI geology-GIS data.
GRI Digital Surficial Geologic Map

Surficial Geology Unit List

The surficial geology units present in the digital surficial geologic-GIS data produced for Minute Man National Historical Park, Massachusetts (MIMA) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qal - Alluvium). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (MMSRUNIT) table included with the GRI geology-GIS data.

Quaternary Period

Postglacial Deposits
- Qaf – Artificial fill
- Qal – Floodplain alluvium
- Qsw – Swamp deposits

Glacial Stratified Deposits
- Qsdc – Glacial stratified deposits, coarse
- Qsdf – Glacial stratified deposits, fine

Glacial Till Deposits
- Qt – Thin till
- Qtt – Thick till

** Although Qaf is listed as a Postglacial Deposit and was included with other Postglacial Deposits in the same source GIS data layer, in the GRI digital geologic-GIS data Qaf areas are in their own distinct GIS data layer.

Surficial Geology Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

Qaf - Artificial fill (Quaternary)

Earth materials and manmade materials that have been artificially emplaced, primarily in highway and railroad embankments, and in dams; may also include landfills, urban development areas, and filled coastal wetlands. (Open File Report 2006-1260A)

Qal - Floodplain alluvium (Quaternary)

Sand, gravel, silt, and some organic material, stratified and well sorted to poorly sorted, beneath the floodplains of modern streams. The texture of alluvium commonly varies over short distances both laterally and vertically, and generally is similar to the texture of adjacent glacial deposits. Along smaller streams, alluvium is commonly less than 5 ft thick. The most extensive deposit of alluvium on the map is along the Charles, Assabet, and Concord Rivers where the texture is predominantly sand, fine gravel, and silt, and total thickness is as much as 25 ft. Alluvium typically overlies thicker glacial stratified deposits. (Open File Report 2006-1260A)
Qsw - Swamp deposits (Quaternary)

Organic muck and peat that contain minor amounts of sand, silt, and clay, stratified and poorly sorted, in kettle depressions or poorly drained areas. Most swamp deposits are less than about 10 ft thick. Swamp deposits overlie glacial deposits or bedrock. They locally overlie glacial till even where they occur within thin glacial meltwater deposits. (Open File Report 2006-1260A)

Glacial Stratified Deposits

Sorted and stratified sediments composed of gravel, sand, silt, and clay (as defined in particle size diagram) deposited in layers by glacial meltwater. These sediments occur as four basic textural units—gravel deposits, sand and gravel deposits, sand deposits, and fine deposits. On this interim map, gravel, sand and gravel, and sand deposits are not differentiated and are shown as Coarse Deposits where they occur at land surface. Fine Deposits also are shown where they occur at land surface. Textural changes occur both areally and vertically, however subsurface textural variations are not shown on this interim map.

Qsdc - Glacial stratified deposits, coarse (Quaternary)

Gravel deposits composed mainly of gravel-sized clasts; cobbles and boulders predominate; minor amounts of sand within gravel beds, and sand comprises few separate layers. Gravel layers generally are poorly sorted and bedding commonly is distorted and faulted due to postdepositional collapse related to melting of ice. Sand and gravel deposits composed of mixtures of gravel and sand within individual layers and as alternating layers. Sand and gravel layers generally range from 25 to 50 percent gravel particles and from 50 to 75 percent sand particles. Layers are well to poorly sorted; bedding may be distorted and faulted due to postdepositional collapse. Sand deposits composed mainly of very coarse to fine sand, commonly in well-sorted layers. Coarser layers may contain up to 25 percent gravel particles, generally granules and pebbles; finer layers may contain some very fine sand, silt, and clay. (Open File Report 2006-1260A)

Qsdf - Glacial stratified deposits, fine (Quaternary)

Very fine sand, silt, and clay that occurs as well-sorted, thin layers of alternating silt and clay, or thicker layers of very fine sand and silt. Very fine sand commonly occurs at the surface and grades downward into rhythmically bedded silt and clay varves. Locally, this map unit may include areas underlain by fine sand. (Open File Report 2006-1260A)

Qt - Thin till (Quaternary)

Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered gravel clasts and few large boulders; in areas where till is generally less than 10-15 ft thick and including areas of bedrock outcrop where till is absent. Predominantly upper till of the last glaciation; loose to moderately compact, generally sandy, commonly stony. Two facies are present in some places; a looser, coarser-grained ablation facies, melted out from supraglacial position; and an underlying more compact, finer-grained lodgement facies deposited subglacially. In general, both ablation and lodgement facies of upper till derived from fine-grained bedrock are finer grained, more compact, less stony and have fewer surface boulders than upper till derived from coarser grained crystalline rocks. Fine-grained bedrock sources include the red Mesozoic sedimentary rocks of the Connecticut River lowland, marble in the western river valleys, and fine-grained schists in upland areas. (Open File Report 2006-1260A)
Qtt - Thick till (Quaternary)

Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered gravel clasts and few large boulders at the surface; in the shallow subsurface, compact, nonsorted matrix of silt, very fine sand, and some clay containing scattered small gravel clasts in areas where till is greater than 10-15 ft thick, chiefly in drumlin landforms in which till thickness commonly exceeds 100 ft (maximum recorded thickness is 230 ft). Although upper till is the surface deposit, the lower till constitutes the bulk of the material in these areas. Lower till is moderately to very compact, and is commonly finer grained and less stony than upper till. An oxidized zone, the lower part of a soil profile formed during a period of interglacial weathering, is generally present in the upper part of the lower till. This zone commonly shows closely spaced joints that are stained with iron and manganese oxides.

(Open File Report 2006-1260A)
GRI Digital Bedrock Geologic Map

Bedrock Geology Unit List

The bedrock geologic units present in the digital bedrock geologic-GIS data produced for Minute Man National Historical Park, Massachusetts (MIMA) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Dihh - Indian Head Hill Igneous Complex). Units are listed by rock type group within local geologic terranes. Information about each geologic unit is also presented in the Geologic Unit Information (MIMAUNIT) table included with the GRI geology-GIS data.

Nashoba Terrane

Intrusive Igneous Rocks

- **Dihh** – Indian Head Hill Igneous Complex
- **UNKhhg** – Hubbard Hill Gabbro
- **DSwd** – White Pond Gabbro
- **DSag** – Andover Granite
- **DSap** – pegmatite
- **DSaqd** – Assabet Quartz Diorite
- **Sgr** – Sudbury Granite
- **Sgrd** – Sudbury Granite, Dark Phase
- **Sgrm** – Sudbury Granite, Mixed Phase

Stratified Rocks

- **COnu** – Nashoba Formation, undifferentiated
- **COnbh** – Nashoba Formation, Balls Hill Gneiss
- **COna** – Nashoba Formation, amphibolite
- **COns** – Nashoba Formation, schist
- **COnp** – Nashoba Formation, pegmatite
- **COM** – Marlboro Formation
- **COMjs** – Marlboro Formation, Jupiter Ridge Schist Member

Avalon Terrane

Intrusive Igneous Rocks

- **MZd** – diabase
- **Dcres** – Cambridge Reservoir Suite
- **DSphgd** – Prospect Hill Gabbro-Diorite
- **MZgwr** – Waltham Granite
- **Sls** – Lexington Suite
- **ZShg** – Fiske Hill Granite
- **DOsic** – Sudbury Valley Igneous Complex
- **ODgd** – Draper Gabbro-Diorite

Stratified Rocks

- **Zwm** – Westboro Formation, Mylonite

Tectonized-Mylonitized Rocks of the Avalon Terrane

- **UNKkgu** – Kendall Green Ultramylonite
- **UNKchm** – Cranberry Hill Mylonite
- **Zhm** – Haywood Brook Mylonite
- **ZDwgh** – Weston Group, Hornblende Member
- **ZDwghb** – Weston Group, Hornblende-Biotite Member
ZDwp – Weston Group, Plagioclase-Hornblende-Biotite Member
ZDwgm – Weston Group, Mylonitized Member
Zv – Mafic to Felsic Tectonite

Intrusive dikes of Unknown Age

bd - Basic dike*

** Small basic dikes (trend unknown) are represented in the GRI geologic-GIS data as a distinct/separate point geologic unit data layer.

** Bedrock outcrops - represented in the GRI geologic-GIS data as a distinct/separate data layer.

Bedrock Geology Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

Dihh - Indian Head Hill Igneous Complex (Mississippian and Devonian)

A multi-phase suite of igneous rocks consisting of three principal lithologies intermixed at sub-mapping scale:

1.) Granodiorite: Light- to medium-gray, brownish-yellow to greenish-gray weathering, medium- to coarse-grained, massive to weakly foliated granodiorite to quartzmonzodiorite. Composed mainly of plagioclase, potassium feldspar, quartz, biotite, muscovite, epidote ±hornblende.
2.) Granite: Light-gray to pink on weathered surfaces, fine- to medium-grained, massive granite to granodiorite. Composed of potassium feldspar, plagioclase, quartz, muscovite, biotite, ±hornblende. Age: 349 ± 4 Ma (U-Pb/zircon,titanite; Hepburn et al., 1995).

UNKhhg - Hubbard Hill Gabbro

Dark-gray to black, medium-grained, rusty weathering, gabbro. Intrudes the Nashoba Formation (OZn). Named for Hubbard Hill, Concord. (Langford, C.D., and Hepburn, C.J.)

DSwd - White Pond Gabbro (Devonian? to Silurian?)

Medium-gray to dark-greenish-gray, fine- to medium-grained, rusty weathering, generally massive, equigranular, biotite-hornblende tonalite to diorite. Intrudes the Andover Granite (DSag) and the Nashoba Formation (OZn). Possibly correlative with Sharpner’s Pond Diorite. Named for White Pond, Concord. (Langford, C.D., and Hepburn, C.J.)

DSag - Andover Granite (Devonian to Silurian?)

Light-gray to white to light-pink on fresh surfaces, weather to light-dull-gray, medium- to coarse-grained, massive unfoliated to strongly foliated, granite to pegmatite. Composed chiefly of alkali feldspar, plagioclase, quartz, muscovite, ±biotite, and ±garnet. Intrudes the Marlboro (COm) and Nashoba Formations (OZn). Age of crystallization of massive granite: 412 ± 2 Ma (U-Pb/zircon; Hepburn et
foliated granite: 446 ± 32 Ma (Rb-Sr/whole-rock; Zartman and Naylor, 1991).

**DSap - pegmatite (Devonian to Silurian?)**

Small bodies of granite pegmatite occur in nearly every outcrop of the Nashoba formation. Shown where large enough to map separately. (Langford, C.D., and Hepburn, C.J.)

**DSaqd - Assabet Quartz Diorite (Devonian to Silurian?)**

Medium- to dark-gray, medium-grained, locally weakly foliated, quartz diorite. Composed chiefly of plagioclase, hornblende, quartz, and biotite. Locally contains granitic pegmatitic veins (DSap) with biotite grains up to 5 cm. Intrudes the Nashoba Formation. May be correlative with the Sharpner’s Pond Diorite. (Langford, C.D., and Hepburn, C.J.)

**aqd - Assabet quartz diorite (Carboniferous)**

Medium- to dark gray medium-grained, vaguely foliated rock composed of andesine, hornblende, quartz and biotite. Contains considerable apatite and some sphene and hematite. On weathered surface biotite is altered to a bronze red. (Hansen, W.R.)

**Sgr - Sudbury Granite (Silurian?)**

Characteristically salmon-pink, medium- to coarse-grained, massive and non-foliated, granite. Commonly rusty weathering. Composed of alkali feldspar, plagioclase, quartz, and accessory biotite. Intrudes the White Pond Diorite. (Langford, C.D., and Hepburn, C.J.)

**Sgrd - Sudbury Granite, Dark Phase (Silurian?)**

Dark-gray and pink, medium- to coarse-grained, massive and non-foliated, granite to granodiorite. Commonly rusty weathering. (Langford, C.D., and Hepburn, C.J.)

**Sgrm - Sudbury Granite, Mixed Phase (Silurian?)**

A mixed phase of a white to pink, medium- to coarse-grained, massive and non-foliated, granite and the other phases of Sudbury Granite (Sgr and Sgrd) intermixed at a sub-mapping scale. (Langford, C.D., and Hepburn, C.J.)

**COnu - Nashoba Formation, undifferentiated (Cambrian to Ordovician)**

Medium- to dark-gray, fine- to coarse-grained, layered and well foliated, muscovite-biotite gneiss and schist. Composed chiefly of plagioclase, quartz, muscovite, and biotite. May locally contain potassium feldspar, sillimanite, garnet, and magnetite. Many exposures contain intrusions of Andover Granite and pegmatite. (Langford, C.D., and Hepburn, C.J.)

**Cn - Nioshoba formation (Carboniferous)**

Predominantly light-gray to medium-gray medium-grained biotite paragneiss. Unit Cn, composed chiefly of quartz, biotite and sodic plagioclase (generally albite oligoclase) and containing minor but locally considerable amounts of orthoclase, garnet, sillimanite, and magnetite. Contains numerous interbedded layers of amphibolite schist (OZNa and OZNs), hornblende gneiss, variably feldspathized quartzite beds that range in thickness from a fraction of an inch to many feet, and a few beds of marble. Most exposures contain some igneous material as small dikes, intrusive sheets or irregular masses of granite,
Aplite or pegmatite (OZnp). (Hansen, W.R.)

Age now recognized to be Cambrian to Ordovician (as per personal communication with source map author Chris Hepburn).

COnbh - Nashoba Formation, Balls Hill Gneiss (Cambrian to Ordovician)

Light- to medium-gray, fine- to coarse-grained, layered and well foliated, quartz-feldspathic gneiss. Composed chiefly of plagioclase, quartz, and biotite. Named for Balls Hill in Concord. (Langford, C.D., and Hepburn, C.J.)

Age now recognized to be Cambrian to Ordovician (as per personal communication with source map author Chris Hepburn).

COna - Nashoba Formation, amphibolite (Cambrian to Ordovician)

Dark-greenish-gray, fine- to medium-grained, hornblende-plagioclase dominated amphibolite found in the Nashoba Formation (OZn). Shown separately where possible at this scale. (Langford, C.D., and Hepburn, C.J.)

am - Nioshoba formation amphibolite (Carboniferous)
Interbedded layers of amphibolite schist (Hansen, W.R.)

Age now recognized to be Cambrian to Ordovician (as per personal communication with source map author Chris Hepburn).

Cons - Nashoba Formation, schist (Cambrian to Ordovician)

Rusty, dark-gray to black, sulfidic, muscovite, biotite schist. Mapped separately when possible at this scale within the Nashoba Formation (OZnu). (Langford, C.D., and Hepburn, C.J.)

Age now recognized to be Cambrian to Ordovician (as per personal communication with source map author Chris Hepburn).

Conp - Nashoba Formation, pegmatite (Cambrian to Ordovician)

Exposures (of OZnu) contain some igneous material as small dikes, intrusive sheets or irregular masses of granite, aplite or pegmatite. (Hansen, W.R.)

Age now recognized to be Cambrian to Ordovician (as per personal communication with source map author Chris Hepburn).

Com - Marlboro Formation (Cambrian to Ordovician or Older?)

Commonly light- to dark-greenish-gray, fine- to medium-grained, massive to well foliated, schistose amphibolite. Mainly composed of hornblende, plagioclase, and biotite. Epidote present in many exposures. Mylonitized locally into very thinly laminated alternating layers of creamy-white to dull-olive-gray, sheared rock that contains epidote and quartz nodules and veins. Minor cream-colored quartzite lenses to 2 meters in length. Sheared marble observed at one exposure. (Langford, C.D., and Hepburn,
COMjs - Marlboro Formation, Jupiter Ridge Schist Member (Cambrian to Ordovician or Older?)

Rusty, dark-gray to black, sulfidic, muscovite-biotite schist with minor accessory pyrite and/or marcasite. Found as a lense within the Marlboro Formation (COM). Named for Jupiter Ridge, Lincoln. (Langford, C.D., and Hepburn, C.J.)

MZd - Diabase (Mesozoic)

Small intrusions of very fine-grained, unaltered, massive diabase. (Langford, C.D., and Hepburn, C.J.)

Dcrs - Cambridge Reservoir Suite (Devonian)

Suite of rocks after Kohut (1999), mapped as Salem Gabbro-diorite by Emerson (1917) and Zdigb by Zen et al. (1983) including:

1.) Gabbro-diorite: Dark-blue-gray, medium- to coarse-grained, hornblende-bearing, gabbro-diorite. Thin veins of epidote common. Intruded by all other members of the suite.
2.) Gabbro-diorite: Dark-gray, fine- to very fine-grained, pyroxene- and hornblende-bearing gabbro-diorite. Intruded by white and tan granites. Intrudes coarse grained gabbro-diorite.
3.) Granite: White with a greenish tinge, medium- to coarse-grained, mafic poor granite-alaskite.
4.) Granite: Tan, fine-grained, biotite- and hornblende-bearing granite. (Langford, C.D., and Hepburn, C.J.)

DSphgd - Prospect Hill Gabbro-Diorite (Devonian to Silurian?)

Medium-gray, medium-grained, pyroxene-bearing gabbro-diorite with a diabasic texture. Laths of gray plagioclase with interstitial dark gray to black pyroxenes common. Composition more subalkaline than other mafic rocks locally in the Avalon Terrane (Kohut, 1999). Intrudes the Waltham Granite (wgr) and Lexington Suite (Sls). (Langford, C.D., and Hepburn, C.J.)

MZwgr - Waltham Granite (Mid-Paleozoic?)

Creamy to orange-pink, fine- to medium-grained, mafic poor granite with a sugary texture. Greenish black specks of hornblende common. (Langford, C.D., and Hepburn, C.J.)

Sls - Lexington Suite (Silurian)

Suite of rocks including: medium-gray, medium- to very coarse-grained, quartz-bearing, hornblende-biotite diorites and minor felsic rocks. (Langford, C.D., and Hepburn, C.J.)

ZSfhg - Fiske Hill Granite (Neo-Proterozoic to Silurian)

Gray-pink, medium-grained, inequigranular, biotite-bearing granite with white plagioclase and pink-orange microcline. Commonly seen as cataclasites and fault breccias. (Langford, C.D., and Hepburn, C.J.)

Age now recognized to be Neo-Proterozoic to Silurian (as per personal communication with source map author Chris Hepburn).
DOsic - Sudbury Valley Igneous Complex (Devonian to Ordovician?)

This igneous complex is made of several phases believed to be contemporaneous. Lithologies are intermixed at sub-mapping scale:

1.) Granite: Medium- to dark-gray, medium- to coarse-grained, granite to granodiorite. Composed chiefly of altered plagioclase, potassium feldspar, quartz, hornblende, and ±biotite. Biotite flakes and occasional large (>6 mm) grains of white feldspar may be prominent. Locally very rusty weathering.

2.) Diorite: Medium- to dark-greenish-gray, very fine-grained, massive and very hard, diorite. Composed mainly of hornblende, altered plagioclase and quartz. (Langford, C.D., and Hepburn, C.J.)

Odgd - Draper Gabbro-Diorite (Ordovician?)

Gray-green, medium to coarse-grained, hornblende-bearing gabbro-diorite with areas of a mottled greenish-gray coloration and small clusters of chalky, greenish-white plagioclase grains visible. May be contemporaneous with Boston Post Diorite (bpd). (Langford, C.D., and Hepburn, C.J.)

Zwm - Westboro Formation, Mylonite (Neo-Proterozoic?)

Interlayered light-tan to light-gray and dark-greenish-gray, very fine-grained, thinly laminated, mylonitized quartzite. Commonly rusty weathered. (Langford, C.D., and Hepburn, C.J.)

Age older than ~600 Ma to as old as ~1,000 Ma (as per personal communication with source map author Chris Hepburn).

UNKkgu - Kendall Green Ultramylonite

Dark-gray to pale-green, very fine-grained, finely layered ultramylonite with thin layers of calcite. Psuedotachylite present locally. Multiple protoliths likely. (Langford, C.D., and Hepburn, C.J.)

UNKchm - Cranberry Hill Mylonite

Very dark gray-green, fine-grained, mylonitized mafic rock containing meter-sized stretched pods of epidote and calcite and coticule veins up to 3 cm long. Mapped separately due to uncertainty of the protolith. (Langford, C.D., and Hepburn, C.J.)

Zhm - Haywood Brook Mylonite (Neo-Proterozoic?)

Dark-gray with prominent pinkish-white layers, fine- to medium-grained, blastomylonite. Composed chiefly of hornblende, and plagioclase with quartz, muscovite ±biotite locally containing garnet. Mapped separately due to uncertainty of the protolith. (Langford, C.D., and Hepburn, C.J.)

ZDwgh - Weston Group, Hornblende Member (Neo-Proterozoic to Devonian)

Dull-greenish-black, very fine-grained rock consisting of hornblende, chlorite, epidote, and oligoclase with a well defined schistose foliation. (Langford, C.D., and Hepburn, C.J.)
ZDwghb - Weston Group, Hornblende-Biotite Member (Neo-Proterozoic to Devonian)

Shiny-dark-gray to black, very fine-grained rock consisting of hornblende, biotite, and oligoclase with a well defined schistose foliation. Porphyroblasts of hornblende (1-2mm) common, folded veins (5 mm) of plagioclase and magnetite present. (Langford, C.D., and Hepburn, C.J.)

ZDwgp - Weston Group, Plagioclase-Hornblende-Biotite Member (Neo-Proterozoic to Devonian)


ZDwgm - Weston Group, Mylonitized Member (Neo-Proterozoic to Devonian)

Fine- to very fine-grained mylonitized rocks of the Weston Group. Epidote, chlorite, and quartz observed as alteration products. Fibrous calcite veins with crack and seal structures evident. (Langford, C.D., and Hepburn, C.J.)

Zv - Mafic to Felsic Tectonite (Neo-Proterozoic)

Dull-black and dark-gray to shiny-black, commonly rusty weathering, fine-grained, unfoliated gabbro-diorite to weakly foliated tectonite with a sugary texture. Secondary calcite common. Adapted after Zen et al. (1983). (Langford, C.D., and Hepburn, C.J.)

bd - Basic dike (age unknown)

Location of small basic dike. (Hansen, W.R.)

Bedrock outcrops and areas of abundant outcrop or shallow bedrock

In areas of shallow bedrock, surficial materials are less than 5-10 ft thick. Small outcrops too numerous to map individually:(Open File Report 2006-1260A)

** Individual bedrock outcrops, as well as areas of shallow bedrock are included the the GRI digital geologic-GIS data as their own distinct data layer.
GRI Source Map Citations

Langford, C.D., and Hepburn, C.J. (BC M.S. Thesis)


Index Maps

Extracted from (Langford, C.D., and Hepburn, C.J.)

Mapping Contributions By.


Drafted and digitized by Colin D. Langford, March, 2007

Extracted from (Langford, C.D., and Hepburn, C.J.)
**Although the source publication legend indicates that both trend and plunge of lineation and strike of vertical foliation features are present neither were found on the actual map.**

**Map References**


Stone, J.R., and Stone, B.D. (OFR 2006-1260A)


** Only data within the extent of the Concord 7.5' quadrangle, as well as a 2.5' by 2.5' area in the northeastern corner of the Maynard 7.5' quadrangle was used for the GRI surficial geologic-GIS map.

Grain Size Classification

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Extracted from (Open File Report 2006-1260A)
Index Maps

- 7.5-minute quadrangles in this compilation

*Extracted from: [Open File Report 2006-1260A](#).*

**Only data within the extent of the 7.5' Concord quadrangle, and a 2.5' by 2.5' area in the northeastern corner of the Maynard 7.5' quadrangle was used.*
Compilation Areas in Massachusetts. The area applicable to the source digital data presented in the previous figure is area A in this figure.


**Quadrangle Sources**

**Concord Quadrangle**

Map units were reproduced from Koteff (1964). Glacial Stratified Deposits in this quadrangle include deposits of glacial lakes Sudbury and Concord, and other smaller valley deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of glacial Lakes Sudbury and Concord (unit Qlsb and Qlcb of Koteff, 1964); these units have been extended beneath adjacent water bodies and postglacial deposits on this map. Thick till areas shown on this map were inferred from photographic image and topographic analysis and drumlin symbols shown by Koteff (1964).  

**Maynard Quadrangle**

Map units were produced from Hansen (1956). Glacial Stratified Deposits in this quadrangle include various glacial lake and stream deposits. Fine-grained glacial stratified deposits at land surface include lake-bottom deposits of Lake Sudbury (parts of unit Qsg of Hansen, m 1956); this unit has been extended beneath adjacent water bodies and postglacial deposits on this map. Drumlin till unit was reproduced from the published map; other areas of thick till were inferred from photographic image and topographic analysis.
Hansen, W. R. (Bulletin 1038)


** Only a 2.5' by 2.5 area in the northeastern corner of the Maynard Quadrangle was used.

** No graphics were captured from this map as these either pertained to the full map extent (e.g., listing of map units), or were not in the extent of the map area used (e.g., cross sections).
GRI Digital Data Credits

This document was developed and completed by Philip Reiker (NPS GRD, Lakewood, Colorado) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality Control of this document by Georgia Hybels (NPS GRD, Lakewood, Colorado) and Stephanie O’Meara (Colorado State University). The dataset was updated to include coverage for the northwestern area of the park, and the dataset was migrated to an ESRI 10.0 file geodatabase format by Stephanie O’Meara.

The information contained here was compiled to accompany the digital geologic-GIS map(s) and other digital data for Minute Man National Historical Park, Massachusetts (MIMA) developed by Philip Reiker (NPS GRD, Lakewood, Colorado). QC (Quality Control) of GRI geologic-GIS data by Dave Green (Colorado State University) and Georgia Hybels (NPS GRD, Lakewood, Colorado). This document was updated by Stephanie O’Meara to include additional unit descriptions and source map information from the incorporation of a part of the Hansen, 1956 source map.

GRI finalization by Stephanie O’Meara.

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).