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PRELIMINARY BEDROCK GEOLOGIC MAP OF THE HUDSON 7.5' QUADRANGLE WORCESTER AND MIDDLESEX COUNTIES, MASSACHUSETTS

By
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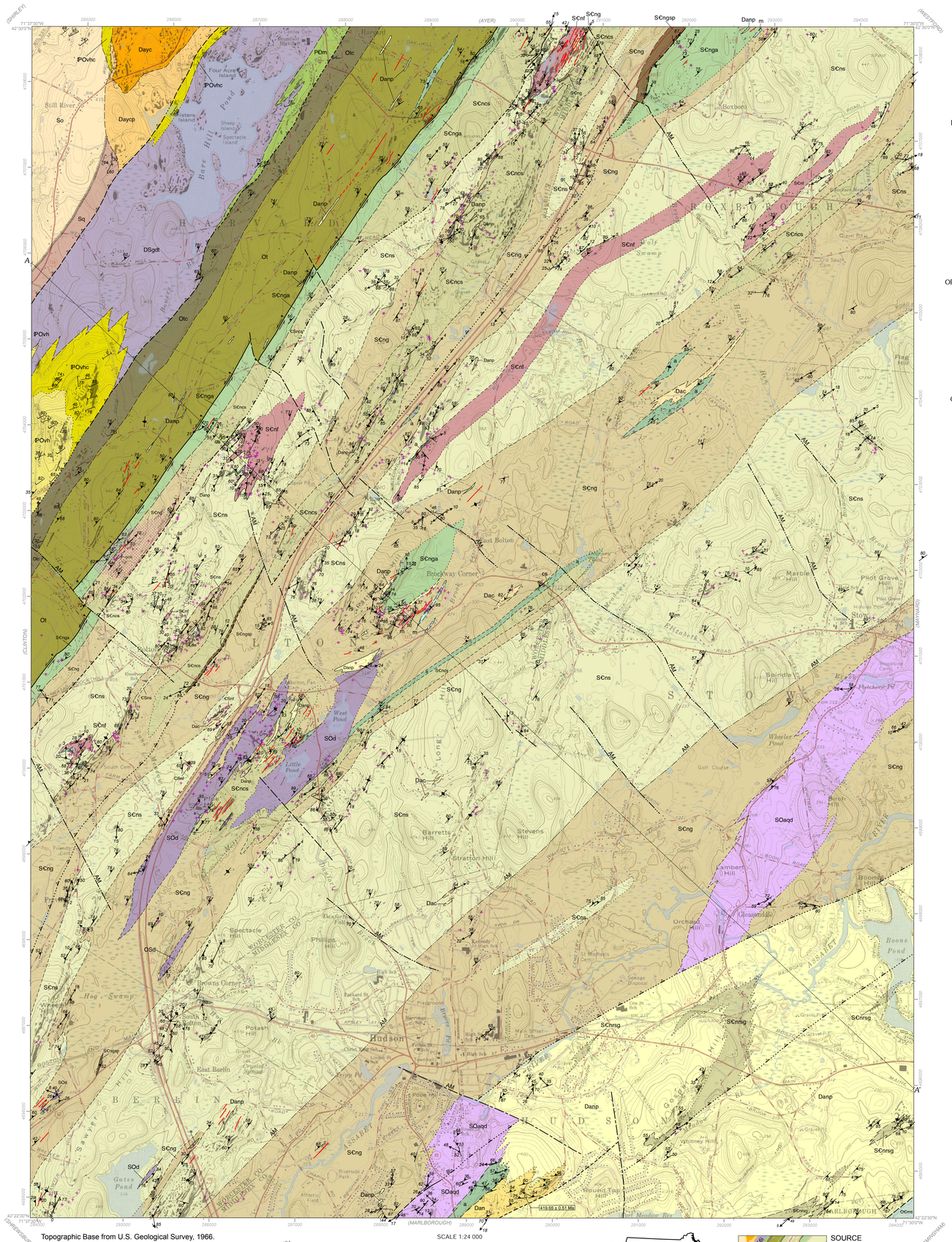
PRELIMINARY BEDROCK GEOLOGIC MAP OF THE HUDSON 7.5' QUADRANGLE, MASSACHUSETTS
Explanatory pamphlet accompanies map
2014



Topographic Base from U.S. Geological Survey, 1966.
Reprojected to EPSG 26986:
Mass. State Plane Mainland (FIPS 2001)
Lambert Conformal Conic Projection
Lat/Long Tics are from GCS North American 1983
Geographic Coordinate System (GRS 1980 Spheroid)

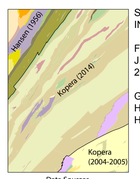
1000-meter tick marks from UTM (Zone 19 N), NAD 1983

APPROXIMATE MEAN DECLINATION, 2014

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION



Data Sources

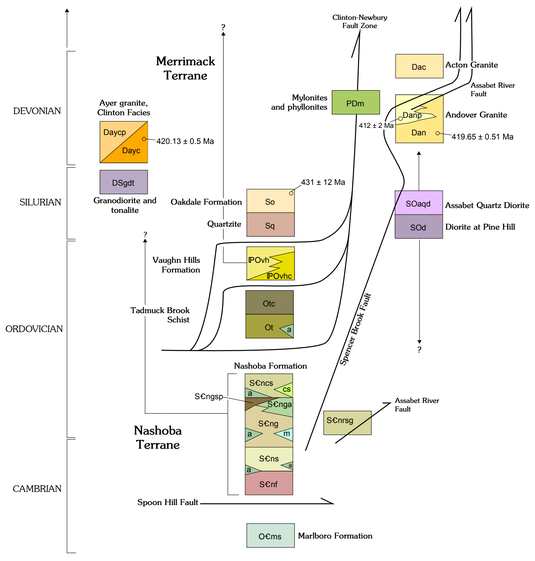
SOURCE INFORMATION:

Field mapping by J. Kopera (2004-2005, 2008, 2010, 2012, 2014)

Geology northwest of Ball Hill Fault modified from Hansen (1956).

CORRELATION OF MAP UNITS

(see pamphlet for radiometric age sources)



EXPLANATION OF MAP SYMBOLS

map symbols used are from the FDGC Digital Cartographic Standard for Geologic Map Symbolization (FDGC, 2006)

Contact –Solid where location certain; Long dash where location approximate; Short dash where location uncertain; Dotted where contact inferred.

Contact –Gradational

Contact –Inferred from aeromagnetic lineament.

RELIABILITY

Natural Bedrock Outcrop from Hansen (1956; Total exposure = 1.56%)

Field Station where not overlapped by structural symbol (1461 total field stations: Kopera 2004, 2014)

Location of boring or well log used to determine lithology (Fernandez et al., 2005).

Abandoned quarry

Active quarry

FAULTS

(See pamphlet for discussion)

Mylonitic thrust fault –Pre- to syn-D_2. Usually overprinted by subsequent D_2 and later strike slip and/or normal motion (see pamphlet for discussion). Solid where location certain; Long dash where location approximate; Short dash where location uncertain; Dotted where inferred.

Mylonitic oblique slip fault –Syn- to post-D_2; displaying predominant sinistral-normal movement.

Brittle Fault –Long dash where location approximate. Dotted where inferred.

Brittle Fault –Location determined by topographic or aeromagnetic ("AM") lineament. Faults determined by aeromagnetic lineaments commonly have associated topographic lineaments. Predominantly steeply northeast dipping with oblique normal motion. Presumed to be Mesozoic in age (see pamphlet).

SELECTED STRUCTURAL DATA

(See pamphlet for discussion; Symbols radiate from point of observation where more than one feature is present.)

Strike and dip of bedding in Merrimack Belt rocks.

First and second generation fabrics (D_1/D_2)

Strike and dip of dominant foliation. Not age specific but dominantly S_2 or an S_1 - S_2 composite foliation parallel to compositional layering in the Nashoba Formation and tectonic foliation in igneous rocks. Barbs on both sides where vertical. Axial planar to F_1 - F_2 folds where observed.

Strike and dip of heavily contorted dominant foliation. Barbs on both sides where vertical.

Strike and dip of cleavage in Merrimack Belt rocks. Not age specific but dominantly S_2. Barbs on both sides where vertical

Strike and dip of axial plane of F_2 fold.

Trend and plunge of F_2 fold axis

Trend and plunge of L_2 mineral or L_1- L_2 intersection lineation. In vast majority of outcrops L_2 mineral and L_1- L_2 intersection lineations are the same.

Third generation fabrics (D_3)

Strike and dip of axial plane of D_3 fold. Barbs on both sides where vertical.

Trend and plunge of D_3 fold axis.

Fourth generation fabrics (D_4)

Strike and dip of S_4 foliation and/or crenulation cleavage in schistose rocks. Barbs on both sides where vertical.

Strike and dip of axial plane of F_4 asymetric fold. Barbs on both sides where vertical.

Trend and plunge of asymmetric (sinistral, down plunge) F_4 fold axis.

Trend and plunge of L_4 intersection lineation

Trend and plunge of L_4 crenulation axis

Fifth generation fabrics (D_5)

Strike and dip of S_5 ductile shear zone. Displays silliminite to chlorite-grade northwest-side down normal motion.

Zone of intense sulfide and oxide mineralization

Location of Radiometric age date. See pamphlet for source.

Line of Cross Section

REFERENCES CITED ON MAP

Daniels, D.L., and Snyder, S.L., 2004, New England States Aeromagnetic and Gravity Maps and Data: A Web Site for Distribution of Data: U.S. Geological Survey Open File Report 2004-1258. Digital resource only available online: http://pubs.usgs.gov/of/2004/1258/

Federal Geographic Data Committee [prepared for the Federal Geographic Data Committee by the U.S. Geological Survey], 2006, FGDC Digital Cartographic Standard for Geologic Map Symbolization: Reston, Va., Federal Geographic Data Committee Document Number FGDC-STD-013-2006, 290 p., 2 plates.

Fernandez, M., Duncan, C., and Mabee S.B., 2005, Well inventory of the Hudson quadrangle. Office of the Massachusetts State Geologist Well Inventory 05-01. Digital Product: ESRI Arcview 3.1 GIS Database.

Hansen, W.R., 1956, Geology and mineral resources of the Hudson and Maynard quadrangles, Massachusetts: U.S. Geological Survey Bulletin 1038. 104p and 2 plates.

LIST OF MAP UNITS

(See the complete Description of Map Units in the accompanying pamphlet)

PDm **Felsic Mylonite And Phyllonite (Late Devonian To Permian?)**

Intrusive Rocks in the Merrimack Terrane

Daycp, Dayc **Ayer Granite, Clinton Facies (Devonian)**
Daycp - megacrystic phase
Dayc - granite to granodiorite

DSgdt **Granodiorite And Tonalite (Silurian To Devonian?)**

Metasedimentary Rocks in the Merrimack Terrane

So **Oakdale Formation (Silurian)**
So - Metasiltstone and phyllite

Sq **Quartzite (Silurian?)**
Sq - Quartzite with minor phyllite

POvh, POvhc **Vaughn Hills Formation (Ordovician to Pennsylvanian?)**
POvh - Turbiditic quartzite and phyllite
POvhc - Conglomerate

Intrusive Rocks of the Nashoba Terrane

Dac **Acton Granite (Devonian?)**
Dac - granite to tonalite

dikes and sills of Danp (as mapped by Hansen, 1956)

Danp, Dan **Andover Granite (Devonian)**
Danp - Pegmatitic phase
Dan - Biotite granite

SOaqd **Assabet Quartz Diorite (Silurian?)**
SOaqd – diorite to tonalite

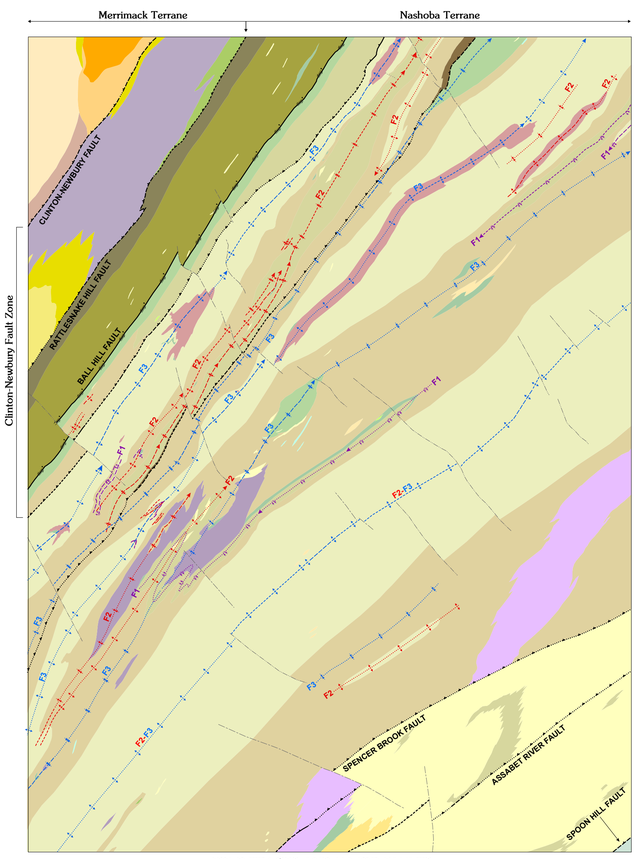
SOd **Diorite At Pine Hill (Silurian?)**
SOd – diorite

Metasedimentary Rocks of the Nashoba Terrane

Otc, Ot **Tadmuck Brook Schist (Ordovician?)**
Otc – Chlorite schist and phyllonite
Ot – Sulfidic schist and quartzite
a – Amphibolite

S€ncs, S€ngsp, S€nga, S€nrsg, S€ng, S€ns, S€nf **Nashoba Formation (Cambrian to Silurian?)**
S€ncs – Calc-silicate gneiss
cs – Coarse grained calc-silicate pods
a – Amphibolite
S€ngsp – Sulfidic calcareous schist and phyllonite
S€nga – Amphibolite gneiss
S€nrsg – Rusty schist and granofels
S€ng – Garnet bearing biotite gneiss
a – Amphibolite
m – Marble
S€ns – Magnetite bearing muscovite-silliminite gneiss
gc – garnet coticule
S€nf – Felsic biotite gneiss

O€ms **Marlboro Formation (Cambrian to Ordovician?)**
O€ms - Muscovite schist



FOLD TRACES AND MAJOR FAULTS

Scale 1:48000

Axial trace of F_1 antiform - Long dash where location approximate; short dash where location uncertain; dotted where inferred.

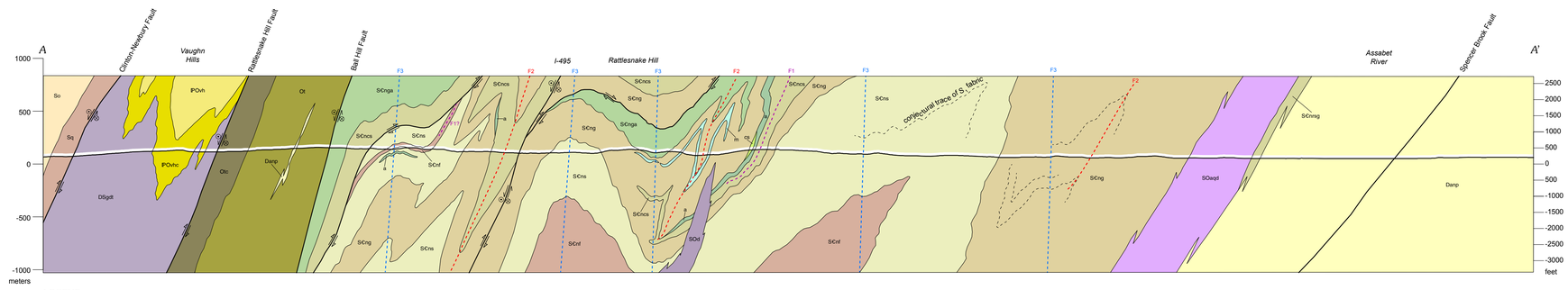
Axial trace of F_1 synform - Long dash where location approximate; short dash where location uncertain; dotted where inferred.

Axial trace of F_2 antiform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

Axial trace of F_2 synform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

Axial trace of F_3 antiform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

Axial trace of F_3 synform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.



LEGEND

Fault Motion
(see pamphlet for discussion)

D_1-D_2 thrust motion

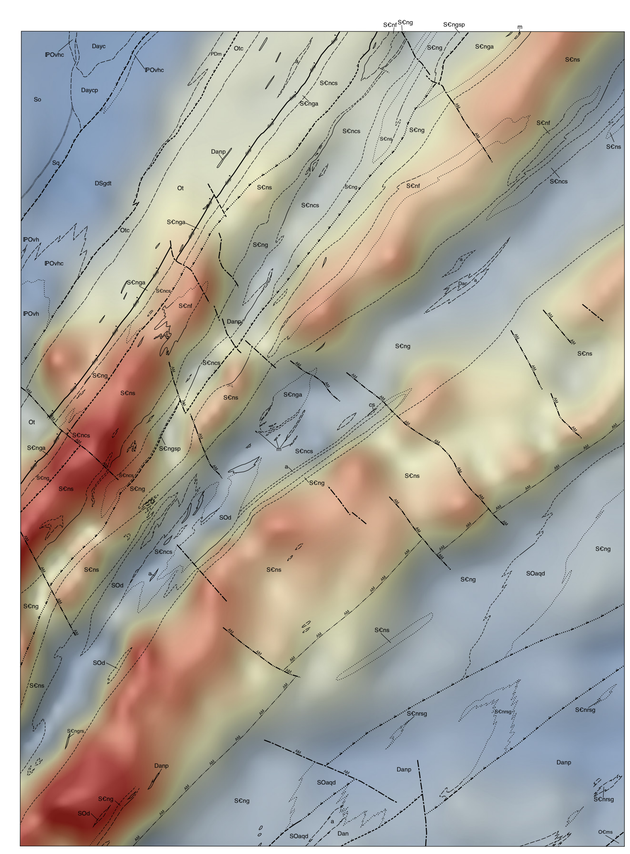
D_2-D_3 sinistral-normal motion

Selected Fold Axial Traces
(see pamphlet for discussion)

F_1

F_2

F_3



CORRELATION OF AEROMAGNETIC DATA WITH BEDROCK GEOLOGY

Aeromagnetic data from Daniels and Snyder (2004)
Scale 1:48000

Gammas
2700
-502

Comments to the Map User

This map and the accompanying report have not been peer reviewed or edited to conform with editorial standards of the Massachusetts Geological Survey or with the North American Stratigraphic Code. The contents of the report and map should not be considered final and complete until reviewed and published by the Massachusetts Geological Survey as a Geologic Map (GM) product.

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