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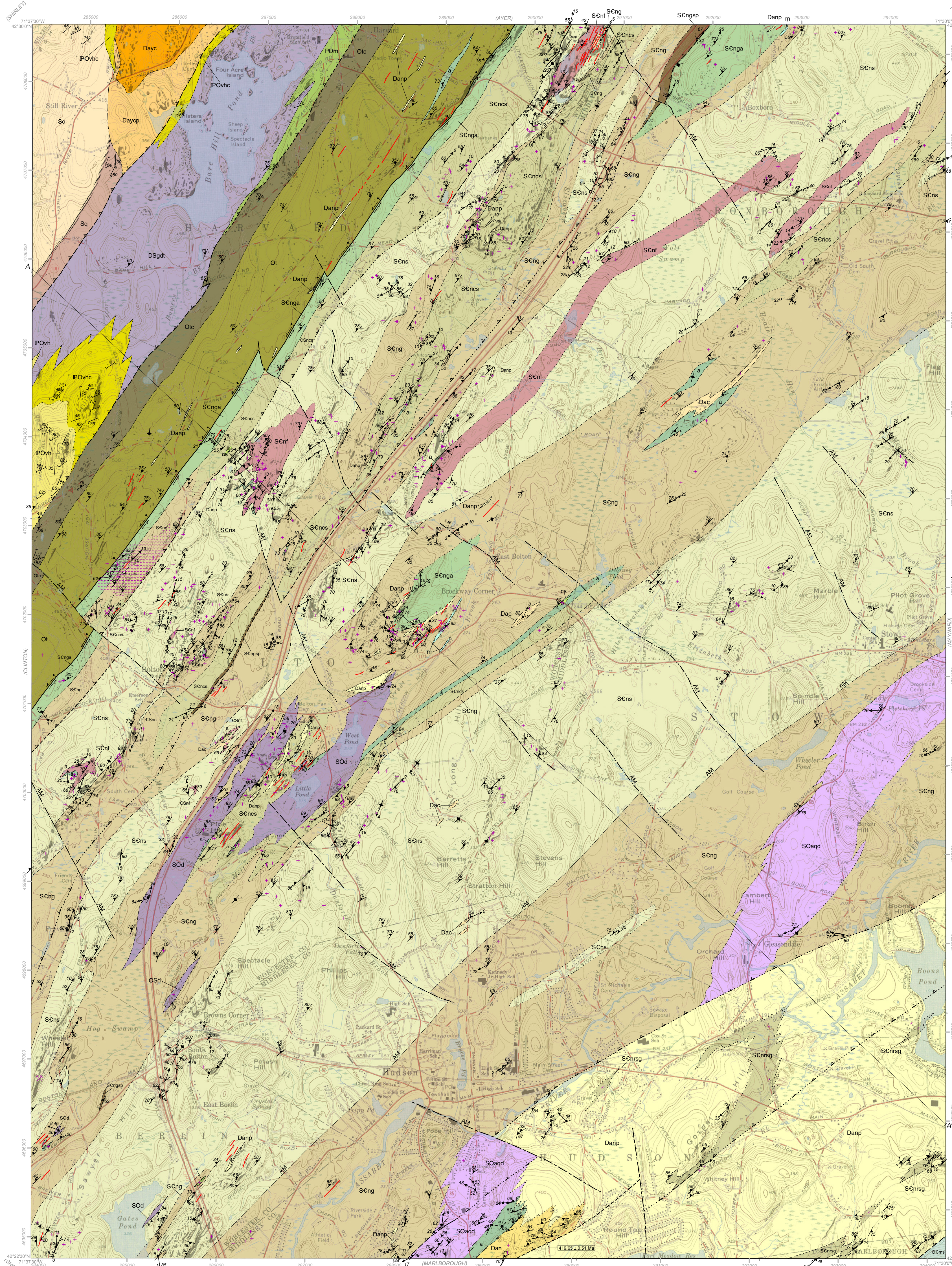
Preliminary Bedrock Geologic Map of the Hudson 7.5' Quadrangle Worcester and Middlesex Counties, Massachusetts

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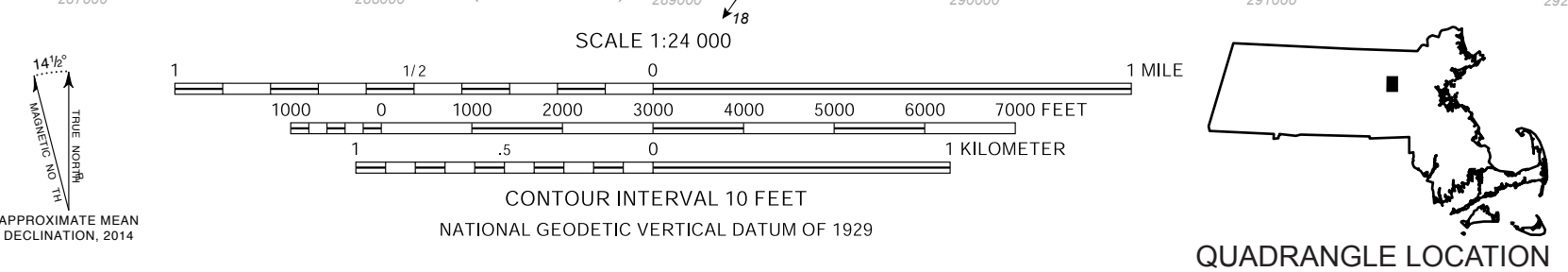
PRELIMINARY BEDROCK GEOLOGIC MAP OF THE HUDSON 7.5' QUADRANGLE WORCESTER AND MIDDLESEX COUNTIES, MASSACHUSETTS

By
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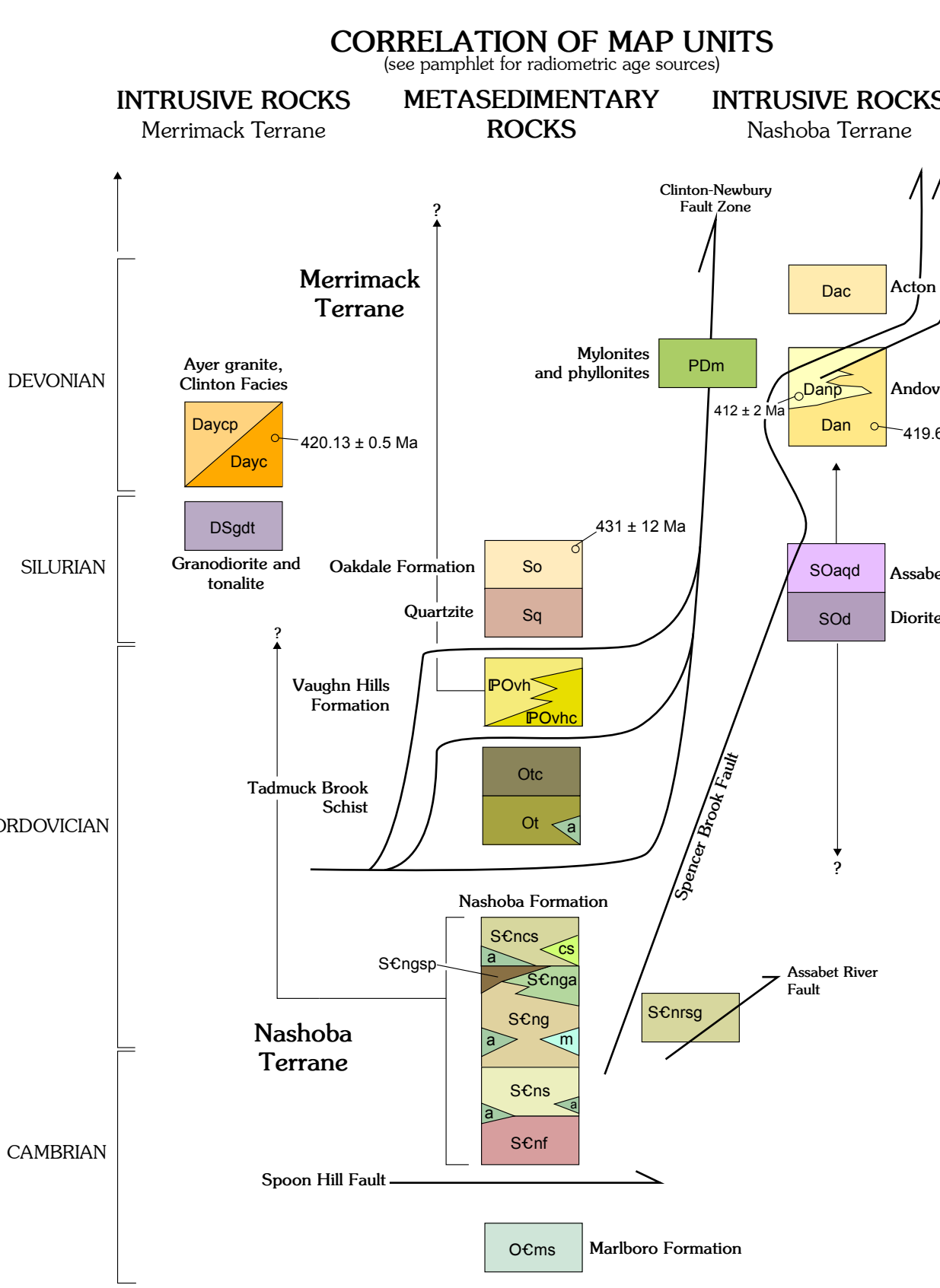


Topographic Base from U.S. Geological Survey, 1956.
 Reprojected to EPSG 26986:
 Mass. State Plane Mainland (FIPS 2001)
 Lambert Conformal Conic Projection
 Lat/Long Tics are from GCS North American 1983
 Geographic Coordinate System (GRS 1980 Spheroid)
 1000-meter tick marks from UTM (Zone 19 N), NAD 1983



QUADRANGLE LOCATION

SOURCE INFORMATION:
 Field mapping by
 J. Kopera (2004-2005,
 2008, 2010, 2012, 2014)
 Geology northwest of Ball
 Hill Fault modified from
 Hansen (1956).
 Data Sources



EXPLANATION OF MAP SYMBOLS
 map symbols used are from the FGDC Digital Cartographic Standard for Geologic Map Symbolization (FGDC, 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. Invariant.

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-D₁. Usually overprinted by subsequent D₂ 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-D₂ displaying predominant sinistral-normal movement.

--- Brittle Fault - Long dash where location approximate; Dotted where inferred.

--- Brittle Fault - Location determined by topographic or aeromagnetic ("AM") lineaments. Faults determined by aeromagnetic lineaments commonly have associated topographic lineaments. Preferentially 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 (D₁/D₂)

--- Strike and dip of dominant foliation. Not age specific but dominantly S₁ or an S₁-S₂ composite. Foliation parallel to compositional layering in the Nashoba Formation and tectonic foliation in igneous rocks. Barbs on both sides where vertical. Axial plane to F₁-F₂ 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 S₂. Barbs on both sides where vertical.

--- Strike and dip of axial plane of F₂ fold.

--- Trend and plunge of F₂ fold axis.

--- Trend and plunge of L₁ mineral or L₁-L₂ intersection lineation. In vast majority of outcrops L₁ mineral and L₁-L₂ intersection lineations are the same.

Third generation fabrics (D₃)

--- Strike and dip of axial plane of D₃ fold. Barbs on both sides where vertical.

--- Trend and plunge of D₃ fold axis.

Fourth generation fabrics (D₄)

--- Strike and dip of S₄ foliation and/or crenulation cleavage in schistose rocks. Barbs on both sides where vertical.

--- Strike and dip of axial plane of F₄ asymmetric fold. Barbs on both sides where vertical.

--- Trend and plunge of asymmetric (sinistral, down plunge) F₄ fold axis.

--- Trend and plunge of L₄ intersection lineation.

--- Trend and plunge of L₄ crenulation axis.

Fifth generation fabrics (D₅)

--- Strike and dip of S₅ ductile shear zone. Displays sillinite 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.

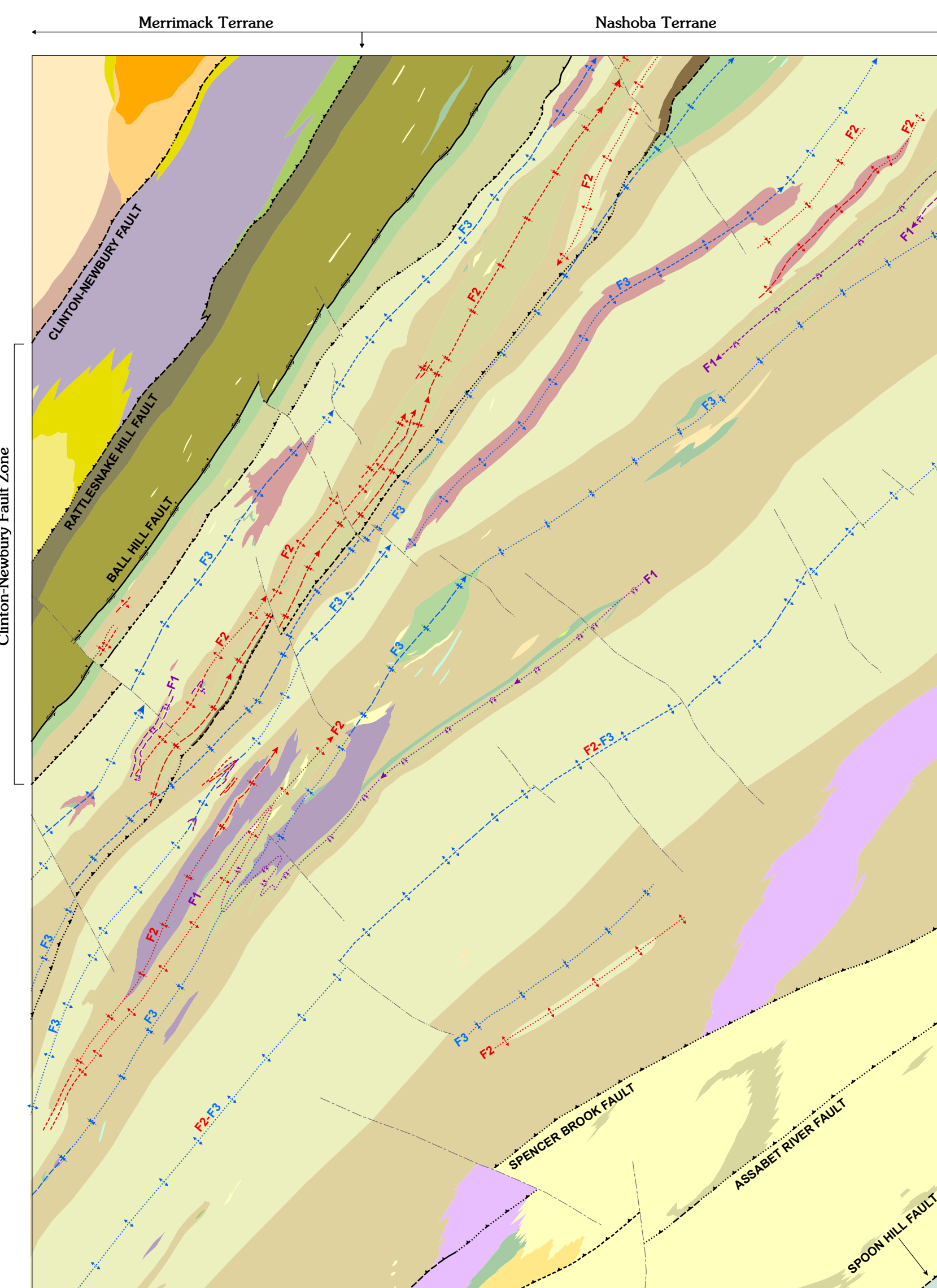
Fernandez, M., Duncan, C., and Mahoe S.B., 2005. Well inventory of the Hudson quadrangle. Office of the Massachusetts State Geologist Well Inventory 05-01. Digital Product: ESRV Aview 3.1 GIS Database.

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)

- PCm - Felsic Mylonite And Phyllonite (Late Devonian To Permian?)
- Intrusive Rocks in the Merrimack Terrane**
 - Dayp - Ayer Granite, Clinton Facies (Devonian)
 - Dayc - megacrystic phase
 - Dayg - granite to granodiorite
 - DSgt - Granodiorite And Tonalite (Silurian To Devonian?)
- Metasedimentary Rocks in the Merrimack Terrane**
 - So - Oudake Formation (Silurian)
 - Sc - Metaslutite and phyllite
 - St - Quartzite (Silurian?)
 - Sq - Quartzite with minor phyllite
 - POvh - 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
 - Damp - Andover Granite (Devonian)
 - Damp - Pegmatitic phase
 - Dam - Biotite granite
 - SCqd - Assabet Quartz Diorite (Silurian?)
 - SCqd - diorite to tonalite
 - SDi - Diorite At Pine Hill (Silurian?)
 - SDi - diorite
- Metasedimentary Rocks of the Nashoba Terrane**
 - Otc - Tadmack Brook Schist (Ordovician?)
 - Otc - Chlorite schist and phyllonite
 - Ot - Sulfidic schist and quartzite
 - a - Amphibolite
 - SCns - Nashoba Formation (Cambrian to Silurian?)
 - SCns - Calc-silicate gneiss
 - cs - Coarse grained calc-silicate pods
 - a - Amphibolite
 - SCng - Sulfidic calcareous schist and phyllonite
 - SCga - Amphibolite gneiss
 - SCrg - Rhyolite schist and gneiss
 - SCm - Garnet bearing biotite gneiss
 - a - Amphibolite
 - m - Marble
 - SCs - Magnetite bearing muscovite-sillinitic gneiss
 - ge - garnet cotecule
 - SCf - Felsic biotite gneiss
 - OCms - Marlboro Formation (Cambrian to Ordovician?)
 - OCms - Muscovite schist



FOLD TRACES AND MAJOR FAULTS
 Scale 1:48000

--- Axial trace of F₁ antiform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

--- Axial trace of F₂ antiform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

--- Axial trace of F₃ antiform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

--- Axial trace of F₁ synform - Long dash where location approximate; short dash where location uncertain; dotted where inferred.

--- Axial trace of F₂ synform - Long dash where location approximate; short dash where location uncertain; dotted where inferred. Arrowhead shows direction of plunge.

--- Axial trace of F₃ 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)

--- D₁-D₂ thrust motion

--- D₁-D₂ sinistral-normal motion

Selected Fold Axial Traces
 (see pamphlet for discussion)

--- F₁

--- F₂

--- F₃

Comments to the Map User

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