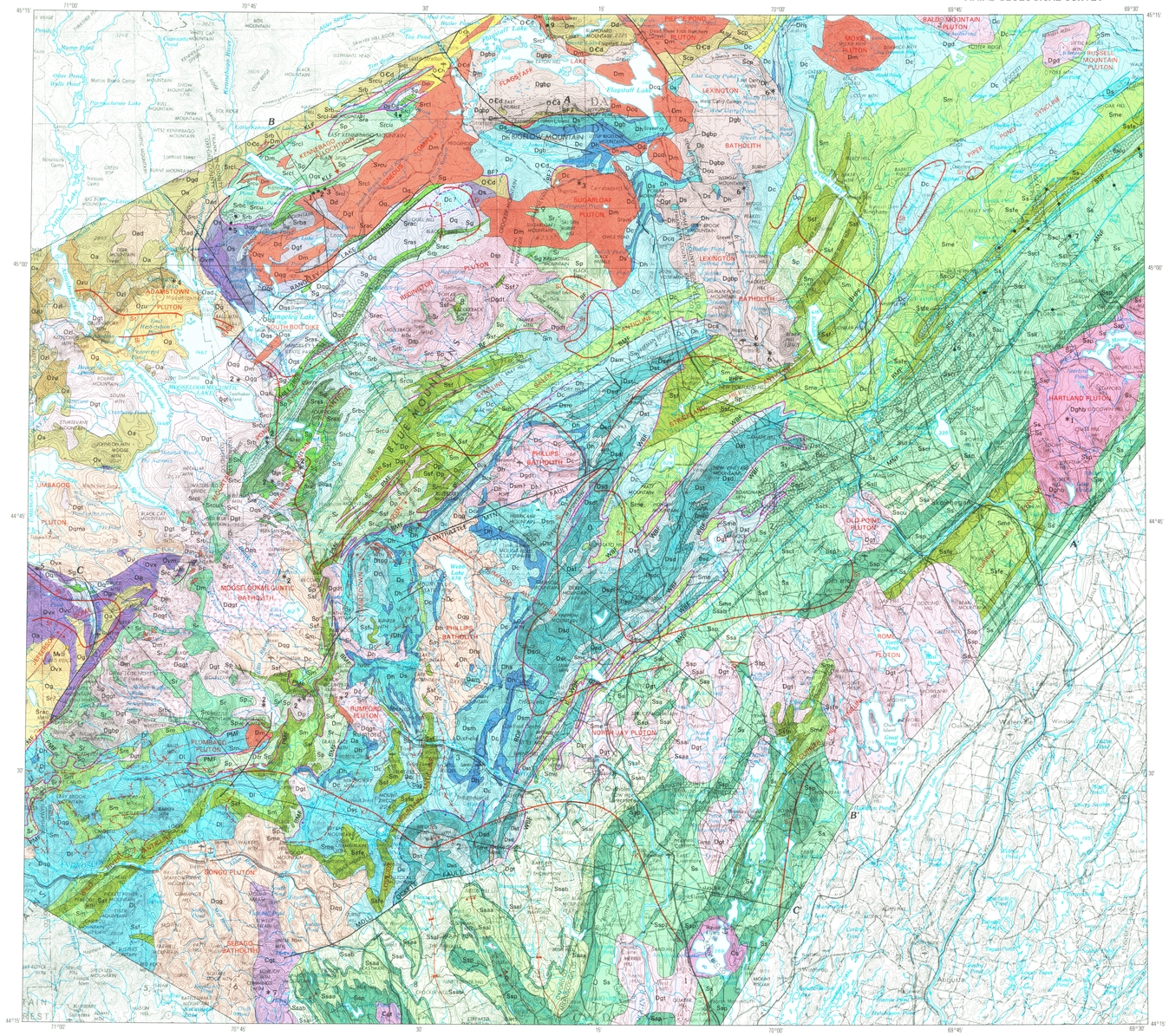
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
MAINE GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-1692

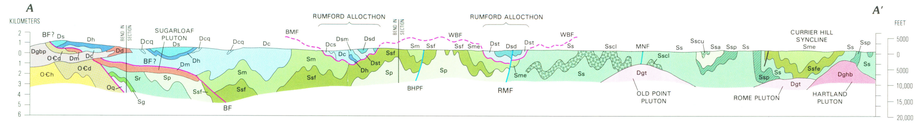


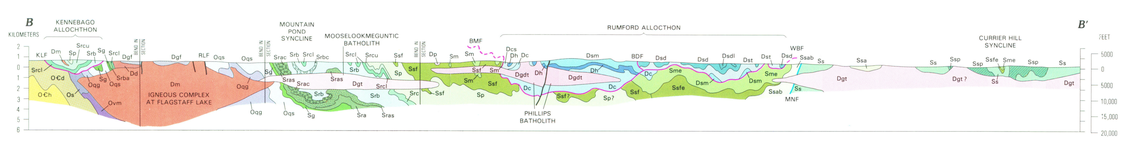
Base from U.S. Geological Survey
Bangor, 1956-65; Lewiston, 1956-72;
Millinocket, 1954-67; Sherbrook, 1961
100,000-foot grids based on Maine coordinate system, east and west zones, and New Hampshire coordinate system

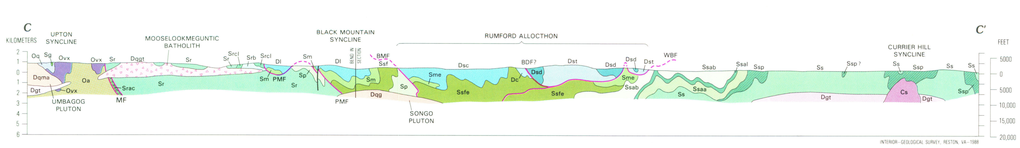
SCALE 1:250 000
5 0 5 10 15 MILES
5 0 5 10 15 KILOMETERS
CONTOUR INTERVAL 50 AND 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology revised and reinterpreted in 1976-82 from sources shown in index

LOCATION OF MAP







STRUCTURE SECTIONS SHOWING INFERRED EXTENT AND CORRELATIONS OF PREMETAMORPHIC EARLY FAULTS AND SHAPES OF PLUTONIC BODIES (MODIFIED IN PART FROM CARNESE, 1981). STRUCTURAL AND STRATIGRAPHIC RELATIONSHIPS ARE CONJECTURAL WHERE COVERED BY RUMFORD ALLOCHTHON OR BY PLUTONIC SHEETS.

GEOLOGIC MAP OF WESTERN INTERIOR MAINE

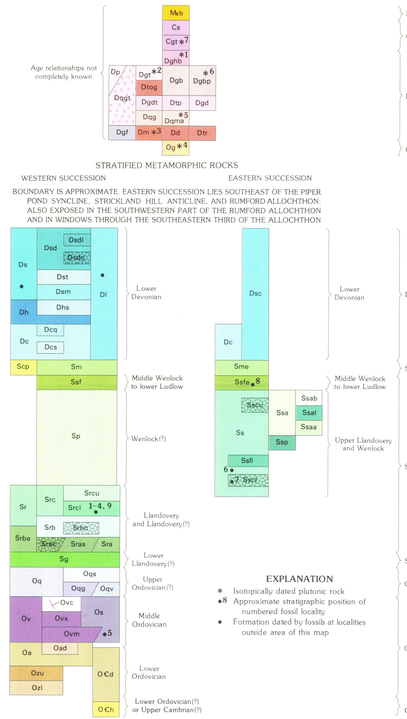
By

Robert H. Moench[1] and Kost A. Pankiwskyj[2]

With contributions by
Gary M. Boone[3], Eugene L. Boudette[1], Allan Ludman[4],
William R. Newell[3], and Thomas I. Vehrs[3]

1988

CORRELATION OF MAP UNITS



EXPLANATION

* Isotopically dated plutonic rock

•8 Approximate stratigraphic position of numbered fossil locality

• Formation dated by fossils at localities outside area of this map

CONTACT—Dashed where conjectural or poorly located; dotted across large lakes

FAULTS AND SLIDES—Dotted across large lakes. Three generations recognized

Postmetamorphic fault—Truncates Devonian and older plutonic and metamorphic rocks, but locally contains dikes of sheared light-colored Devonian granite and probably originated during late stage of Devonian plutonism. Characterized by sheared, locally pyritized quartz, slickensides, breccia, and slip-cleaved wall rocks. Named postmetamorphic faults are Tantrattle Mountain, Moll Ockett, and Rangeley Lake faults

SSF — Late premetamorphic fault—Bar and ball on downthrown side. Cuts early folds and faults, but not known to cut metamorphic isograds; locally warped and cut by Devonian granite. Locally has quartz veins and sheared granite, but also has tight surfaces showing little evidence of cataclasis or brittle deformation. Named younger premetamorphic faults: BHPF, Black Hill Pond fault; RMF, Rowell Mountain fault; SSF, South Solon Fault; MNF, Madison fault

PMF — Early premetamorphic fault and slides—Bar and ball on downthrown side; dashed where conjectural. Cut by Devonian granitic and mafic plutonic rocks; metamorphosed gabbro (and trondhjemite at one locality) common along or near faults. Early folds both deform the faults and are cut by the faults. Characterized by sharp surfaces crossed by early cleavage; little or no evidence of cataclasis or brittle deformation; bedding in wall rocks may be truncated at low angles (Moench, 1970). Mahoosuc fault apparently truncates Plumbago Mountain fault and has an unusual style: a knife-sharp surface cut by early schistosity, but wall rocks are extremely flattened in belt as wide as 500 m, and clasts in metaconglomerate are extremely elongated subvertically. Mahoosuc fault is correlated with Hill 2808 fault and is interpreted to be a deep expression of that fault. The Blueberry Mountain and Winter Brook faults delineate the margins and sole of the Rumford allochthon, interpreted as a younger-over-older detached mass of predominantly Devonian strata that lies discordantly above predominantly Silurian strata. Maximum displacement, not necessarily normal to present strike, probably was less than 10 km. In contrast, the Winter Brook fault is interpreted as a west-verging older-over-younger thrust on the new "Bedrock Geologic Map of Maine" (Osberg and others, 1984), which would require a minimum displacement normal to strike of about 25 km. Named early faults: KLF, Kennebago Lake fault; HILL 2808 F, Hill 2808 fault; BF, Barnjum fault; MF, Mahoosuc fault; BMF, Blueberry Mountain fault; PMF, Plumbago Mountain fault; BDF, Bald Mountain fault; WBF, Winter Brook fault

FOLDS—Two major generations recognized. Folds of first generation are defined by the regional stratigraphic pattern and are shown by name only; names are placed on or near axial zones of major anticlines and synclines. Pervasive early slaty cleavage or schistosity is subparallel to axial surfaces. Early folds originated during or before greenschist-facies metamorphism and accompanied formation of premetamorphic faults and slides. Folds of second generation (late folds) are antiforms and synforms that deform early folds and do not necessarily reflect stratigraphic succession. Late crenulation cleavage or schistosity is parallel to axial surfaces of late folds; it deforms and locally destroys early cleavage; two or more generations of small late folds and cleavage may be found in single outcrops. Late folds are largest and most abundant in sillimanite zone; most originated during metamorphic peak contemporaneously with Devonian plutonism

Synform—Showing approximate trace of axial surface of late fold

Antiform—Showing approximate trace of axial surface of late fold. Northeastern end of Jefferson dome and the Tumbledown dome are named. Jefferson dome is northernmost of Oliverian gneiss domes of New Hampshire. Tumbledown dome is an asymmetrical dome of migmatitic gneiss unlike the gneiss domes of New Hampshire

St — METAMORPHIC ISOGRAD—Approximately located; hachures point to area of higher rank. In part from Guidotti (1970, 1977) and Holdaway and others (1982), but zones of two major events of Holdaway and others (1982) and Moench and Zartman (1976) are combined to show maximum grade attained without regard to age. K, postassium feldspar plus sillimanite; Si, sillimanite; St, staurolite (partly based on retrograded pseudomorphs). Isograds of metamorphic aureoles around plutons in the northeastern part of the area are not shown

APPROXIMATE BOUNDARY OF MIGMATITIC GNEISS—Hachures point to area where metasedimentary rock shows evidence of partial melting and is characterized by coarsely crystallized gneissic texture, commonly abundant semiconcordant layers and lenses of granitoid rocks, small pods of quartz, and disrupted bedding. Beds of metasandstone or calc-silicate rock are commonly preserved only as meter-sized remnants, some disoriented relative to the fabric of the gneiss. Identification of stratigraphic units is more difficult than on the unhachured side and is commonly conjectural. Calcareous granofels and calc-silicate rocks of the Hildreths and Madrid Formations are particularly disrupted and are shown only where abundant remnants are recognized

•6 FOSSIL LOCALITY—Unnumbered localities yielded the least definitive fossils (from Harwood, 1973, and Pankiwskyj and others, 1976). The numbered localities yielded the most definitive faunal assemblages, as follows:

Localities **1**, **2**, and **3**—Brachiopods in quartz granule conglomerate of lower member of part C, Rangeley Formation; identified by A. J. Boucot, who assigned a restricted late Llandovery C_4-C_5 age to the faunal assemblage (Moench and Boudette, 1970)

Locality **4**—Brachiopods in metamorphosed laminated impure limestone above quartz conglomerate, both of lower member of part C, Rangeley Formation; identified by A. J. Boucot, who assigned a late Llandovery C_4-C_5 age to the faunal assemblage

Locality **5**—Graptolites in black slate of unit **Os** indicating a Middle Ordovician age, or graptolite zone 12 of the Caradoc (Harwood and Berry, 1967)

Locality **6**—Graptolites in rusty-weathering phyllite of the Sangerville Formation; late Llandovery through Wenlock (Pankiwskyj and others, 1976, loc. F7A51)

Locality **7**—Graptolites in rusty phyllite of the Sangerville Formation; middle Wenlock (Pankiwskyj and others, 1976, loc. F71D36)

Locality **8**—Graptolites in rusty phyllite of eastern facies of the Smalls Falls Formation, formerly assigned to Parkman Hill Formation; early Ludlow (Pankiwskyj and others, 1976, loc. F9D4)

Locality **9**—Shelly fauna in calc-silicate hornfels of unit **Srcl**(?) at Limestone Hill at the northern border of the Stratton quadrangle; mapped by Pankiwskyj (1959), who collected fossils from calc-silicate hornfels near the base of the sequence where it was intruded by mafic plutonic rock. Although conglomerate is absent, the rocks can be correlated tentatively with impure metalimestone that lies above quartz conglomerate at localities 1-4. The collections suggest an age of late Llandovery (C_1-C_4), but they do not rule out an early Wenlock age (Boucot and Heath, 1969, p. 46)

*3 ISOTOPICALLY DATED PLUTONIC ROCK—Number refers to locality of single sample or to body from which several samples were obtained:

1—Hartland pluton. Dallmeyer and others, 1982: 360±8 m.y., Rb/Sr whole rock

2—Two-mica granite of Mooselookmeguntic batholith, Rumford pluton, and pegmatite at Whitecap Mountain. R. E. Zartman in Moench and Zartman, 1976: 371±6 m.y. (new constant), Rb/Sr whole rock (10 locs.)

3—Dike of foliated granitic rock that intrudes gabbro near the margin of the Sugarloaf pluton (Boone, 1973, p. 48). Zartman and others, 1970, table 1, Maine sample 8: 406 ±12 m.y. (new constant), K/Ar biotite. Source of dike is unknown, but the date places an approximate minimum age on gabbro of the Sugarloaf pluton, which intrudes the Seboomook Formation of Early Devonian age

4—Metamorphically foliated granite of Adamstown pluton. About 445 m.y., U/Pb zircon (J. N. Aleinikoff, written commun., 1982)

5—Massive biotite-hornblende quartz monzodiorite near border of Umbagog pluton. About 382 m.y., U/Pb zircon (J. N. Aleinikoff, written commun., 1982)

6—Musovite-bearing biotite granite of Lexington batholith. Gaudette and Boone (1985) and H. E. Gaudette (written commun., 1985), Rb/Sr whole-rock and mineral isochrons (4 locs.): 399 ±6 m.y. (whole rock) and 399 ±3 m.y. (mineral)

7—Two-mica granite of Sebago batholith; samples of pink and white varieties collected at 2 localities south of map area. Aleinikoff and others (1985): 325 ±3 m.y., U/Pb zircon

LIST OF MAP UNITS

A detailed description of map units is given in the accompanying pamphlet

PLUTONIC ROCKS

Mzb MESOZOIC
Alkali-olivine basalt and associated basaltic breccia

CARBONIFEROUS

Cs Alkali gabbro and syenite

Cgt Two-mica granite and pegmatite

DEVONIAN

Dghb Biotite and hornblende-biotite granite and granodiorite

Dp Pegmatitic granite, pegmatite, and aplite

Dqgt Biotite and hornblende-biotite quartz diorite to granodiorite and two-mica granite

Dgt Two-mica granite

Dtog Garnetiferous biotite tonalite

Dgb Biotite granite

Dgbp Porphyritic biotite granite

Dqdt Two-mica granodiorite

Dtp Porphyritic two-mica granodiorite

Dgd Biotite granodiorite

Dqg Biotite and hornblende-biotite quartz diorite to granodiorite

Dqma Augite-bearing hornblende-biotite quartz diorite and quartz monzodiorite

Dgf Garnet granofels

Dm Mafic rocks

Dd Dioritic rocks

Dtr Trondhjemite

ORDOVICIAN

Og Granite and minor granodiorite

STRATIFIED METAMORPHIC ROCKS

Ds SEBOOMOOK FORMATION (LOWER DEVONIAN)

Dsd Day Mountain Member

Dsdl Limestone of Day Mountain Member

Dsdc Conglomerate of Day Mountain Member

Dst Temple Stream Member

Dsm Mount Blue Member

Dh HILDRETHS FORMATION (LOWER DEVONIAN)

Dhs Sulfidic shale member

Dc CARRABASSETT FORMATION (LOWER DEVONIAN)

Dcq Quartzwacke lenses

Dcs Sulfidic shale member

Dl LITTLETON FORMATION (LOWER DEVONIAN)

Dsc SEBOOMOOK, HILDRETHS, AND CARRABASSETT FORMATIONS (LOWER DEVONIAN)

Scp CALCAREOUS PHYLLITE AND CALC-SILICATE ROCK (SILURIAN?)

Sm MADRID FORMATION (SILURIAN?)

Sme Eastern facies

Saf SMALLS FALLS FORMATION (SILURIAN, MIDDLE WENLOCK TO LOWER LUDLOW)

Safe Eastern facies

Sp PERRY MOUNTAIN FORMATION (SILURIAN, WENLOCK?)

Ss SANGERVILLE FORMATION (SILURIAN, UPPER LLANDOVERY TO LOWER LUDLOW)
Principal facies

Sscu Upper conglomerate lenses

Ssa Anasagunticook Member

Ssab Upper part of Anasagunticook Member

Ssal Limestone of Anasagunticook Member

Ssaa Lower part of Anasagunticook Member

Ssp Patch Mountain Member

Sall Lower limestone lenses

Sscl Lower conglomerate lenses

Sr RANGELEY FORMATION (SILURIAN, LLANDOVERY AND LLANDOVERY?)
Undivided

Src Part C, undivided

Srcu Upper member of part C

Srcl Lower member of part C

Srb Part B
Nonconglomeratic rocks of part B

Srbc Conglomeratic rocks of part B

Srba Parts B and A, undivided

Sras Part A
Polymictic conglomerate of part A

Sras Feldspathic sandstone of part A

Sra Interbedded shale and sandstone of part A

Sg GREENVALE COVE FORMATION (SILURIAN?, LOWER LLANDOVERY?)

Oq QUIMBY FORMATION (UPPER ORDOVICIAN?)

Oqs Shale member

Oqg Graywacke member

Oqv Silicic volcanic member

Os BLACK METASHALE (MIDDLE ORDOVICIAN)

Ov VOLCANIC ROCKS (MIDDLE ORDOVICIAN)

Ovc Calc-silicate layer

Ovx Mixed volcanic rocks

Ovm Mafic volcanic rocks

Oa ALBEE FORMATION (MIDDLE AND LOWER ORDOVICIAN)

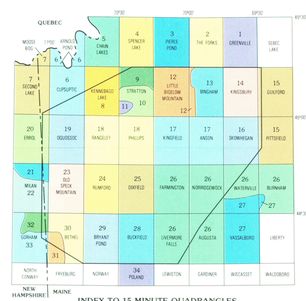
Oad Dwer Mountain Member

Ozu AZISCOHOS FORMATION (LOWER ORDOVICIAN)
Upper member

Ozl Lower member

O-Cd DEAD RIVER FORMATION (LOWER ORDOVICIAN AND UPPER CAMBRIAN?)

O-Ch UNNAMED EUXINIC MELANGE (LOWER ORDOVICIAN? OR UPPER CAMBRIAN?)



INDEX TO 15-MINUTE QUADRANGLES
(Numbers refer to listed sources of data)

SOURCES OF DATA

Identified by author and date listed in references at the end of the pamphlet text

1. Espenshade and Boudette (1964, 1967)
2. E. W. Post (unpub. mapping)
3. G. M. Boone (unpub. mapping) and Boucot (1961) revised by G. M. Boone
4. Burroughs (1979)
5. E. L. Boudette (unpub. mapping) and Boucot (1961) revised by E. L. Boudette
6. Harwood (1973)
7. Green (1968)
8. Boudette (1978) revised by E. L. Boudette
9. A. W. Griscom (unpub. mapping) revised by E. L. Boudette and G. M. Boone
10. Vehrs (1975)
11. Vehrs (1975) revised by R. H. Moench
12. Boone (1973)
13. Newell (1978)
14. Ludman (1978)
15. Ludman and Griffin (1974) and Pankiwskyj and others (1976)
16. Ludman (1977)
17. Pankiwskyj (1979)
18. Moench (1971)
19. Guidotti (1977)
20. Green (1964)
21. Milton (1968) revised by R. H. Moench and J. L. Schneider
22. R. H. Moench, J. L. Schneider, J. S. Selverstone, and A. R. Pyke (unpub. mapping)
23. Milton (1961) revised by R. H. Moench
24. Moench and Hildreth (1976)
25. Pankiwskyj (1964), Warner and Pankiwskyj (1965), and Pankiwskyj (1981)
26. Pankiwskyj and others (1976) revised by K. A. Pankiwskyj
27. Osberg (1968) and Pankiwskyj and others (1976)
28. Warner (1967), Warner and Pankiwskyj (1965), Pankiwskyj (1981), and Pankiwskyj and others (1976)
29. Guidotti (1965) revised by R. H. Moench in north and K. A. Pankiwskyj in southeast
30. Fisher (1962) revised by R. H. Moench
31. Fisher (1962) revised by N. L. Hatch, Jr. (unpub. mapping)
32. Billings and Fowler-Billings (1975) revised by R. H. Moench north of Androscoggin River
33. Billings and Fowler-Billings (1975) revised by N. L. Hatch, Jr. (unpub. mapping), south of Androscoggin River
34. Creasy (1979)

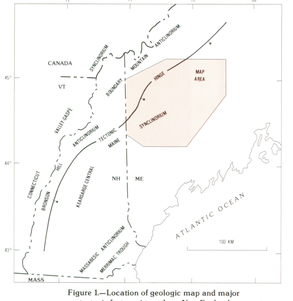
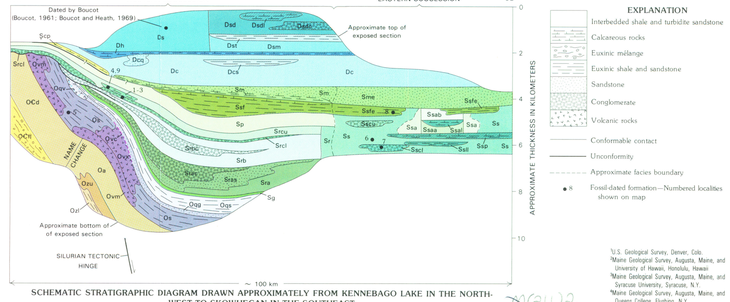


Figure 1.—Location of geologic map and major tectonic features in northern New England



SCHEMATIC STRATIGRAPHIC DIAGRAM DRAWN APPROXIMATELY FROM KENNEBAGO LAKE IN THE NORTHWEST TO SKOWHEGAN IN THE SOUTHEAST

EXPLANATION

Interbedded shale and turbidite sandstone
Calcareous rocks
Euxinic mélange
Euxinic shale and sandstone
Sandstone
Conglomerate
Volcanic rocks
Conformable contact
Unconformity
Approximate facies boundary
•8 Fossil-dated formation—Numbered localities shown on map

[1]U.S. Geological Survey, Denver, Colo.
[2]Maine Geological Survey, Augusta, Maine, and University of Hawaii, Honolulu, Hawaii
[3]Maine Geological Survey, Augusta, Maine, and Syracuse University, Syracuse, N.Y.
[4]Maine Geological Survey, Augusta, Maine, and Queens College, Flushing, N.Y.

For sale by U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225
Explanatory pamphlet accompanies map