

Figure 3. Map showing tectonic association of stratified metamorphic rocks. Ordovician to Early Cretaceous plutonic and associated volcanic rocks, undivided, are uncolored.

ISOTOPICALLY DATED ROCK-SAMPLE LOCALITIES

- K-1 Early Cretaceous intrusive rocks
  - C-3 Porphyritic hornblende-biotite granite (K7b) of Pleasant Mountain pluton (index 80). Foland and Faul (1977). K-Ar biotite age of 112±3 Ma.
- K-2 Cabro-diorite (K9, first emplacement), hornblende-biotite granite (K7b), and porphyritic biotite granite (K7a). Last emplacement of Mount Mansuet pluton (index 102). Foland and others (1986). <sup>40</sup>Ar/<sup>39</sup>Ar biotite data from diorite and granite indicate emplacement of 124±2 Ma. <sup>40</sup>Ar/<sup>39</sup>Ar hornblende data from gabbro and syenite are less reliable, because of irregularities and low potassium contents, but support an age of 124 Ma.
- J-1 Jurassic intrusive rocks
  - D-1 Granite segregations in quartz syenite (J4b) of Monarch Mountain pluton (index 48). Foland and Faul (1977). K-Ar biotite age of 171.4 Ma.
  - J-2 Conway-type granite (J7c) of Gore Mountain pluton (index 43). Foland and Faul (1977). K-Ar biotite age of 168±3 Ma.
  - J-3 Conway-type granite (J7b) of Percy pluton (index 42). Foland and Faul (1977). K-Ar biotite age of 164±4 Ma.
  - J-4 Conway-type granite (J7a) of Pleasant Mountain pluton (index 55). Foland and Faul (1977). K-Ar amphibole age of 188±5 Ma.
  - J-5 Conway-type granite (J6b) of Cannon Mountain pluton (index 83). Foland and Faul (1977). K-Ar biotite age of 194±4 Ma.
  - J-6 Conway-type granite (J7d) of South Baldface Mountain pluton (index 79). Foland and Faul (1977). K-Ar biotite age of 171.4 Ma.
  - J-7 Conway-type granite (J7b) of White Mountain batholith (index 81). Foland and Faul (1977). K-Ar biotite age of 180±4 Ma.
  - J-8 Conway-type granite (J7c) of White Mountain batholith (index 81). Reardon, NH. Ely and others (1992) obtained a K-Ar biotite age of 183±5 Ma from this body and first age that range from 182±4 Ma to 171±4 Ma from Conway-type granite at five other localities in White Mountain batholith. See Foland and Faul (1977, app. 2) for other data.
  - J-9 Conway-type granite (J7b), hornblende-biotite granite (J4b), and hornblende-biotite quartz monzonite and related rocks (J4c) of Pleasant Mountain pluton (index 55), and hornblende-biotite porphyry (J7d) of Pleasant Mountain pluton (index 55). Foland and Faul (1977). K-Ar biotite age of 183±5 Ma.
  - J-10 Mount Osoyoz Granite (J6a) of White Mountain batholith (index 81). Ely and others (1992). Rb-Sr whole-rock isochron age of 183±21 Ma for suite as a whole.
  - J-11 Conway-type granite (J7b) of northeastern side of White Mountain batholith (index 81). Ely and others (1992). K-Ar biotite age of 154±4 Ma.
  - J-12 Ferronitic syenite and quartz syenite (J7h) of Hart Ledge pluton (index 82). Ely and others (1992). K-Ar biotite age of 168±1 Ma and K-Ar amphibole age of 163±5 Ma.
  - J-13 Mount Garfield Porphyritic Quartz Syenite (J4b) at northwest side of White Mountain batholith (index 81). Ely and others (1992). K-Ar hornblende age of 201±9 Ma and 193±6 Ma.
  - J-14 Southern ring dike of Albany Porphyritic Quartz Syenite (J4b) near southeast side of White Mountain batholith (index 81). Ely and others (1992). Rb-Sr whole-rock isochron age of 170±3 Ma.
  - J-15 Rhyolite granite (J1h) of northeastern side of White Mountain batholith (index 81). Ely and others (1992). K-Ar amphibole age of 177±5 Ma.
  - J-16 Mount Osoyoz Granite (J6a) of White Mountain batholith (index 81). Ely and others (1992). Rb-Sr whole-rock isochron age of 183±21 Ma.
  - J-17 Northern ring dike of Albany Porphyritic Quartz Syenite (J4b) of White Mountain batholith (index 81). Ely and others (1992). K-Ar biotite age of 179±5 Ma.
  - J-18 Porphyritic hornblende-biotite granite (J7b) at Mount Campden in White Mountain batholith (index 81). Ely and others (1992). Rb-Sr whole-rock isochron age of 193±2 Ma.
  - J-19 Mount Lafayette Granite (J7b) of White Mountain batholith (index 81). Ely and others (1992). K-Ar biotite age of 195 Ma.
  - J-20 Mount Osoyoz Granite (J6a) of White Mountain batholith (index 81). Ely and others (1992). Rb-Sr whole-rock isochron age of 173.1±5 Ma (lower part of Mt. Osoyoz) and 162.2±12 Ma (upper part of Mt. Osoyoz), and K-Ar whole-rock ages of 169±4 Ma and 162±4 Ma (trachyte in Mt. Osoyoz).
  - C-1, C-2 Carboniferous intrusive rocks
    - D-11 Hornblende-biotite quartz monzonite (D6) of Parnassus pluton (index 13). Eisenberg (1987) recalculated by Alenikoff (1985) and others (1985); further studies of zircon from the same and other localities indicate a Permian/Silurian age of about 290-300 Ma for the batholith (Alenikoff, this map).
    - C-3 Two-mica granite (D1m) of Long Mountain pluton (index 40). Harrison and others (1987). U-Pb zircon data indicate a Mississippian age of about 350 Ma.
    - C-4 Hornblende gabbro of Mt. Mansuet and Androsogog Lake pluton (index 74). tentative <sup>40</sup>Ar/<sup>39</sup>Ar (hornblende) plateau ages of about 330 Ma, based on two of four analyses, two analyzed and yield meaningful data. Analyses by Donald R. Lux (in Lathrop, 1990), furnished by J.W. Creasy (written communication, January 1993). Previous <sup>40</sup>Ar/<sup>39</sup>Ar hornblende ages of 287 and 289 Ma (Northern Utilities Corporation, 1973) probably represent a Permian thermal event.
    - D-1 Dike of unroofed foliated granite rock intrusive into, or segregated from, gabbro (D2b) of Sparrow Plateau (index 24). Age from Boone (1973). Zartman and others (1970, table 1, 1E sample No. 8, recalculated using new constants). K-Ar biotite age of 406±12 Ma.
    - D-2A Chain of Ponds pluton (index 8), mainly hornblende-biotite gabbro of units D2-6 and D2-3A. Heider and others (1986). <sup>40</sup>Ar/<sup>39</sup>Ar incremental release yielded mean plateau ages for hornblende of 373.3±2 Ma.
    - D-2B Seven Ponds pluton (index 9), mainly biotite- and hornblende-biotite granodiorite of unit D2-3A. Heider and others (1986). <sup>40</sup>Ar/<sup>39</sup>Ar incremental release yielded mean plateau ages for hornblende of 367.7±1.3 Ma.
    - D-2C Spider Lake Lac Anagapog pluton (index 7), mainly hornblende-biotite granodiorite of unit D2-6. Heider and others (1986). <sup>40</sup>Ar/<sup>39</sup>Ar incremental release yielded mean plateau ages for hornblende of 367.7±1.3 Ma.
    - D-3 Two-mica granite (D1m), biotite granite (D1b), and porphyritic quartz syenite (D1-4) of Loring batholith (index 21). Gaudette and Boone (1983) and H.E. Gaudette (written communication, 1985). Rb-Sr whole-rock and mineral isochron ages of 299±3 Ma (mineral) and 299±4 Ma (whole-rock).
    - D-4 Two-mica granite (D1m) of Mooseokongog batholith (index 34A) and pegmatite granite and pegmatite (D1m) of Ramford (index 29) and Whittapog Mountain (index 30) plutons. R.E. Zartman in Moech and Zartman (1976). Rb-Sr whole-rock isochron age of 371.1±4 Ma (recalculated using new constants).
    - D-5 Hornblende-biotite quartz monzonite (D5-6) of Umbagog pluton (index 36). Alenikoff and Moech (1987). U-Pb zircon age of 381±4 Ma.
    - D-6 Porphyritic biotite granite (D1b) of Eggall Lake pluton (index 19B). Stratton, GJ. Gaudette and others (1990). Rb-Sr whole-rock isochron age of 414±12 Ma. An age of about 458 Ma for the Whitefield is supported by the fact that the western segment of the pluton is intruded by the Sprag Granite as used by Billings (1937, p. 510-511, O11b). Age of about 456±3 Ma (S-8).
    - D-7 Hornblende-biotite granodiorite (D2-6) of Sprag pluton (index 69). Sample from locality shown on map yielded a U-Pb zircon age of about 382 Ma. Lux and others (1986). U-Pb zircon age of 414±12 Ma. Lux and others (1986). U-Pb zircon age of 450±5 Ma.
    - D-8 Foliated porphyritic granite to granodiorite (O1h-2h) of Adamstown pluton (index 58). Lyons and others (1986). U-Pb zircon age of 452±5 Ma.
    - D-9 Foliated porphyritic hornblende-biotite granite (O1h) of Alton pluton (index 2). Lyons and others (1986). U-Pb zircon age of 452±5 Ma.
    - D-10 Matrix of dacite from the Chain Lakes mass (CPd) sampled about 300 m north of Saratoga Falls, on ME Route 27, Chain Lakes, and at other localities (see M-6a) in Chain Lakes and Afton. Osg. 1987. At site M-6, R.S. Naylor (in Naylor and others, 1973) obtained a strongly discordant U-Pb zircon age of about 1,500 Ma, which has been interpreted as the basis for assignment of a Middle Proterozoic age to the mass. On the basis of Rb-Sr and Sm-Nd whole-rock studies, Chappin and others (1989) concluded that the Chain Lakes mass, Mooseokog Mt., NH. Alenikoff and Moech (1987). U-Pb zircon age of 456±5 Ma. Intruded foliated probable granodiorite (O2b) of Whitefield pluton (index 61). Stratton, GJ. Gaudette and others (1990). Rb-Sr whole-rock isochron age of 468±3 Ma (lumpy intergrade with concordant) and a lead/lead age of about 451 Ma (<sup>207</sup>Pb/<sup>206</sup>Pb data). Inconsistency

of result of extremely high uranium contents in the zircons and consequent lead loss (Alenikoff, this map).

Foliated, muscovite-bearing biotite monzonite (D6) of Nulhegan pluton (index 48). Alenikoff and Moech (1987) and later work by Alenikoff. U-Pb zircon age of 454±5 Ma.

Metamorphosed foliated granitic rocks (O1h-2h and O2-9h) from two localities in Lost Nation pluton (index 53). Alenikoff (this map). At southern locality, U-Pb zircon and sphene analyses for samples from gneiss (O2-9h), medium-grained granodiorite (O2-9h) yielded ages of 442±4 Ma and 450±4 Ma, respectively. The zircon ages of 442±4 Ma and 450±4 Ma are from a block of dioritic core with rocks of the mass, but exposed along Riviere des Plantes, Quebec, about 80 km north of Suroost Falls in range of the St. Daniel Formation. Abraded zircon grains from diorite from the mass yielded nearly concordant U-Pb zircon ages ranging from 1,841 Ma to 1,013 Ma, and zircon from the Riviere des Plantes locality yielded ages ranging from 2,708 to 571 Ma. Durand and Coatsworth (1990) also suggested a Middle Ordovician age (Taconian) for the high-grade metamorphism of the Chain Lakes.

In view of these inconsistencies, we consider the rocks of the Chain Lakes mass to be undated. Available data permit a Proterozoic or a Cambrian age of formation, because the reported zircon age of about 571 Ma came from a rock that does not necessarily correlate with the Chain Lakes mass. The Chain Lakes rocks are probably, but not necessarily, older than the structurally overlying Cambrian(?) Boil Mountain Complex. We emphasize the need for completion of mapping in the mass and for thorough isotopic studies that account for the recognized rock.

Felsic, late-crustal mafic of proximal bimodal volcanic facies of Frontenac Formation (SFr), southeast corner of Indian Stream of Alenikoff and Moech (1985), who reported U-Pb zircon age of 414±4 Ma. New zircon analyses and recalculated yield ages of 432±10 Ma (Alenikoff, this map). Zircon separates were furnished by J.C. Green.

Felsic, late-crustal mafic of felsic volcanic lens in Small Falls Formation (SFr), north of Mt. Mansuet and Moech (1985). U-Pb zircon data yield an apparent age of about 430 Ma, but the data are difficult to interpret because of strong inter-zircon age dispersion. The reported age is probably 10-20 m.y. too old for the Small Falls Formation.

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A slightly discordant, 1.1-1.5 m thick, fine-grained quartz porphyritic metatuffite on the south side of Hart Mountain Road at approximate crest of power line; similar tuff are common elsewhere in units Spt and Spva. Igneous zircon grains yielded an unstratified age between 410 and 430 Ma; the data do not yield a precise concordance interval.

A highly discordant, 1.1-1.5 m thick, of massive rhyolite lapilli tuffite exposed near center of power line, about 1.6 km north of Hart Mountain Road. Sill intrudes the variably felsic quartzite and shale facies of the Perry Mountain Formation (SPr); near the lower contact of the Perry Mountain and below the level at which metamorphic rocks typically occur for the formation. Interpreted as a feeder to stratigraphically higher volcanic rocks in the Perry Mountain Formation to Ironbound Mountain Formation sequence. Igneous zircon grains yielded an upper intercept age of 412±2 Ma.

A conformable layer of fine-grained quartz porphyritic metatuffite about 4 m thick, sampled from several places from about 50 m to 100 m south of Hart Mountain Road, near the contact with the lower contact of the Perry Mountain and below the level at which metamorphic rocks typically occur for the formation. Interpreted as a feeder to stratigraphically higher volcanic rocks in the Perry Mountain Formation to Ironbound Mountain Formation sequence. Igneous zircon grains yielded an upper intercept age of 412±2 Ma.

Fragmental metatuffite from proximal bimodal volcanic facies of Frontenac Formation (SFr), exposed on ridge 300-400 m north of Saratoga Falls, on ME Route 27, Chain Lakes, and at other localities (see M-6a) in Chain Lakes and Afton. Osg. 1987. Matrix of dacite from the Chain Lakes mass (CPd) sampled about 300 m north of Saratoga Falls, on ME Route 27, Chain Lakes, and at other localities (see M-6a) in Chain Lakes and Afton. Osg. 1987. At site M-6, R.S. Naylor (in Naylor and others, 1973) obtained a strongly discordant U-Pb zircon age of about 1,500 Ma, which has been interpreted as the basis for assignment of a Middle Proterozoic age to the mass. On the basis of Rb-Sr and Sm-Nd whole-rock studies, Chappin and others (1989) concluded that the Chain Lakes mass, Mooseokog Mt., NH. Alenikoff and Moech (1987). U-Pb zircon age of 456±5 Ma. Intruded foliated probable granodiorite (O2b) of Whitefield pluton (index 61). Stratton, GJ. Gaudette and others (1990). Rb-Sr whole-rock isochron age of 468±3 Ma (lumpy intergrade with concordant) and a lead/lead age of about 451 Ma (<sup>207</sup>Pb/<sup>206</sup>Pb data). Inconsistency

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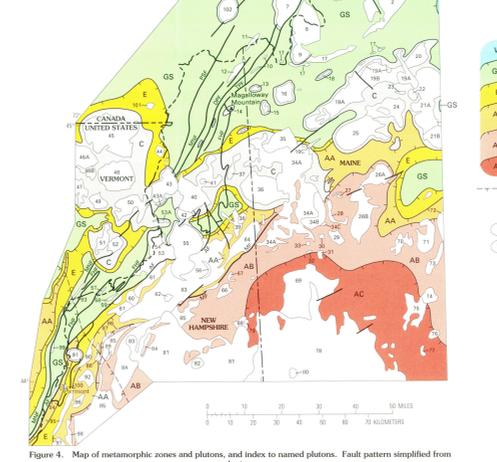


Figure 4. Map of metamorphic zones and plutons, and index to named plutons. Fault patterns simplified from geologic map.

- Metamorphic zones—Boundaries approximately located. Data are from cited reports, from unpublished mapping, and from Billings (1936), Doh and others (1961), Green (1963), Alton (1968), Thompson and Norton (1968), Lyle (1976), Moech and Zartman (1976), Holdaway and others (1982), and Gaudette (in Osg. and others, 1985).
- Contact zones—Hornblende and local schist or gneiss in metamorphic zones bordering Devonian and younger plutons that intrude regional GS, E, and AA facies. Grades to regional AA and AB facies near Mooseokongog batholith (index 34A, 34B) and Afton (index 45) and farther southwest. Mineral assemblages vary from contact granitic gabbro, sillimanite, andalusite, staurolite, almandine, cordierite, and muscovite.
- Regional zones—Ticks point to higher rank facies. Widespread schist, and migmatite gneiss in metamorphic zones not obviously related to individual plutons.
- Weakly metamorphosed—May contain local occurrences of porphyry or porphyroblasts.
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