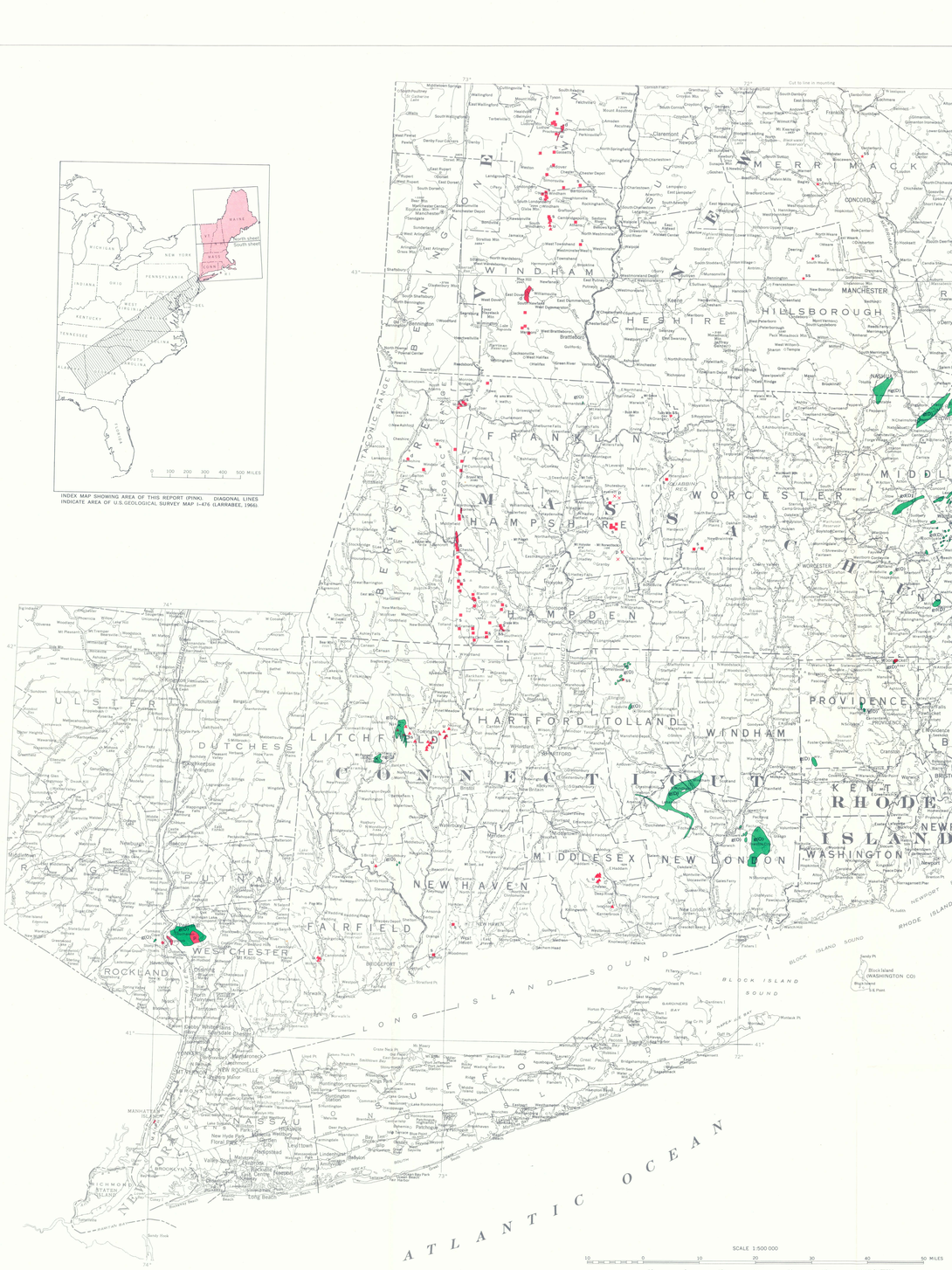

INTRODUCTION

This map shows the distribution of ultramafic and intrusive mafic rocks from the Hudson River to the Canadian boundaries of New England. It is a companion to U.S. Geological Survey Map I-476 (Larrabee, 1966), at the same scale, which shows the distribution of similar rocks from the Hudson River southwest into Alabama. Although Map I-476 includes all such mafic rocks regardless of age, the present map represents an attempt to eliminate any possible Precambrian intrusive bodies, and anything later than Cretaceous?. All occurrences of ultramafics and mafic intrusive bodies, regardless of size, that could be located from available published and unpublished maps and reports were plotted on topographic maps at a scale of 1:250,000, and reduced to 1:500,000; the final map reflects geographic adjustments between the reduced compilation maps and the several State base maps at 1:500,000 scale.

Although the original intent was to show no bodies less mafic than gabbro, in many places this proved to be impossible. Gabbro-diorite, then, has been used as the lower mafic cutoff where such separations could be made.

The mafic rocks of the Cortlandt Complex (containing both peridotite and pyroxenite), near Peekskill, New York, and the Mount Pleasant and Hodges mafic complexes in Connecticut, although containing rocks that range widely in composition, have been shown simply as gabbro. In eastern Massachusetts, the Dracut norite-gabbro likewise is shown as such, and the "Salem" and "Nahant" gabbro-diorite bodies are shown rather than the term indicates, and in places actually contain rocks of more than one age (K. G. Bell, written commun., 1969). Some of the locations of bodies taken from the Preliminary Geologic Map of Maine, where shown as gabbro and diorite, were not separated as to rock type.

In the course of such a compilation, as in Map I–476, mafic rocks of more than one age have been included. Conflicting evidence of age, particularly in the plane and state of metamorphic degrees of certainty result in different ages having been assigned to similar rock bodies in the same general area by different workers. In the interest of simplicity, we have generally attempted to weed the least dangerous path through the interpretation of published reports and modern work in progress by reassigning ages in the light of the most recent thoughts.

In an area having considerable glacial cover of drift, and therefore relatively few outcrops, problems of age relations are rarely simple. This is particularly true of the mafic rocks in Massachusetts. Present and recent field workers are not at all reluctant to differ with previous ones on the subject. In Massachusetts a Devonian or probable Devonian age for the "Salem" and "Nahant" gabbro-diorite bodies is shown, in large part based upon the work of the late Kenneth G. Bell (written commun., 1969). N. P. Cuppels (written commun., 1969) considers the "Salem" to be pre-Devonian, but these rocks appear to be also relatives to be pre-Devonian, but these rocks appear to include either the "Nahant" or the "Salem" (Cuppels, 1969). Page (1968), however, is in agreement with Bell. The Dracut norite-gabbro is considered by R. O. Castle (written commun., 1969) to be Devonian in age. The "serpentinite" formerly shown as present in the Reading quadrangle, Mass., has been determined by Bell to be metamorphosed stratified basic volcanic sediments interlayered with dolomite and calc-silicate rocks. For the purposes of this map, whether or not a mafic intrusive rock has been referred to as the "Salem" or "Nahant" is relatively unimportant; the composition and age are of greater interest.

Most ultramafics in New England are believed to be of Ordovician age, and closely related to mafic rocks of that age. Some of these ultramafics, especially in southern Vermont, contain economically mineable bodies of talc and asbestos. Chidester (1968) reported that the main structural feature related to the economically important ultramafic rocks in Vermont is the Green Mountain anticlinorium; most bodies are east of the anticlinal axis. The distribution of these ultramafics clearly reflects such a major structural control. These ultramafics are rather closely associated with greenstone and amphibolite, but also occur in other rocks. On this map, the various metamorphic rocks have not been distinguished although some not certainly were originally gabbroic.

In New Hampshire, small occurrences of talc schist or soapstone are present in the narrow Fitchburg Plutonic Complex and in the Ordovician Formation, of Ordovician?) age, according to Douglas Rumble 3d (written commun., 1969). Other ultramafic deposits in this State appear to be distributed almost uniformly, as compared with the well-defined belt extending northerly through Massachusetts and Vermont, and across Quebec. In west-central Maine, most ultramafics occur in a belt of Ordovician rocks southeast of the Moose River synclinorium, and extend east-northeastward.

Comparing this map with Map I–476, a radical change in trend of the main belt of ultramafic rocks from northeastward in Pennsylvania and New Jersey to northward through western Massachusetts and Vermont into Quebec is obvious, and these rocks are fewer than in the Southeast. Also, the ultramafic rocks of New England contain fewer non-serpentinized dunite and pyroxenite bodies, and no harzburgite intrusions have been reported, to my knowledge. In New England, no long narrow bodies of soapstone, similar to the Virginia deposits, are apparent. Rhode Island contains the only body of cumberlandite, named for the nearby town of Cumberland. The deposits in northern Vermont generally are better economic sources of talc and asbestos than elsewhere, the asbestos deposits greatly increasing in Quebec. None of the ultramafics in Maine is known to contain asbestos deposits of economic interest.

Mafic intrusive rocks of presumed Ordovician and Devonian ages appear to be distributed in two poorly defined "belts" extending across Connecticut, and sporadically through Massachusetts to Maine, where the "belts" are better developed and more widely separated—one along the coast and the other in the west-central part of the State. All nickel deposits of possible economic interest northeast of the Hudson River are believed to be related to mafic rocks of Devonian age (Page, 1968).

TERMINOLOGY FOLLOWED IN THIS COMPILATION

As used on this map, the terms *ultramafic* and *ultramafite* refer to plutonic intrusive rocks composed essentially of pyroxene and olivine, or minerals derived therefrom; such rocks contain little or no quartz or feldspar.

Peridotite is an intrusive rock containing olivine as an essential mineral and commonly also pyroxene or other ferromagnesian minerals, but little or no feldspar.

Dunite is a green, granular rock composed essentially of olivine, and commonly containing small amounts of chromite. The above two rock types have been combined on this map.

Serpentinite is a green or greenish-black rock composed chiefly of serpentine-group minerals, in most places derived from olivine and pyroxene by metamorphic processes. On this map it includes bodies of talc and chrysotile asbestos.

Pyroxenite is a rock composed essentially of pyroxene. Pyroxenite of the Cortlandt Complex contains emery deposits, formerly mined.

Soapstone is a soft, soapy rock composed chiefly of talc and chlorite; included as soapstone on the map are talc schist and soapstone-like rocks containing amphiboles and other metamorphic minerals. Some was quarried for hearth stones and heating stones prior to 1900.

Cumberlandite is an ultramafic rock composed chiefly of magnetite, ilmenite, and olivine with minor plagioclase and spinel. A small quantity was used as iron ore.

The *mafic* rocks shown on the map are of basaltic or gabbroic composition and most are believed to be intrusive; they average 50 percent or more ferromagnesian minerals, and with increase in dark minerals they grade into the ultramafic rocks.

Gabbro is a dark plutonic rock composed chiefly of labradorite or bytownite feldspar and pyroxene or hornblende, or both. Olivine and magnetite may be accessory minerals. In places gabbro was quarried for building stone, and referred to as "black granite".

Metagabbro is a metamorphosed gabbro.

Norite is a gabbroic plutonic rock in which the amount of orthorhombic pyroxene, usually hypersthene, equals or exceeds monoclinic pyroxene.

Diorite is a plutonic rock composed chiefly of sodic plagioclase and hornblende, biotite, or pyroxene. Small amounts of quartz and orthoclase may be present.

SOURCES OF DATA

Wherever possible, original sources of data were consulted; where this was not feasible boundaries of ultramafic and mafic bodies were taken from State geologic maps. Most of the ultramafites in Vermont were copied directly from the Geologic map of Vermont (Doll, 1961); those in New Hampshire were taken from a compilation by Meyers (1941), and a map by Douglas Rumble 3d (written commun., 1969). The nomenclature used, so far as possible, is that of the original author or compiler. The author has tried to avoid interpreting the field work of others but in such a compilation some interpretation and generalization is necessary, especially in the mafic rocks.

In most instances, only those references that provided locations of direct use in the compilation have been listed, but a few references of indirect use have been included.

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Unpublished data used on this map were generously furnished by the following geologists, most of whom are members of the U.S. Geological Survey, working in the areas listed:

G. M. Boone, Pierce Pond and Little Bigelow Mtn., Maine, quadrangles; E. J. Brodette, Kennebago Lake, Maine, quadrangle; R. O. Castle, Lawrence and Reading, Massachusetts, quadrangles; N. P. Cuppels, Concord, Massachusetts, quadrangle; W. H. Dennen, Ipswich, Massachusetts, quadrangle; Richard Goldsmith and D. S. Harwood, Greenwich, Connecticut-Rhode Island, quadrangle; D. S. Harwood, Cupsuptic and Arnold Pond, Maine, quadrangles; N. L. Hatch, Jr., Worthington and Worcester, Massachusetts, quadrangles; N. L. Hatch, Jr., and E. S. Stanley, Blandford, Massachusetts, quadrangle; N. L. Hatch, Jr., S. A. Norton, and R. G. Clark, Jr., Chester, Massachusetts, quadrangle; Richard Krull, Norwalk North, Connecticut, quadrangle; C. W. Martin, Torrington, Connecticut, quadrangle; G. E. Moore, East Killingly, Connecticut, quadrangle; A. E. Nelson, Natick, Massachusetts, quadrangle; S. A. Norton, Windsor, Massachusetts, quadrangle; F. H. Osberg, N. L. Hatch, Jr., and S. A. Norton, Plainfield, Massachusetts, quadrangle; E. V. Post, The Forks, Maine, quadrangle; Douglas Rumble 3d, Mt. Cube, New Hampshire, quadrangle; R. W. Schnabel, Southwick, Massachusetts-Connecticut, and West Granville, Massachusetts-Connecticut, quadrangles; Robert Scott, Southbury, Connecticut, quadrangle; and D. B. Stewart, Deer Isle, Maine, quadrangle.

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EXPLANATION

ULTRAMAFIC ROCKS

Ordovician

- d — Dunite and peridotite. *Dot indicates small body*
- p — Pyroxenite (metapyroxenite). *X indicates small body*
- s — Serpentinite. *Includes talc and chrysotile asbestos deposits. Square indicates small body*
- ss — Soapstone. *Includes talc and talc schist*
- c — Cumberlandite. *Found only in Rhode Island*
- u — Ultramafic rock, undivided or highly variable. *Triangle indicates small body*

MAFIC ROCKS

Ages indicated by letters: (P) probably Permian to Cretaceous, inclusive; (D) Devonian or probably Devonian; (O) Ordovician or probably Ordovician

- g — Gabbro (Metagabbro). *In places grading into norite and other mafic rocks. Includes various mafic complexes, and in places, diorite*
- gd — Gabbro-diorite. *Including rocks ranging from gabbro to diorite*
- no — Norite and gabbro
- Ni — Nickel-bearing rock

Contact

South sheet
MAP SHOWING DISTRIBUTION OF ULTRAMAFIC AND INTRUSIVE MAFIC ROCKS FROM NEW YORK TO MAINE

By
David M. Larrabee
1971

Base map from U.S. Geological Survey

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