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The Diorite at West Warren, South-Central Massachusetts

By J. S. Pomeroy, Reston, Va.

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The diorite at West Warren, south-central Massachusetts

By J. S. Pomeroy, U.S. Geological Survey, Beltsville, Md.

Abstract.--Foliated, syntectonic, concordant intrusive bodies of mostly diorite and meladiorite with less abundant quartz diorite and norite have been mapped in the West Warren area of south-central Massachusetts. The rocks of the pluton range from a medium colored phase of diorite and quartz diorite to a dark colored phase of meladiorite and norite. Major minerals in the dioritic rocks are calcic andesine, green hornblende, brown biotite, and hypersthene. Igneous textures are dominant, and retrograde or deuteric effects are generally minor. Silica and alumina contents of the dioritic rocks are somewhat higher than for average diorites; conversely, the oxides of iron, magnesium, and calcium are generally lower. Normative quartz, albite, and anorthite are higher and orthoclase is lower in the samples than in the average diorite. Sizeable plutons of diorite-norite are uncommon in central Massachusetts. The West Warren body, roughly 26 km² (10 square miles) in area, bears little petrochemical relation to adjacent rock units. The pluton can be construed as belonging to a belt of intrusive mafic rocks which stretches from southeastern New York to coastal Maine.

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Introduction

Approximately midway between Worcester and Springfield is a large sill-like body and adjacent satellite bodies of diorite and norite (fig. 1). The diorite and norite are part of a crystalline terrane in

Figure 1 near here

which the adjacent metamorphic rocks have minerals characteristic of the sillimanite-almandine-orthoclase subfacies of the almandine-amphibolite facies (Turner and Verhoogen, 1960, p. 549).

A petrographic and chemical study was made of the diorite and related rocks as part of the U.S. Geological Survey's regional mapping program, in cooperation with the Massachusetts Department of Public Works. Modal analyses (table 1) were made on 42 thin sections. All thin sections were treated with sodium cobaltinitrate to detect potash feldspar (Rosenblum, 1956). The statistical method of Michel-Lévy (Rogers and Kerr, 1942; Moorhouse, 1959) was used in determining the character of the plagioclase. The descriptive modal classification of Peterson (1961) was used.

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Figure 1.--Generalized sketch map of part of south-central Massachusetts showing areal extent of diorite pluton.

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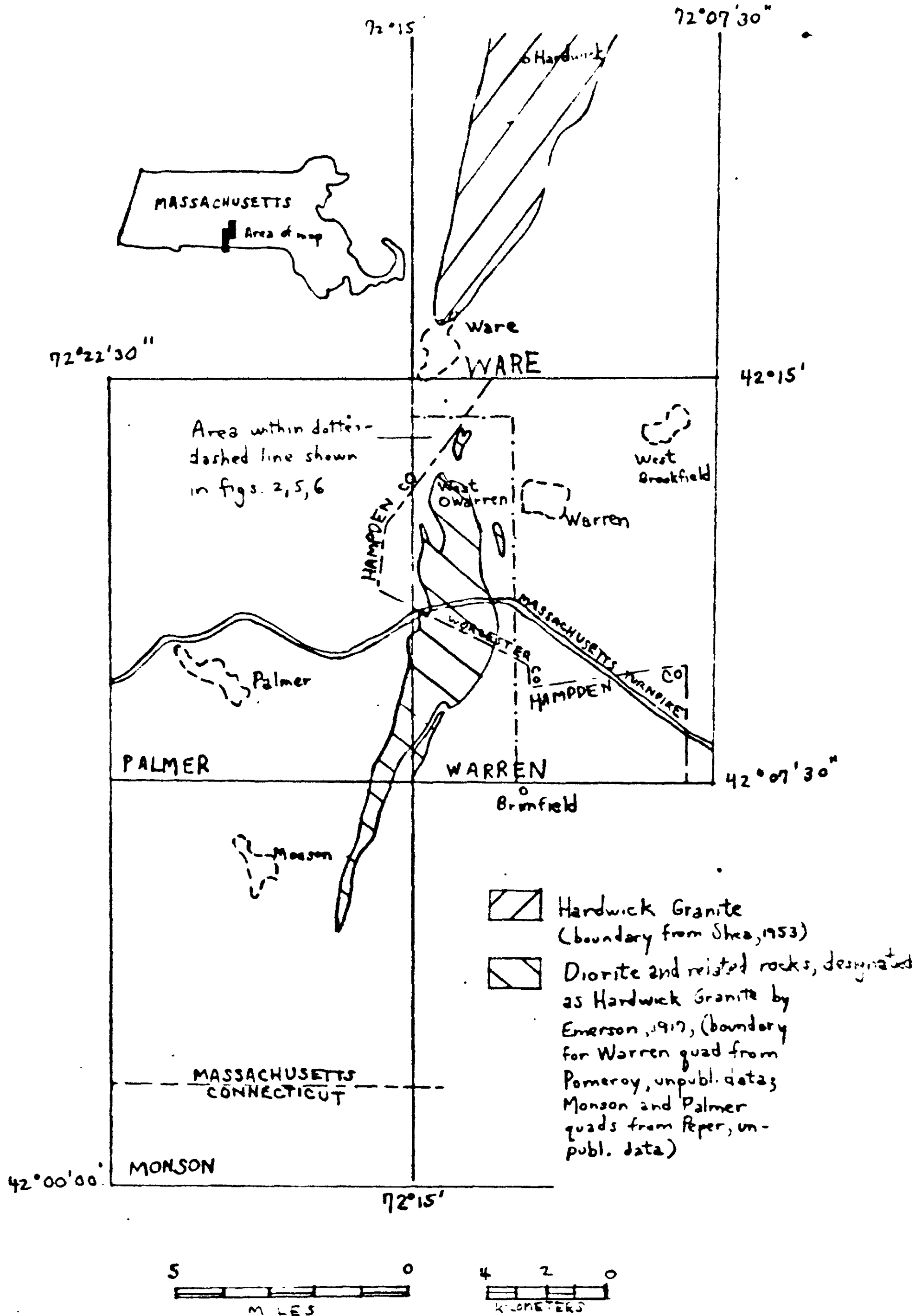

Figure 1. Generalized sketch map of a portion of south-central Massachusetts showing areal extent of dioritic pluton

Modal studies of plutonic bodies have been described in recent publications by Olmsted (1971), Waskom and Butler (1971), Clemons and Long (1971), and Bateman and Lockwood (1970). The sampling density for modal studies varied in these reports from 0.3 sample per square mile ($1.6 km^2$) to slightly greater than 1.0 sample per square mile ($1.6 km^2$). In this report the sample density is about 4.5 samples per square mile ($1.6 km^2$).

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Geologic setting

Emerson (1898, 1917) applied the name Hardwick Granite to the belt of rock discussed in this paper (fig. 1). The Hardwick Granite was described as a dark thick-bedded biotite gneiss (1898) and was later defined as a black biotite granite (1917). The belt occupies roughly (10 square miles), mostly in the western part of the Warren 7½-minute quadrangle and to a lesser extent in the adjoining Palmer and Monson 7½-minute quadrangles (fig. 1). On the Massachusetts geologic map Emerson (1917) correctly shows a separation of a few miles between the Warren-Monson-Palmer pluton and the more extensive Hardwick pluton north of the Warren quadrangle in the Ware-Hardwick area (fig. 1). A reconnaissance investigation and subsequent modal analyses of five samples from the type locality of the Hardwick Granite show the Hardwick to be biotite granodiorite and biotite quartz diorite. Future mapping of the main body of the Hardwick Granite may shed more light on any possible correlation between the type Hardwick and the West Warren pluton. It is significant to show, however, that the rocks described in this paper are distinctly different from those to the north. Peper (1966, p. 67) noted that in the Palmer and Monson 7½-minute quadrangles the region shown on the Massachusetts geologic map (Emerson, 1917) as Hardwick Granite is an intrusive complex of diorite and gabbro with little or no granite. Later Peper (1967, p. 106, 110) mentioned the Hardwick Granite of Emerson as pyroxene-hornblende-biotite diorite and quartz diorite.

Excellent exposures of the West Warren pluton crop out in the highland area 0.4 km (1/4) to 1.6 km (1 mile) south to southwest of the town, and in large fresh roadcuts along the Massachusetts Turnpike. There are few exposures on the eastern side of the main body (fig. 2). Contacts with

Figure 2 near here

the garnetiferous gneissic country rock (Mt. Pisgah Formation of J. D. Peper, M. H. Pease, and V. M. Seiders, unpub. data) along the east side of the pluton are not exposed. On the west side, however, south to southwest of West Warren, the contact with a porphyritic granite (Coys Hill Granite of Emerson, 1917) consists of interlayered zones ranging from several tens to several hundreds of feet. A complex transitional zone more than 304.8 m (1000 feet) thick is exposed along the Massachusetts Turnpike where the diorite intertongues to the west with Coys Hill Granite.

Age relationships of the Coys Hill Granite and diorite are enigmatic and contradictory from outcrop to outcrop as well as in the well-exposed area 1.6 km (1 mile) southwest of West Warren where the granite and diorite interpenetrate on a small scale. Chilled contacts are lacking. The author believes that the two lithologies might be of largely comagmatic origin. However, at two localities fine-grained diorite dikes intrude the Coys Hill Granite; and if one assumes that the dikes are related to the main diorite body, then the diorite is clearly younger than the granite. Based on evidence seen to date, part of the diorite may be roughly equivalent in age to the Coys Hill and part may be ~~younger than the Coys Hill Granite.~~

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Figure 2.--Map showing sample localities in diorite pluton, West Warren area, Massachusetts.

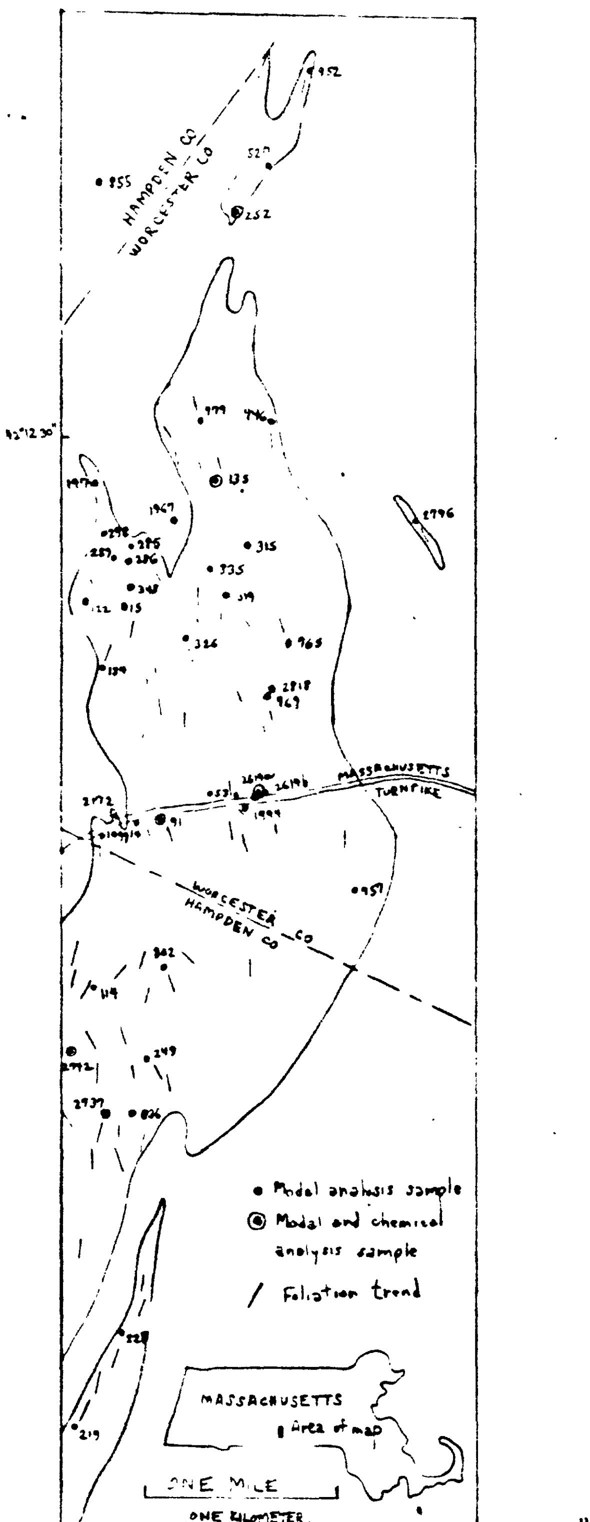

Figure 2. Map showing sample localities in dioritic pluton, West Warren area, Massachusetts

Megascopic description

The plutons shown in figure 2 are composed chiefly of medium-grained, equigranular to locally subporphyritic (feldspar), distinctly to weakly foliated hypidiomorphic granular diorite and meladiorite.[1] Quartz diorite and norite are less abundant (table 1). The most abundant minerals are plagioclase, hornblende, biotite, and pyroxene in order of decreasing abundance. The rock is commonly dark gray in freshly cut exposures. A few foliation-plane surfaces are stained reddish brown by iron oxide. The diorite generally weathers to a smooth massive medium-gray surface, but friable and crumbly, sometimes iron-stained, outcrops are not uncommon where the depth of weathering varies from a fraction of a foot to several feet.

Grains generally range from 1 to 3 mm without any apparent size differences between rock types. Grains in excess of 5 mm are rare and are usually plagioclase.

Light and dark schlieren are locally conspicuous but make up less than 1 percent of the total volume of the plutons. Thin, generally coarse-grained granitic to granodioritic sills and dikes penetrate the dioritic rocks. Migmatitic zones are scarce, at least in exposed sections.

[1] The writer defines a meladiorite as a diorite whose color index exceeds 40.

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Mineralogic data

The major constituents of the West Warren pluton are calcic andesine, hornblende, biotite, and hypersthene. Unlike most diorites, orthopyroxene is more abundant than clinopyroxene. Potassium feldspar is present in only three samples. Accessory minerals such as magnetite, garnet, and apatite locally exceed 10 percent of the rock (table 1). Alteration is slight, and igneous textures usually show relatively little modification.

Quartz is interstitial between the feldspars and mafic minerals and is regarded as the last mineral to crystallize. Most quartz shows undulatory extinction. Many grains exhibit slight fracturing and moderate granulation. The potassium feldspar is orthoclase (usually untwinned).

Most of the plagioclase in the dioritic rocks is calcic andesine. Grains are anhedral to subhedral and commonly randomly oriented. They infrequently show well-defined normal zoning, but zoning is obscure in the more mafic rocks. Twinning is albite and pericline which is usually more distinct in the more mafic rocks. Effects of deformation are confined to local shearing and intergranular crushing and slight to moderately bent lamellae. Much of the plagioclase from the west edge of the main dioritic body along the Massachusetts Turnpike is altered to very fine grained sericite and some calcite.

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The modes of potassium feldspar, plagioclase, and quartz in 42 rock specimens from the diorite of the West Warren area are plotted on figure 3. The plots show a very heavy abundance of points in the

Figure 3 near here

diorite (and gabbro) field and a lesser number in the more quartz-rich fields. The modes above the 10 percent line in the diagram are from rocks located less than 0.32 km (0.2 mile) from the contact.

Figure 4 is a point diagram of volume percent of biotite, pyroxene, and hornblende of 42 modes of the dioritic rock. Contours

Figure 4 near here

based on color index values indicate that the hornblende-rich diorites and meladiorites generally exhibit higher color indices than do the hypersthene-rich diorites and some gabbros (table 1).

Figure 5 is a color index variation map. A fairly distinctive

Figure 5 near here

north-northwest-trending high in the western part of the main body is hornblende-rich.

Figure 3.--Summarized plots of 42 modes from dioritic pluton. Numerals in parentheses refer to number of modes with same proportion of quartz-K-feldspar-plagioclase

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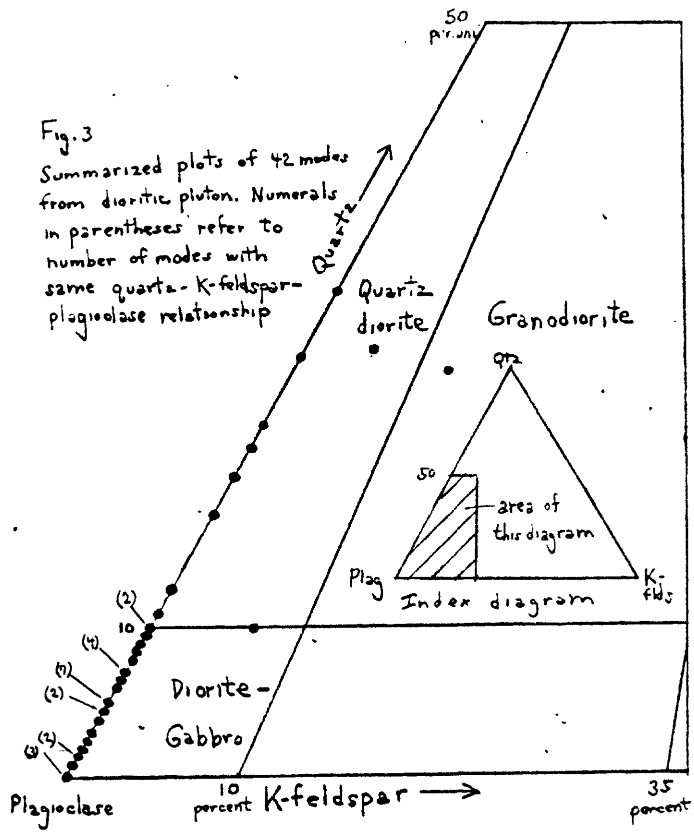

Fig. 3
Summarized plots of 42 modes from dioritic pluton. Numerals in parentheses refer to number of modes with same quartz-K-feldspar-plagioclase relationship

9.1267

Figure 4.--Contour diagram of color index values in relation to biotite-pyroxene-hornblende content of 42 samples. Vertical-ruled pattern in areas where color index exceeds 50. Hachures show depressions. Contour interval (10 ~~feet~~ percent).

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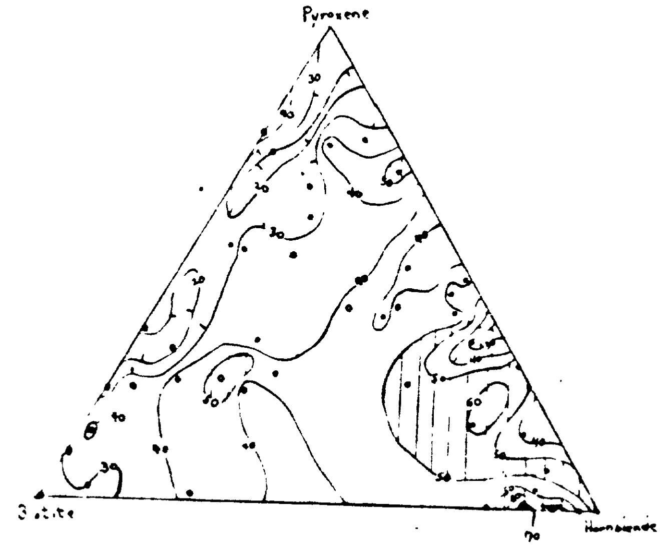

Figure 4. Contour map of color index values in relation to biotite-pyroxene-hornblende content of 42 samples. Vertical ruled pattern in areas where color index value exceeds 50 Hachures show depressions. Contour interval 10 [redacted] percent.

Figure 5.--Color index variation map in diorite pluton, West Warren area, Massachusetts

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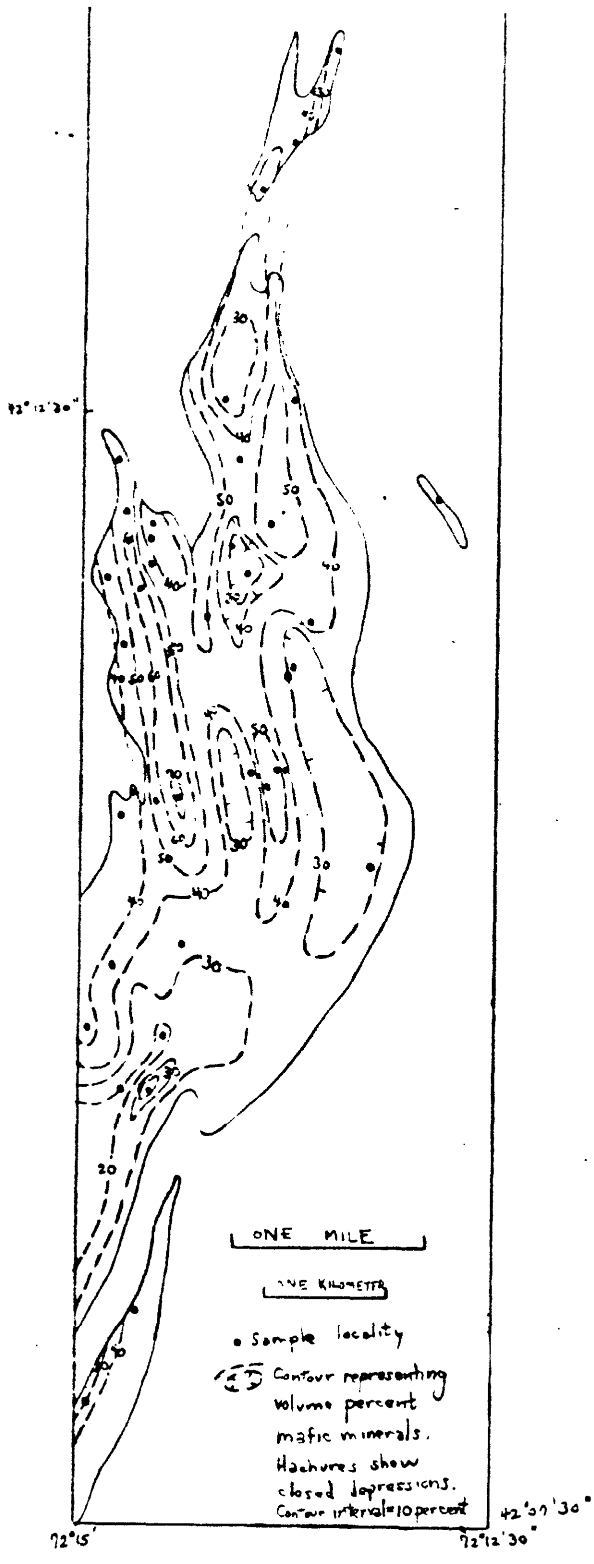

Figure 5. Color index variation map in dioritic pluton, West Warren area, Massachusetts

Biotite is in shades of straw yellowish brown, pale brown, olive brown, dark brown, and reddish brown. The paler colors are probably the result of leaching during weathering. In places alteration of biotite produces an interleaving of chlorite. Some biotite displays deformed lamellae.

Most hornblende is olive green to bluish green, but some hornblende is pale brown to brownish green. Interference colors are commonly masked by the color of the mineral itself. Hornblende commonly occurs as an alteration rim around pyroxene and in places is itself altered to chlorite.

Most pyroxene is hypersthene which varies in pleochroism from weak to very strong (green to pale red or pink). Although most hypersthene exhibits moderate to pronounced pleochroism, some shows very little. Interference colors are commonly of the highest first order, but lower first-order colors (gray) are more characteristic. A few grains of hypersthene contain exsolved plates and blebs of clinopyroxene. Hypersthene is frequently surrounded by irregular alteration rims of hornblende or less commonly of biotite.

Magnetite and ilmenite are both present.

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Apatite is ubiquitous. It is especially abundant in the norite where locally it may form over 5 percent of the rock. Sphene and zircon are less common accessory minerals. Garnet (almandite) is sometimes an accessory mineral. It is usually highly fractured and shows sieve texture. Its presence may be the result of the assimilation of pelitic (aluminous) country rock. The highest concentrations of garnet in the thin sections (table 1, samples 757, 2796) are from areas immediately adjacent to the garnetiferous gneisses of the proposed Mt. Pisgah Formation.

Based on modal studies the diorite pluton exhibits a medium-colored phase in the southern, eastern, and some border areas, and a dark-colored phase which occupies a smaller and irregularly shaped area in the interior and northwest parts of the main body (fig. 6).

Figure 6 near here

Boundaries between the two phases were not observed.

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Figure 6.--Map showing distribution of medium- and dark-colored (patterned) phases and rock types in diorite pluton, West Warren area, Massachusetts.

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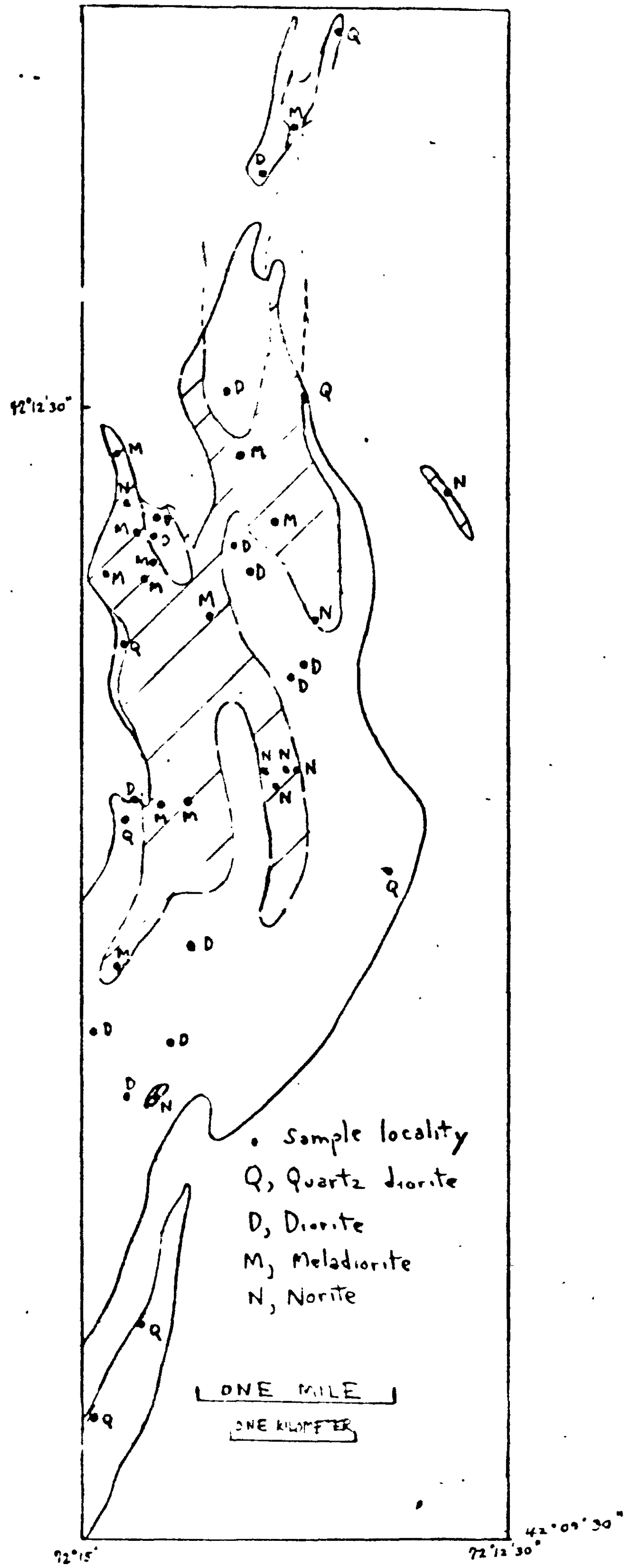

Figure 6 Map showing distribution of medium and dark-colored (patterned) phases and rock types in pluton, West Warren area, Massachusetts

The mineralogy differs between the two phases. Modal quartz averages about 7.5 percent in the medium-colored phase and about 3.5 percent in the dark-colored phase. Rocks containing more than average quartz tend to be more abundant less than (0.2 mile) from the country rock-diorite contact. Potassium feldspar is present in only a few samples in the medium-colored phase and is totally absent in the dark-colored phase. Plagioclase, the predominant mineral, varies from an average of nearly 60 percent in the medium-colored phase to approximately 44 percent in the dark-colored phase. The anorthite content averages 42 percent in the medium-colored phase and over 49 percent in the dark-colored phase. Biotite, an ubiquitous mineral, is more conspicuous in the medium-colored phase (average over 12 percent) than in the dark-colored phase (average about 8.5 percent). Hornblende content contrasts sharply from an average of nearly 6 percent in the medium-colored phase to over 26 percent in the dark-colored phase. Averages of modal pyroxene content vary slightly from nearly 10 percent in the medium-colored phase to nearly 12.5 percent in the dark-colored phase. The average color index (total mafic constituents) diverges from 31 in the medium-colored phase to 51 in the dark-colored phase. Garnet and opaque minerals appear to have no direct relation to the common ferromagnesian minerals. Figure 7 shows the distribution of the two phases as well as the rock type at each locality. The medium-colored phase rocks include diorite and quartz diorite whereas the dark-colored phase rocks include meladiorite and norite. In short, the main differences between the medium-colored phase and the dark-colored phase

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Figure 7.--Point diagram of volume percent of quartz, total feldspar (K + plag.), and color index (total mafic minerals) analyses. Dashed line arbitrarily separates the medium- and dark-colored phases of pluton.

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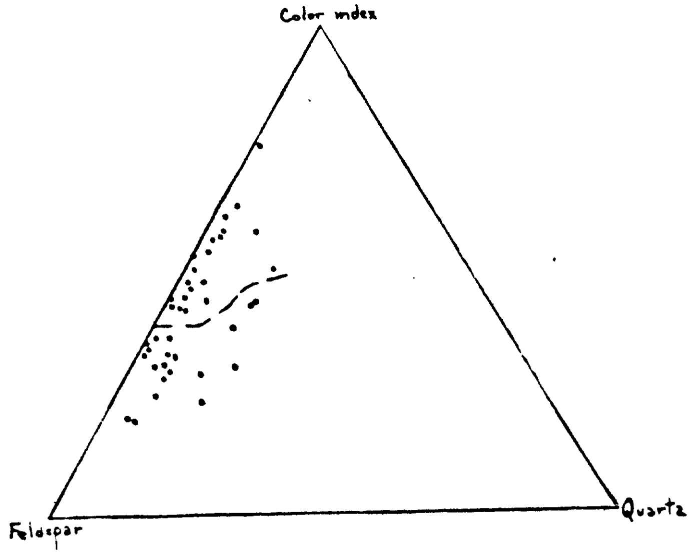

Figure 7. Point diagram of volume percent of quartz, total feldspar (K + plag), and color index (total mafic minerals) in 40 modal analyses. Dashed line arbitrarily separates the medium- and dark-colored phases of pluton.

are the higher quartz, biotite, and plagioclase content, less conspicuous presence of hornblende and pyroxene, lower anorthite content, and the lower color index in the medium-colored phase. Diorite is areally the predominant rock type, followed by meladiorite. Most quartz diorite borders the pluton on the east side and at least locally on the west side. Small bodies of norite are distributed throughout the main body.

Chemical data

Chemical analyses of six samples from the pluton are given in table 2. Samples H_1, H_5, and H_6 represent the medium-colored phase; samples H_2, H_4, and H_7 represent the dark-colored phase. The dark-colored rocks have higher CaO and MgO contents than the medium-colored rocks. All of the sampled rocks are peraluminous.

The analyses of the diorite samples demonstrate a fairly narrow silica range and indicate a higher ratio of sodium to potassium than the Na-K ratio for the average diorite (Nockolds, 1954, p. 1019). The oxides of iron, magnesium, and calcium are generally slightly lower in the dioritic samples than those found in other diorites (Nockolds, 1954). Also, both the silica and alumina values are slightly higher than the averages of Nockolds (53.1 vs. 51.9 and 18.4 vs. 16.4).

Analysis of the only norite sample shows that the oxides of silica, alumina, and magnesium are considerably lower than those for the average norite (Nockolds, 1954) whereas the values for titanium, iron (ferrous), calcium, and sodium are greater.

A silica variation diagram (figure 8) for the analyzed samples shows that as SiO_2 increases, Al_2O_3 is trendless and CaO, MgO, FeO, and Fe_2O_3 decrease. Conversely, Na_2O, K_2O, and TiO_2 show an overall increase as SiO_2 increases.

The pluton bears little petrochemical relation to its geologic environment. Chemical analyses of the bounding Coys Hill granite and garnetiferous gneiss indicate that these rocks contain significantly higher silica (68 and 67 percent respectively) and considerably lower magnesium, lime, and iron than the diorite and norite at West Warren.

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H_1(252) Hypersthene-biotite-hornblende diorite, weathers moderately brownish yellow, equigranular, medium-grained, moderately foliated. Grains average 1 to 2 mm. Sample collected about 30.4m (100 feet) south of O'Neil Road along north slope of knob, Warren 7½-minute quadrangle. Medium-colored phase.

H_2(135) Hornblende meladiorite, medium- to dark-gray, medium- to rarely coarse-grained, moderately foliated. Hornblende grains locally exceed 5 mm. Sample collected about 152m (500 feet) north of Santo Road along east side of upland area, Warren 7½-minute quadrangle. Dark-colored phase.

H_4(91) Hornblende-biotite meladiorite, dark-gray, equigranular, medium-grained, faintly foliated. Hornblende is in excess of 60 percent of rock. Sample collected along south side of Massachusetts Turnpike east of Gilbert Road overpass, Warren 7½-minute quadrangle. Dark-colored phase.

H_5(2737) Hypersthene-biotite leucodiorite, medium-gray, mostly medium-grained, some plagioclase phenocrysts are subporphyritic, faintly to moderately foliated. Sample collected along north-east side of John Haley Road 304m (1000 feet) from Dunhamtown (Palmer) Road intersection, Warren 7½-minute quadrangle. Medium-colored phase.

H_6(2742) Biotite-hypersthene diorite, medium-gray, fine- to medium-grained with phenocrysts rarely exceeding 2 to 3 mm, faintly foliated. Sample collected along west side of John Haley Road just south of Turkey Brook, Warren 7½-minute quadrangle. Medium-colored phase.

H_7(2619a) Norite, dark-gray, equigranular, medium-grained, with abundant hypersthene; faintly foliated, slightly magnetic. Sample collected along north side of Massachusetts Turnpike 0.8km (0.5 mile) east of Gilbert Road overpass, Warren 7½-minute quadrangle. Dark-colored phase.

Figure 8.--Chemical variation diagram of common oxides plotted against SiO_2 for representative dioritic rocks near West Warren, Massachusetts. Numbers inside the diagram refer to the samples.

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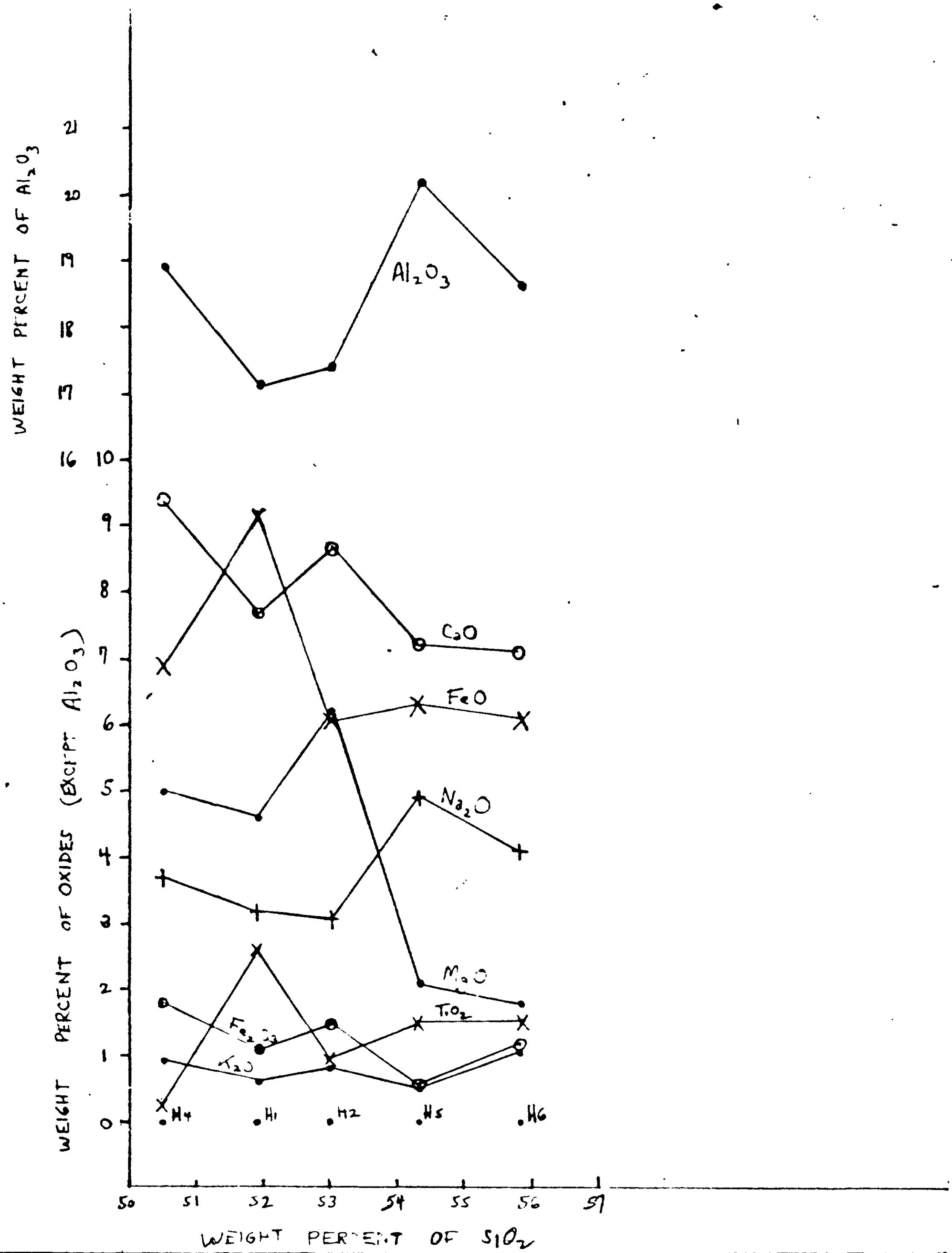

Figure 8. Chemical variation diagram of common oxides plotted against SiO_2 for representative dioritic rocks near West Warren, Massachusetts. Numbers inside the diagram refer to the samples.

In figure 9 both modal and normative quartz-orthoclase-plagioclase

Figure 9 near here

of chemically analyzed rocks are plotted. The modes and norms show a moderate amount of separation. In every case the normative plot is displaced toward the potassium feldspar corner which indicates that the analyses denote more normative orthoclase than there was modal potassium feldspar. Hotz (1971) described a similar trend and attributes the relationship mainly to the potassium oxide of biotite being calculated as normative orthoclase with the amount of albite in solid solution in modal potassium feldspar being insufficient to counterbalance this effect. With but one exception (sample H_2) modal quartz is roughly equivalent to quartz in the norm.

Table 3 shows the average norm for the five dioritic rocks in comparison with those of Nockolds (1954). Norms for closely related rocks are also given. Normative minerals quartz, albite, and anorthite are higher in these samples than those in the average diorite of Nockolds (1954) while the orthoclase norm is lower in comparison. Normative olivine is represented in sample H_4 which is an exceedingly rich hornblende diorite (see mode in table 1). Nockolds' (1954) average hornblende diorite shows comparable normative forsterite and fayalite.

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Figure 9 .--Comparison of modal and normative quartz-orthoclase-plagioclase ratios. Number refers to sample number.

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Figure 9. Comparison of modal and normative quartz-orthoclase-plagioclase ratios. Number refers to H sample number

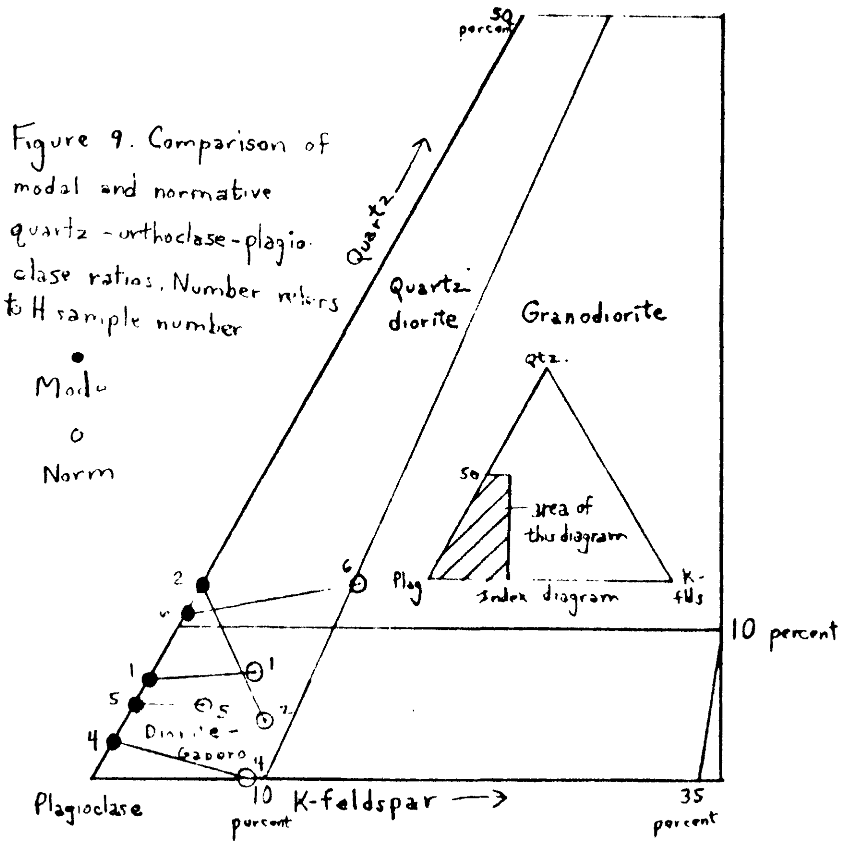

Table 3.--Comparison of normative minerals.

Mineral	Average tonalite (Nockolds, 1954)	Average diorite (Nockolds, 1954)	Average hbl diorite + hbl-pyr diorite (Nockolds, 1954)	Average dioritic rock (5 samples, this report)	Average norite (Nockolds, 1954)
quartz	24.1	0.3	---	4.4	---
orthoclase	8.3	7.8	5.6	4.8	3.3
albite	33.0	28.3	26.2	32.3	15.8
anorthite	20.8	25.8	28.4	30.1	37.8
diopside	0.3	5.6	7.1	3.0	3.7
hypersthene	4.9	15.3	9.2	7.4	21.4
ferrosilite	4.1	8.5	5.0	8.6	10.6
olivine	---	---	8.6	1.9	1.9
magnetite	2.1	3.9	4.6	1.8	1.9
ilmenite	1.2	2.9	3.6	2.6	1.7
apatite	0.5	0.8	0.7	1.6	0.5
corundum	---	---	---	0.4	---
calcite	---	---	---	0.2	---
Total	99.3	99.2	99.0	99.1	99.6

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Results of the semiquantitative spectrographic analyses are shown in table 4. The analyses indicate that the elements barium, chromium, copper, gallium, lead, lithium, nickel, and strontium are less numerous in the sampled rocks than in world averages for intermediate rocks (Krauskopf, 1967, p. 588). Conversely, the elements cobalt, scandium, vanadium, and zirconium are greater than they are in similar rocks (Krauskopf, 1967, p. 588).

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Table 4.--Semiquantitative spectrographic analyses of dioritic rock, West Warren area, Massachusetts

[Analyst: J. L. Harris. N = Not detected at limit of detection. L = Detected but below limit of determination. Elements looked for but not detected: Ag, Au, B, Bi, Cd, Pd, Pt, Sb, Sn, Te, U, W, Zn, Ge, Hf, In, Li, Re, Ta, Th, Tl, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Lu]

Field No.	H_1(252)	H_2(135)	H_4(91)	H_5(2737)	H_6(2742)
Lab No.	859	860	862	863	864
			In parts per million		
Ag	L	L	L	L	L
Ba	100	70	100	150	500
Be	1	1	1	1	1
Co	30	30	15	10	10
Cr	70	50	70	10	15
Cu	10	15	15	5	10
La	N	N	N	50	50
Mo	5	N	N	3	3
Nb	N	N	7	10	10
Ni	N	30	10	N	N
Pb	N	N	N	N	N
Sc	50	30	30	10	10
Sr	200	300	1000	1000	700
V	300	150	200	70	50
Y	50	30	70	50	50
Zr	200	50	100	500	500
Ce	N	N	N	100	100
Ga	20	15	15	20	20
Yb	5	3	7	5	5

Age, origin, and regional significance

No radiometric dating has been done on the pluton so the exact age of the rock is not known. The concordant shapes of the pluton and its satellites with the trends of the enclosing metamorphic rocks and the relative lack of deformation of the plutons suggest that the diorite and related rock types were syntectonic. Possibly they belong to the New Hampshire Plutonic Series of Billings (1934), and the time of emplacement would then have been Middle Devonian (Acadian).

The preferred mineral orientation in the mass coupled with the igneous textures indicates that the resultant foliation is primary. The intrusive rocks bear characteristics of catazonal plutons which according to Buddington (1959) are emplaced in high-grade metamorphic terranes, are concordant with layering and foliation in the adjacent rocks, and have gradational rather than sharp contacts. The more mafic rocks possibly were intruded prior to the main intrusion of the diorite. Unfortunately, actual contacts of the two phases have not been seen. The alteration noted in the plagioclase and ferromagnesian minerals suggests that after emplacement the entire mass was still undergoing at least the waning stages of regional metamorphism. However, the metamorphism probably occurred under "dry" conditions with low stress so that igneous textures were only slightly modified. Spry (1969, p. 274) mentions such conditions are characteristic of igneous assemblages including diorite and gabbro that are emplaced under conditions of the upper amphibolite facies.

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Largely coarse-grained, silicic dikes and sills up to a few feet wide fill fractures throughout the pluton. It cannot be consistently demonstrated whether these fractures were formed by regional tectonic stresses or local stresses related to the pluton itself. Many sills and dikes are slightly deformed and altered which indicate that much of the intrusion that occurred after the diorite was emplaced was subjected to a certain degree of regional metamorphism and deformation.

The plutonic body lies astride the highest contour on the westward side of a prominent north-trending gravity high (Bromery, 1967). It is conceivable that the rocks represent the upper part of a large buried mass which is more mafic (noritic) than the dominant exposed diorite. Outcrops of largely garnetiferous felsic gneiss occupy the center of the gravity high.

Correlation of the rock mass with anomalies on the aeromagnetic map of the Warren quadrangle (U.S. Geol. Survey, 1968) is difficult due at least in part to poor exposures. However, it coincides with a small but intense northeast-trending high near the west edge of the quadrangle. Limited outcrops, however, contain less than the average iron oxide mineral content. To the east well-exposed noritic rocks with a relatively high ilmenite content occur in a wider area of hachured (lower magnetic intensity) contours.

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Large bodies of diorite-norite are uncommon elsewhere in central Massachusetts. There are, however, numerous sills and dikes. Seiders (unpub. data) has mapped a (100-foot)-wide sill of hornblende norite in the adjacent Wales quadrangle to the south, and small ultramafic sills in the Ware quadrangle to the north were noted by Emerson (1918) and Shea (1953). The author has seen very thin (unmappable) ultramafic sills in the eastern part of the Warren quadrangle.

Sizeable dioritic to gabbroic (noritic) bodies of probable Devonian age are widespread throughout eastern Massachusetts, and gabbroic plutons of presumed Ordovician and Devonian ages occur sporadically in eastern and western Connecticut (Larrabee, 1971). As shown by Larrabee, the mafic intrusive rocks in New England appear to be distributed in two belts. Though somewhat less mafic than most of these bodies, the pluton of the West Warren area could be construed as belonging to the easternmost or coastal belt which incorporates all intrusive mafic rocks in southern New England. The inner belt is represented by mafic plutons in west-central Maine.

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