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INTRODUCTION

The bedrock geology of the Gray 7.5-minute quadrangle was mapped during 1995 as part of the State Geologic Mapping Program of the Maine Geological Survey and the U. S. Geological Survey in the Portland 1:100,000-scale map sheet. This report accompanies a bedrock geologic map showing the distribution of bedrock lithologies.

The bedrock of the Gray quadrangle consists primarily of igneous rocks, chiefly granitoids, that constitute a portion of the Sebago pluton of Carboniferous (Hayward and Gaudette, 1984; Aleinikoff and others, 1985; Osberg and others, 1985) or Permian (Tomascak and others, 1996) age. This investigation recognizes three abundant varieties of granite within the map area: muscovite-garnet (tourmaline biotite) granite and migmatite, muscovite-biotite (two-mica) granite, and biotite granite (see also Creasy, 1996; Wise, 1995). All three granites are medium- to coarse-grained but other textural aspects, most frequently pegmatite, are locally developed. Biotite granite is younger than muscovite-biotite granite in the Gray quadrangle. Both biotite granite and muscovite-biotite granite intrude muscovite-garnet granite and migmatite.

Metamorphic rocks, chiefly biotite granofels and pelitic schist, are present within the southeastern part of the Gray quadrangle. Although outcrops of the metamorphic rocks are numerous and occasionally large (500 sq. ft) within this area, all are intruded by muscovite-biotite granite and biotite granite. This area is demarked as a mixture of igneous and metamorphic rocks on the accompanying map, and likely represents the northeasterly continuation of the metamorphic rock units present to the southwest in the North Windham 7.5-minute quadrangle. Biotite granofels and pelitic schist also occur as smaller screens or inclusions within granite and as a component of migmatites. Such occurrences are limited to the eastern edge of the map area. A variety of metamorphic rock types are present, including biotite granofels, pelitic schist, feldspathic biotite schist, and quartzite.

Location and Topographic Setting

The Gray 7.5-minute quadrangle is located in Cumberland County, Maine. The quadrangle includes portions of the towns of Gray, New Gloucester, Poland, and North Yarmouth. The area is predominately rural to rural residential in character, with the exception of the immediate vicinity of the village of Gray located near the south-central border of the quadrangle. The Maine Turnpike and U. S. Route 202 trend approximately north from the village of Gray through the central lowland portion of the quadrangle.

Most of the quadrangle is of low to moderate relief with the highest elevation of 567 feet near Shaker Village in the northwestern corner of the quadrangle. The gentle, glacially sculpted hills of the quadrangle are blanketed by glacial deposits, but provide adequate outcrops for preparation of a bedrock geologic map.

A poorly-drained lowland area subdivides the quadrangle into a steeper western portion (west of the Maine Turnpike) with steep, south-facing slopes that expose large bedrock outcrops and an eastern portion (east of the Maine Turnpike) where moderate slopes are developed on glacial deposits. In this eastern portion, outcrops are smaller, scattered, and less predictable from the topography. This lowland area extends from Gray Meadow, south of the village of Gray, to the northerly margin of the quadrangle, although the maximum width of this lowland is in the central portion of the map area. It is underlain by Quaternary glacial and glaciofluvial sedimentary deposits weakly incised by Eddy and Collyer Brooks towards the south and the Royal River towards the north. A second lowland lies along the

eastern part of the map area, extending northerly from the Pineland Hospital to Cobbs Bridge, and is drained by the Royal River.

Previous Bedrock Geologic Mapping and Related Studies

The bedrock geology of the Gray quadrangle has been mapped at 1:250,000-scale as part of the Portland 2^o map sheet (Hussey, 1985). In the quadrangles bordering the Gray 7.5-minute quadrangle, detailed bedrock mapping is available for the Raymond (Creasy, 1996), North Windham (Hussey, 1996), and Cumberland Center (Creasy, in progress) 7.5-minute quadrangles, and the Poland 15-minute quadrangle (Creasy, 1979).

Surficial Geology

The surficial geology of the Gray 7.5-minute quadrangle is dominated by Quaternary deposits of glacial till, glaciomarine silt and clay, and ice-contact sand and gravel (Thompson, 1976). Glacial till occurs throughout the map area at elevations above 300 feet. The till is thin (less than 10 feet thick) over most of the hills in the northwest part of the quadrangle where bedrock outcrops are abundant. The eastern lowland area of the quadrangle, drained by the Royal River, is underlain by glaciomarine silt and clay of the Presumpscot Formation (Thompson, 1976). The central lowland area south of Dry Mills is also underlain by the Presumpscot Formation. However, to the north of Dry Mills, this central lowland is underlain by ice contact sand and gravel (Thompson, 1976).

Methods Used in this Study

The primary data was obtained by field study. The topographic map and surficial geologic map (T.K. Weddle, personal communication, 1995) were evaluated for likely outcrop locations. These locations, primarily steep topographic slopes, ridge and hill crests, and stream channels, were the basis of field traverses. The locations of these traverses and all observed bedrock outcrops were recorded in the field on a standard USGS 1:24,000-scale topographic map using landmarks, elevation, and, where necessary, satellite Global Positioning System (GPS) techniques. Lithologic and structural data were recorded at the outcrop; samples were collected as necessary for comparison of different rock units. Orientations of structural features were measured in the field at selected outcrops.

LITHOLOGY

Metamorphic Rocks

Metamorphosed sedimentary rocks occur in the southeastern part and in the northeastern corner of the Gray quadrangle. In the southeastern area, they occur as scattered exposures of muscovite-rich (pelitic) schist, gneiss, and migmatite, and of biotite-rich granofels (metawacke?), schist, and minor quartzite. These differing lithologies do not occur in spatially distinct, mutually exclusive areas, so they have not been mapped separately. Rather, the pelitic schist and gneiss and the granofels usually occur within single large outcrops, interbedded on the scale of meters. Compositional layering (apparent bedding) is a common feature of the various metamorphic rock types. Most frequently, this layering results from centimeter-scale alternations of pelitic schist and biotite granofels, suggesting a medial-distal turbidite protolith. Compositional banding in the gneiss and migmatite results from interlayering of pelitic lithology with granitoid or pegmatite.

The exposures of metasedimentary rocks also contain granitoids and pegmatites that account for up to 50% of individual outcrops, and large exposures of these younger granitoids are also widely distributed in areas where metasedimentary rocks occur. Because the metasedimentary rocks are always found together with igneous rocks, the accompanying geologic map shows these areas with a letter symbol for the appropriate igneous rock type together with a shaded overprint to indicate the presence of metasedimentary rocks. A line is drawn on the map to delimit the area of metamorphic rock occurrence. This boundary can be traced to the southwest into the North Windham and Cumberland Center quadrangles where it more clearly separates metasedimentary rocks to the southeast from igneous rocks to the northwest. Given this relationship and the lack of significant metamorphic rocks to the north and west in the Gray quadrangle, this boundary may mark the regional contact of the Sebago pluton in the Gray quadrangle.

Along the eastern and northeastern margin of the map area, metamorphic lithologies are generally limited to small, discontinuous outcroppings and as planar fabric elements within foliated granite and migmatite. These occurrences cannot be adequately represented at the scale of the accompanying geologic map. These occurrences are typical of the contact zone of the Sebago pluton as described by Creasy (1979) in the Poland 15-minute quadrangle.

The rock types and continuity to the southwest suggest that these metasedimentary rocks correlate in general with rocks of the North Windham quadrangle, and are therefore of Silurian to Ordovician age (Hussey, 1985, 1996).

Pelitic Schist, Gneiss, and Migmatite - This rock type is exposed on hill 346 northwest of Gray Station, southeast of Gray station, on the hill west of Route 231 in North Yarmouth near the National Weather Service facility, and east of Route 231 north of the Pineland Hospital. Muscovite, biotite, and quartz occur in subequal proportion and together constitute the majority of the rock. Small amounts of garnet are present in certain horizons and fibrolitic sillimanite is tentatively identified in some samples. With increase in abundance of granitic and pegmatitic leucosome, this unit grades into migmatite.

Biotite Granofels and Schist - This rock type is well exposed as pavement outcrops on hill 281 east of Gray Station and north of the Pineland Hospital property. This rock has a me-

dium-grained granoblastic to schistose texture and consists of quartz, biotite, and feldspar. The ratio of quartz + feldspar : biotite varies considerably within layered sections or between outcrops and is responsible for the variably schistose texture.

Pinstriped Quartzite - This rock type is exposed as centimeter-scale beds of quartzite within biotite granofels, recognized on weathered surfaces by the characteristic weathering pattern. Occurrences are noted on hill 281 east of Gray Station and north of the Pineland Hospital property.

Muscovite-Garnet Tourmaline Biotite Granite and Migmatite (Cmgg)

This unit occurs in the southwestern part of the quadrangle, south and southwest of the village of Dry Mills. It extends into the Cumberland Center 7.5-minute quadrangle (Creasy, in progress) to the south and into the Raymond 7.5-minute quadrangle (Creasy, 1996) to the west. On the ridge southwest of Crystal Lake and west of Libby Hill, this unit is cut by muscovite-biotite granite.

This unit is characterized by several rock types having strong mineralogic similarities but a range of textural expressions or aspects. These textural aspects result from variation in grain size and in the presence of a metamorphic component (migmatite). These aspects are commonly associated on the outcrop scale. Contacts between migmatite and pegmatitic granite are commonly gradational. Because the map scale does not permit subdivision of this unit other than schematically and because all are interpreted to be representations of the same metamorphic/magmatic processes, these rocks are grouped into a single map unit.

Heterotextural muscovite-garnet tourmaline biotite granite - This rock type ranges in texture from coarse granitic to pegmatitic; either aspect may occur individually but frequently both are complexly distributed in gradational contact within single outcrops. Muscovite is abundant, often forming large spangles visible even on weathered surfaces. Garnet is not uniformly distributed throughout the rock but is almost invariably present within all outcrops. Tourmaline and less frequently biotite are present in pegmatitic varieties.

Leucocratic muscovite-garnet aplite - This leucocratic, muscovite-rich rock typically forms centimeter-scale layers within the coarse-grained or pegmatitic granite; where present, outcrops have crude decimeter-scale layering. This association is also present in the adjacent Raymond 7.5-minute quadrangle. This bimodal textural-lithological association reflects heterogeneous distribution of volatiles within the parental anatectic partial melts (Creasy, 1996).

Migmatite - This rock type, subordinate in the Gray quadrangle, consists of muscovite-garnet tourmaline biotite granite, as described above, with inclusions of biotite schist or granofels or pelitic schist as parallel fabric elements. The ratio of granite to metasediment varies from 2:1 to 10:1. The metasedimentary component seldom exceeds 5 cm in thickness and more frequently is 1-2 cm; spacing of these planar features ranges from 5-30 cm. With decreasing abundance of the metasedimentary component, the migmatite passes into the granite.

Muscovite-Biotite (or Two-Mica) Granite (Cg)

This unit occurs throughout the map area and appears to be the most extensive granitoid. In the northwesterly part of the quadrangle, good exposures are present along the Androscoggin-Cumberland County line northeast of Shaker Village and in ledges adjacent to Route 26 north of Crystal Lake. In the southeastern part of the map area, small exposures are widely distributed; one particularly good exposure is south of the Pownal Road on hill 281 east of Gray Station. Where weathered, the two-mica granite has a granular, almost friable texture. This characteristic combined with Quaternary glacial erosion may account for the paucity of outcrop in the lowlands; proximity to more resistant lithologies (biotite granite in northwest; metasedimentary rocks in southeast) may account for the presence of two-mica granite outcrops at these places.

This unit consists of white to pale pink, medium-grained muscovite-biotite granite. The muscovite is typically coarser grained (5 mm) and the biotite finer grained (2-3 mm) with these minerals occurring in subequal amounts. Variants tend to have a higher proportion of muscovite relative to biotite. This unit is relatively free of inclusions of any type and is broadly homogeneous in texture. Muscovite-biotite pegmatite is present in the map area as clearly crosscutting dikes within muscovite-biotite granite, muscovite-garnet granite, and metamorphic lithologies. Pegmatitic aspects of this unit may form relatively homogeneous outcrops, particularly in the southeastern part of the quadrangle.

Biotite Granites

Biotite granite (Cbg) - This unit occurs primarily in the northwestern portion of the Gray quadrangle. It is best exposed on the steep southeasterly slopes of Little Hill, Snows Hill and hill 546 east and south of Sabbathday Lake. Other exposures are on hill 305 north of Cobbs Bridge in the northeastern corner of the quadrangle. Scattered outcrops are present in the southwest portion of the map area.

The granite is medium-grained, locally subporphyritic, and contains accessory muscovite and garnet in some occurrences. The biotite granite is younger than the two-mica granite; however, the reverse relationship is noted in the Raymond quadrangle (Creasy, 1996).

Biotite-garnet granite (Cbgg) - Several small areas of garnet-rich biotite granite are present along the eastern margin of the map area. These rocks are considered a variant of biotite granite differing only in the abundance of garnet. As seen on the accompanying geologic map, these occurrences are found where biotite granite and metamorphosed sedimentary rocks are in contact or inferred to be in contact.

Foliated biotite granite (Cbgf) - This unit is a medium-grained biotite granite with a biotite foliation. It occurs in three widely separated, small areas, the largest present southwest of Colley Hill. This foliated biotite granite is cut by muscovite-biotite granite, intrudes (?) muscovite-garnet granite, and is older than non-foliated biotite granite.

Mesozoic dikes

Compared with the Naples and Raymond quadrangles to the west (Creasy, 1996), very few Mesozoic dikes were noted in the Gray quadrangle. The dikes consist of basalt or trachyte. They are too thin to show as separately mapped areas, so they are indicated by symbols on the accompanying geologic map.

STRUCTURAL DATA

The structural data shown on the accompanying map includes: the orientation of foliation within the metamorphic rocks and the granites, the orientation of joints, and the orientation of dikes. Synoptic rose diagrams and contoured pole diagrams for each feature are included in this report (Figures 1-4). For each diagram the number of data points (N) is given. The contoured pole plots are equal-area, lower hemisphere projections, with north toward the top of the page. The data for each feature were subdivided into geographic domains (northwest, northeast, southeast, southwest) corresponding to the four quadrants of the map area that roughly approximate different bedrock domains. Differences among the four domains can be seen from the mapped data. Figures illustrating the individual domains are not included in this report, but characteristics of each domain are described where appropriate in the following discussion.

Foliation of Metasedimentary Rocks (Figures 1a, 1b)

The foliation in the metasedimentary rocks, defined by the parallel orientation of micas, describes a shallowly dipping, gently undulating surface. Compositional banding, where present, is parallel to foliation in almost all cases. In the northwest domain of the Gray quadrangle, the foliation of metasedimentary rocks dips to the northwest, while in the southeast domain of the quadrangle, the dips are to the southeast. In the southwest domain, the foliation dips gently to the southwest, while in the northeast domain foliation is approximately horizontal.

Foliation of Granites (Figures 2a, 2b)

Foliation is defined by orientation of micas, usually biotite in the granites, or of compositional layering or foliation in the metasedimentary xenoliths. Foliation in the granites of the Gray quadrangle shows several strike directions in a rose diagram (Figure 2a). The foliation in granites of the northwest domain of the quadrangle has two major strike directions, 235^o and 75^o, shown in the rose diagram (Figure 2a). These correspond to relatively steeply dipping orientations in the contoured diagram of poles to foliation (Figure 2b). In the northeast domain of the quadrangle, two major strike orientations, 135^o and 325^o, belong to steeply dipping foliation. Other strike directions in the northeast domain, 235^o and 355^o, belong to a sub-horizontal foliation. Data for the other two domains are sparse, but suggest shallowly dipping foliation in the southwest domain and steeply dipping foliation with various strike directions in the southeast domain.

Joints (Figures 3a, 3b)

Joints are open brittle fractures in the rocks (usually about 1 mm wide) that form repeated parallel planar surfaces frequently enhanced by erosion or weathering. The rose diagram of joint measurements (Figure 3a) from the Gray quadrangle shows a major joint set with strikes of 235^o and 65^o, and a minor set with strikes of 280^o-310^o and 125^o. The contoured diagram of poles to joints (Figure 3b) shows that most of the measured joints are nearly vertical. Some sheeting joints with sub-horizontal orientation were measured, but these are not well represented in the data.

In the northwest domain major joint sets strike 35^o and 235^o; a minor joint orientation strikes 115^o. In the northeast domain, major joint orientations strike 65^o, 235^o, and 305^o. Joints in the southwest domain strike 25^o, 115^o, and 315^o. The southeast domain has one major joint orientation striking 25^o and two minor orientations striking at 165^o and 305^o.

Orientation of Dikes and Veins (Figures 4a, 4b)

Basaltic and trachytic dikes, pegmatitic and granitic dikes, and quartz veins are uncommon in the Gray 7.5-minute quadrangle. The small number of dikes and veins precludes any meaningful analysis by type or domain but, when these features are grouped together, a northeast-striking, steeply dipping orientation is apparent. This northeasterly trend is parallel to major joint orientations.

DISCUSSION OF STRUCTURAL DATA

The structural data seem to show two possible correlations between data sets: (1) correlation between the orientations of foliation in metasedimentary rocks and in granite, and (2) correlation of the orientations of joints and of dikes.

The foliation of metasedimentary rocks and of granite show similar, shallowly dipping orientations in contoured diagrams of poles, although foliation in granite has additional, more steeply dipping orientations. This correlation is well documented in the northeast domain where the granite foliation and metasediment foliation are flat-lying, but the granite has an additional, more steeply dipping foliation. Likewise, in the southeast domain, foliation in metasedimentary rocks and in granites dips at low angles to the southeast. In the southwest domain, both

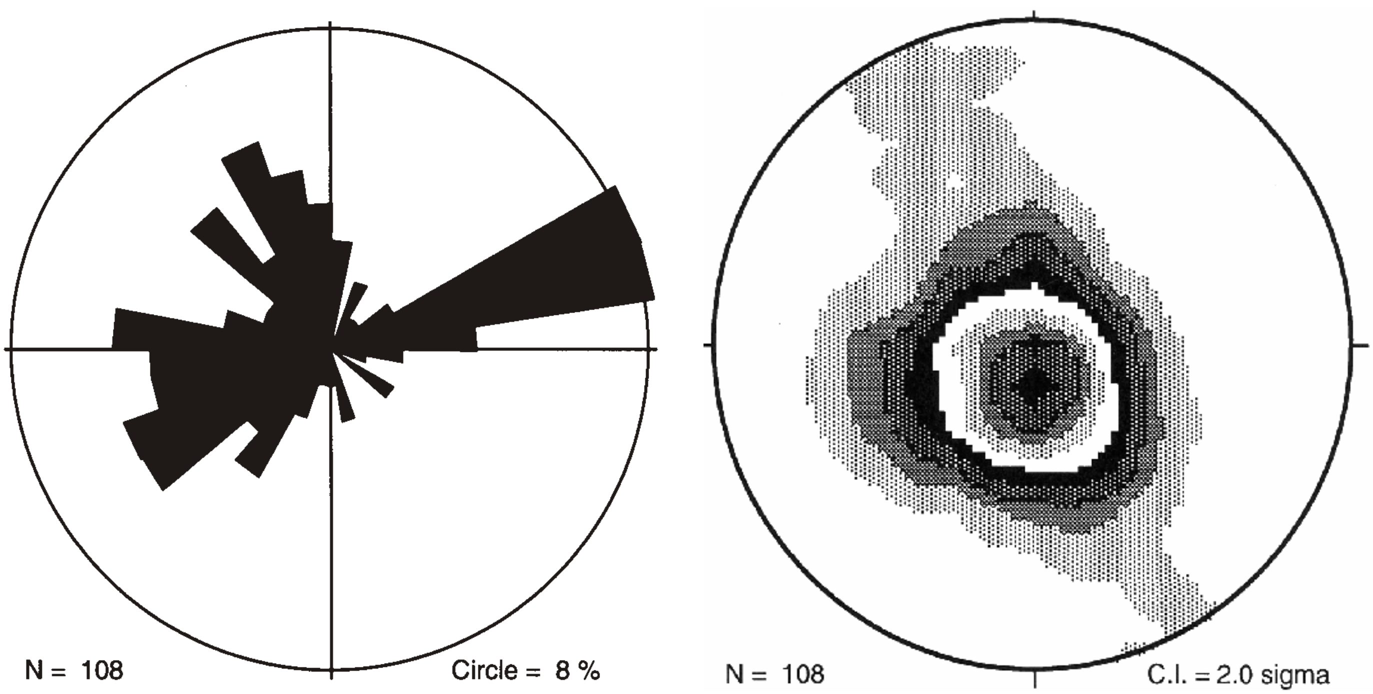

Figure 1. Orientation of foliation (n=108) in metasedimentary rocks of the Gray 7.5-minute quadrangle: (a) rose diagram; (b) contoured pole plot.

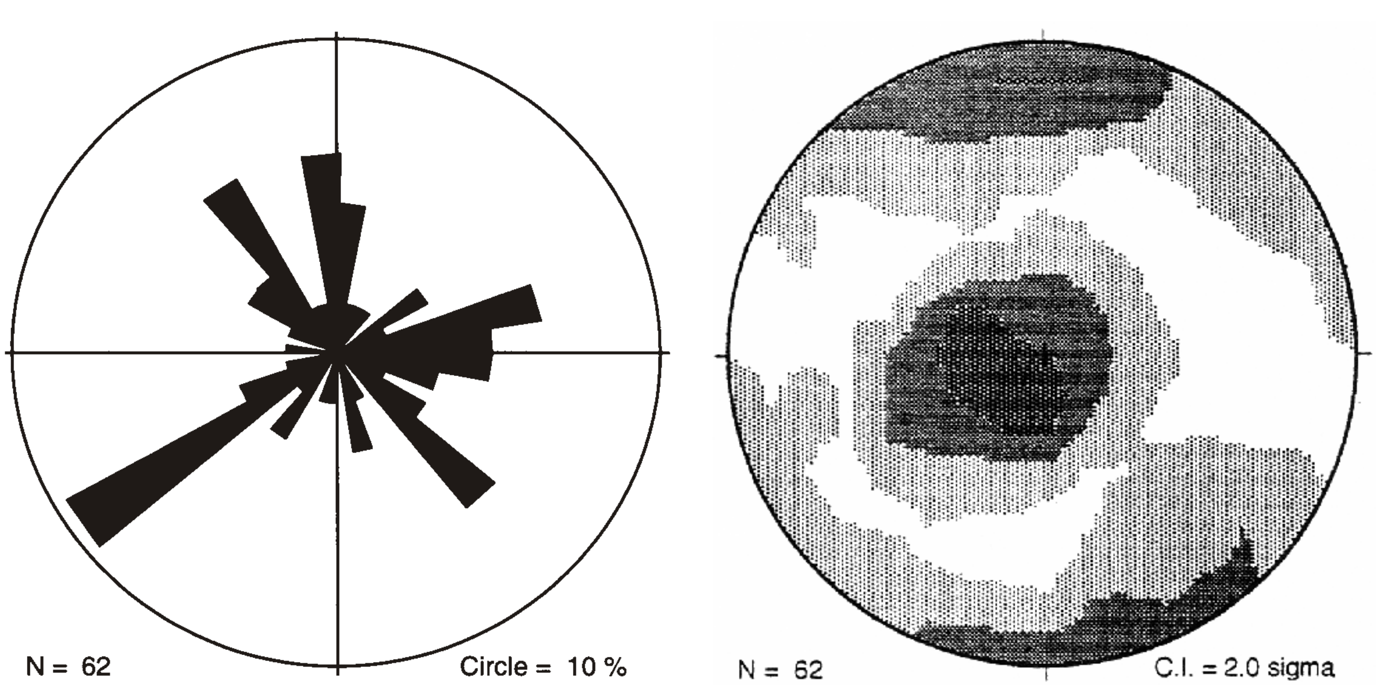

Figure 2. Orientation of foliation (n=62) in granitoids of the Gray 7.5-minute quadrangle: (a) rose diagram; (b) contoured pole plot.

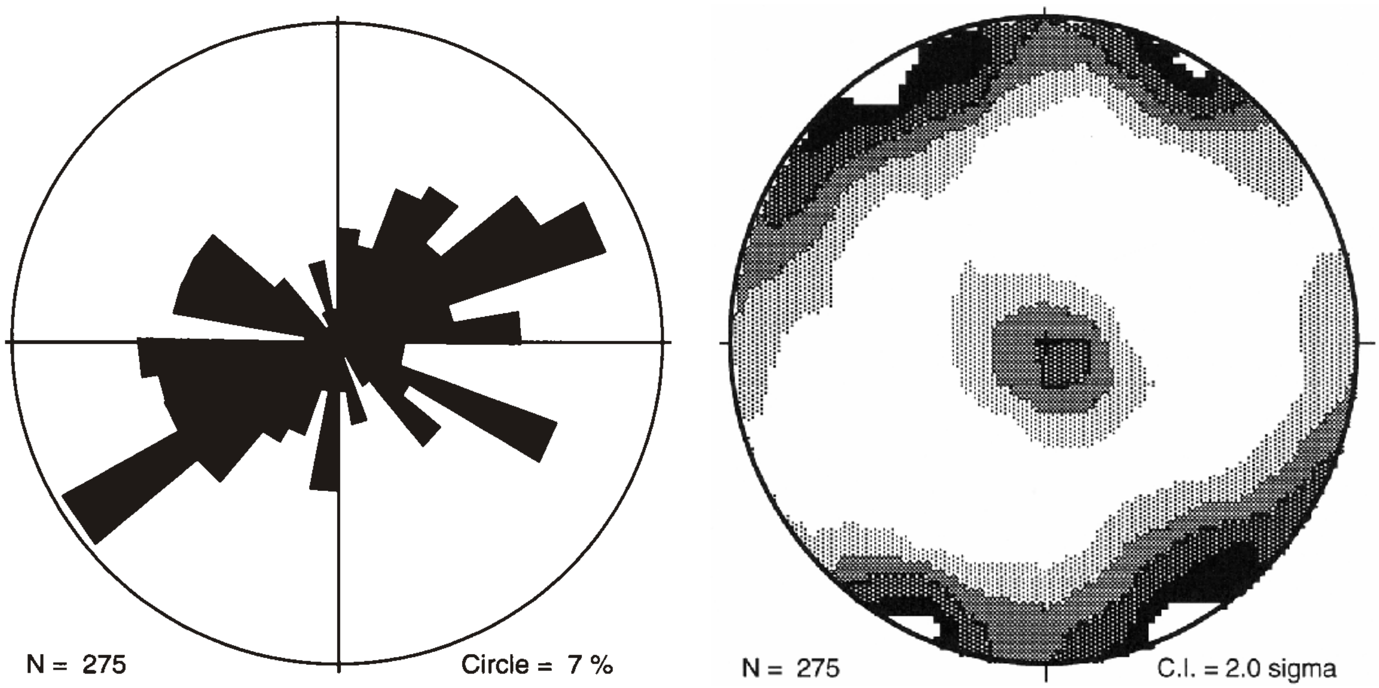

Figure 3. Orientation of joints (n=275) in the Gray 7.5-minute quadrangle: (a) rose diagram; (b) contoured pole plot.

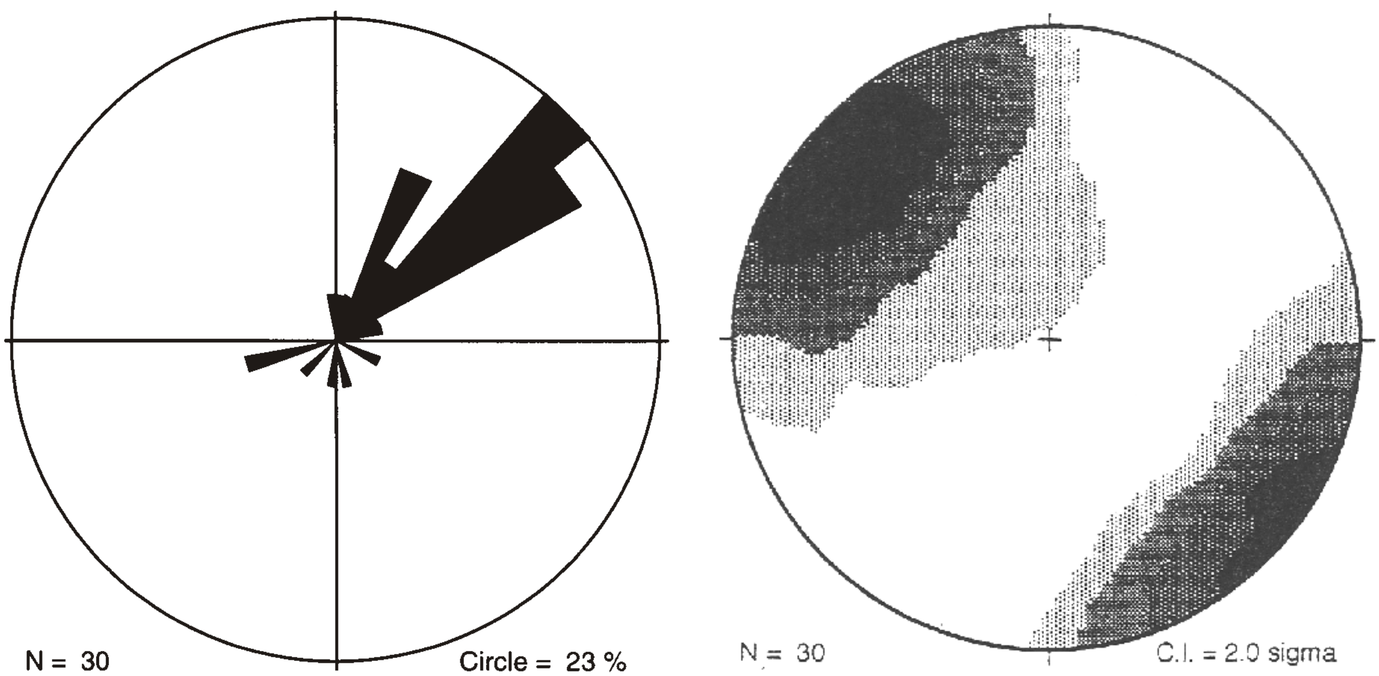

Figure 4. Orientation of all dikes and quartz veins in the Gray 7.5-minute quadrangle: (a) rose diagram; (b) contoured pole plot.

foliations dip gently southwest. This correlation may result from the granite intruding the metasediments in a sheet-like manner parallel to the foliation in the metasediments, imparting a foliation in the granite in the same general direction. Alternately, if metasediments melted in situ to produce the granites, the biotite may retain an orientation similar to that of the original and adjacent metasediments.

There appears to be a general, systematic change in the orientation of the foliation: in the northwest domain foliation dips gently to the northwest; in the southwest domain, foliation dips gently to the southwest; in the southeast domain, foliation dips gently to the southeast; and in the northeast domain, the foliation is essentially horizontal. This may represent a broad, regional antiformal fold within the metasediments contained within the granite with a northeast trend and gentle northeast plunge.

Dikes and veins generally strike northeast-southwest and dip steeply to the southeast or northwest, parallel to the major joints observed in the Gray quadrangle. This parallel orientation is evident in outcrops where both dikes and joints are present. This correlation results from the injection of dikes and veins along a preexisting joint structure. Sub-horizontal joints are also present and probably represent sheeting (expansion) joints developed during exhumation; orientation of dikes or veins does not coincide with sheeting orientations.

DISCUSSION OF THE BEDROCK GEOLOGY

Previous small-scale geologic maps that included the Gray quadrangle (Osberg and others, 1985; Hussey, 1985) have shown granite, assigned to the Sebago pluton, as the sole bedrock lithology present. The present, more detailed investigation confirms the extensive occurrence of granitoids throughout the quadrangle, recognizes several mineralogically distinct, mappable granite types, and recognizes the occurrence of metasedimentary rocks in the southeastern and extreme northeastern portions of the quadrangle. These findings are consistent with and an extension of units mapped in the Raymond 7.5-minute quadrangle to the west (Creasy, 1996) and the Poland 15-minute quadrangle to the north (Creasy, 1979). The Gray quadrangle is in the eastern portion of the Sebago pluton of Osberg and others (1985).

The boundary separating areas containing significant occurrences of metamorphic rocks from those containing few occurrences is indicated on the accompanying geologic map. This boundary may be of regional (pluton-scale) significance, but detailed mapping in the Cumberland Center and North Pownal 7.5-minute quadrangles is needed for proper evaluation. The inferred contacts for the granitoids in the map area cut across this boundary. That is, the map attempts to show the full extent of granitoid intrusions even where metasedimentary rocks may be dominant and where intrusion may be in the form of dikes or irregularly-shaped bodies.

The boundary has some significance in the distribution of minor, variant granitoids. For example, the garnet-biotite granite is distributed along this boundary where the biotite granite is in regional contact with the metasedimentary-rich area. The foliated biotite granite, which appears to be older than the muscovite-biotite granite, is also distributed in the southern part of the map area near the boundary.

That eastern and central parts of the Sebago pluton are complex and heterogeneous, and are spatially and genetically related to high-grade metamorphic rocks, has been previously documented by mapping (Creasy, 1979, 1996) and by other studies (Wise, 1995; Tomascak and others, in press; Hayward, 1989; Lathrop and others, 1994). In contrast, in the southwestern portion of the Sebago pluton, within the North Sebago, Steep Falls, and Sebago Lake 7.5-minute quadrangles (Creasy, in progress), the pluton consists of generally homogeneous medium-grained muscovite-biotite granite. These striking differences suggest caution in applying a single name (Sebago pluton) and implying a simple origin for all the rocks in these areas.

Behn's model thickness of the Sebago pluton, using the modified residual gravity anomaly, gives a thin (<.5 km), nearly horizontal eastern portion (including the Gray and Raymond 7.5-minute quadrangles) and a thicker (up to 2 km), sub-circular western portion (including the Sebago Lake and North Sebago 7.5-minute quadrangles) (Behn, 1996; Behn and others, 1996). This differs from previous models (Hodge and others, 1982; Carnese, 1983; Geoscience Services of Salem, 1986) that depict the pluton as a sheet-like body of relatively uniform thickness. Behn's model is attractive in explaining regional differences as a function of variable geometry of granitoids with respect to enclosing migmatite and metamorphic rocks and the erosion surface.

The regional pattern of foliation in the Gray quadrangle, as noted in the structural discussion, may reflect structural culminations and depressions developed during regional deformation and metamorphism that guided emplacement of the granitoids or may reflect deformation by emplacement of granitoids. The regionally homogeneous texture of the two-mica and biotite granites, the general lack of metamorphic xenoliths, and areal distribution support emplacement of the two-mica and biotite granites as a melt to form a pluton. In contrast, the abundance of associated metamorphic material, the presence of migmatite, the consistency of foliation of planar metamorphic fabric elements, and the heterogeneous texture of the muscovite-garnet granite and migmatite argue for an origin as an earlier, extensive, volatile-charged partial melting zone associated with regional high-grade metamorphism. The muscovite-garnet granite and migmatite unit is intruded by two-mica and biotite granites.

The northeast-striking orientation of Mesozoic basalt and trachyte dikes, coincident with the dominant joint orientation, is controlled by the regional extensional stresses during rifting of eastern North America in late Triassic-early Jurassic time (McHone and Butler, 1984).

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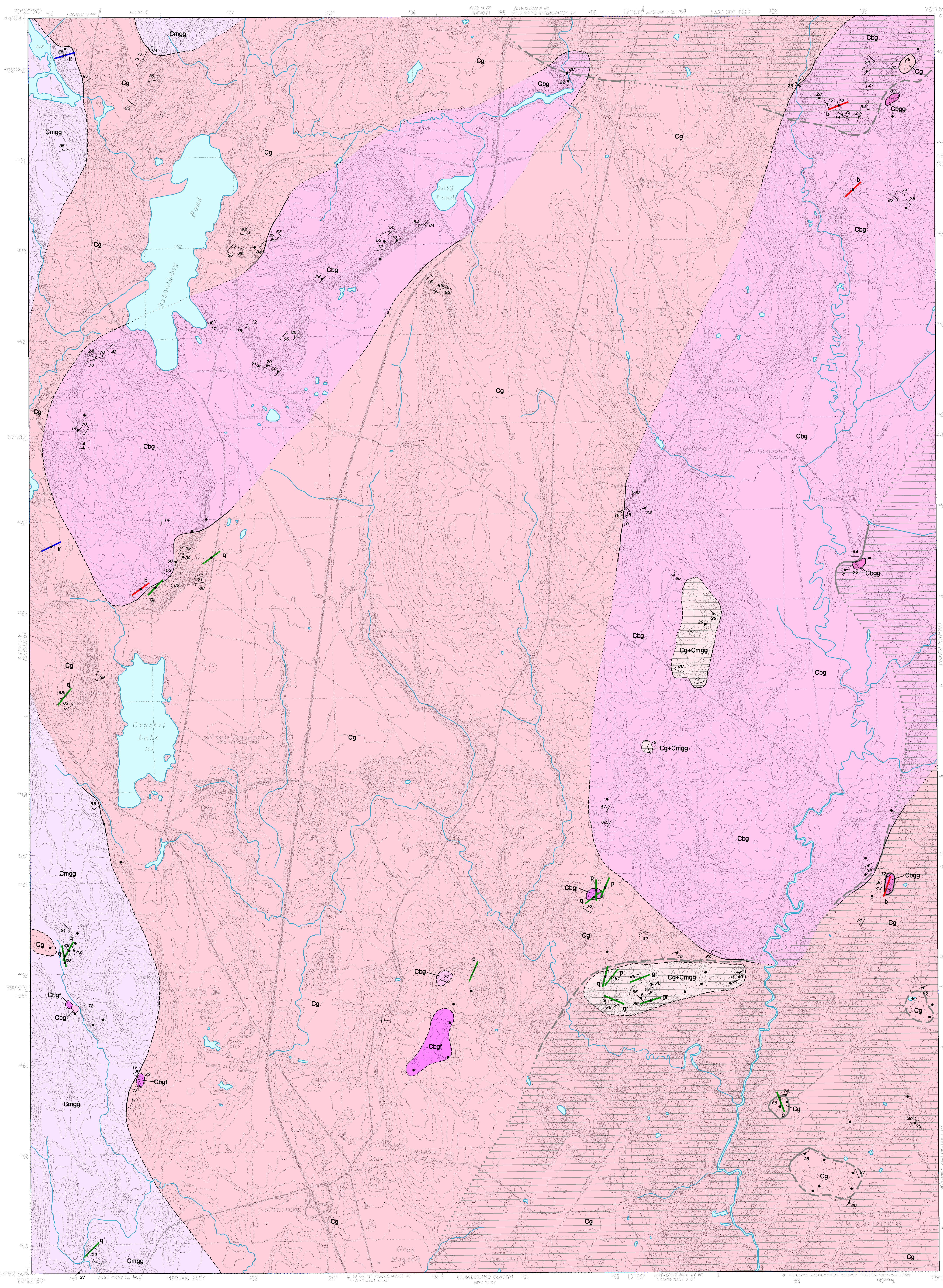

EXPLANATION OF UNITS

Intrusive Rocks

Mesozoic

Fine-grained dikes. (Dikes are too small to be shown as separate map units; symbol not to scale. Symbol is parallel to strike of the dike.)

b = Reddish-brown weathering, dark gray, basaltic dike.

tr = Light greenish-gray trachyte dike.

Carboniferous to Permian

Coarse-grained felsic dikes. p = Pegmatite dike, gr = Granitoid dike, q = Quartz vein. (Dikes are too small to be shown as separate map units; symbol not to scale. Symbol is parallel to strike of the dike.)

Carboniferous to Permian

Cbg — **Biotite granite.** Medium-grained biotite granite with or without accessory muscovite. Frequently associated with pegmatite dikes. Younger than muscovite-biotite granite (Cg).

Cbgg — **Garnet-bearing biotite granite.** Occurs locally within biotite granite near contacts with metasedimentary rocks.

Cg — **Muscovite-biotite granite.** White to pale pink, medium-grained, equigranular, muscovite-biotite granite. Locally pegmatitic. May be intruded by pegmatite dikes of similar mineralogic composition.

Cbgf — **Foliated biotite granite.** Medium grained. Foliation defined by parallel orientation of biotite flakes. Intruded by muscovite-biotite granite (Cg); younger (?) than muscovite-garnet granite (Cmgg).

Cmgg — **Muscovite-garnet granite.** Muscovite-garnet ± tourmaline ± biotite granite and migmatite. The granite is coarse-grained to pegmatitic; muscovite abundant; garnet inhomogeneously distributed and locally abundant; tourmaline and biotite present in pegmatitic zones. Includes leucocratic muscovite-garnet aplite within coarse-grained granite or pegmatite. The rock is heterogeneous within an outcrop, with gradational (centimeter-scale) contacts between aplite and pegmatite. Migmatite consists of muscovite-garnet ± tourmaline ± biotite granite with inclusions of biotite granofels and/or pelitic schist.

Cg + Cmgg — **Muscovite-garnet granite and muscovite-biotite granite.** Muscovite-garnet ± tourmaline ± biotite granite and migmatite intruded by muscovite-biotite granite.

Metamorphic and Intrusive Rocks

Area with metasedimentary rocks. Area with a significant proportion of metasedimentary rock. Includes muscovite-rich schist and gneiss; biotite-quartz-feldspar granofels and schist; and minor pinstriped quartzite; not differentiated on the map. Locally migmatitic. Compositional layering is common. Probably of Silurian or Ordovician age. All metasedimentary types are intruded by igneous rocks which comprise up to 50% of the outcrops. The letter symbol on the map indicates the igneous rock type. Map areas without this pattern contain little or no metamorphic rock.

EXPLANATION OF SYMBOLS

20 — Schistosity or foliation in metamorphic rock - inclined.

20 — Foliation in granitoid rock - inclined, vertical.

20 — Joint or planar brittle fracture - inclined, vertical.

• — Outcrop without structural data.

Intrusive contact.

Boundary separating igneous rock containing substantial amounts of metamorphic rock from igneous rock containing little or no metamorphic rock. This line may mark the boundary of the Sebago pluton in a regional sense (see report for discussion).

Lines on the map are solid where location is well constrained, dashed where location is reasonably inferred, and dotted where location is uncertain.

Bedrock Geology of the Gray Quadrangle, Maine

Bedrock geologic mapping by
John W. Creasy and Alexander C. Robinson

Digital cartography by:
Bennett J. Wilson, Jr.

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State Geologist

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Quadrangle Location

SCALE 1 : 24,000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

TRUE NORTH

SOURCES OF INFORMATION

Bedrock mapping by John W. Creasy and Alexander C. Robinson completed during the 1995 field season.

Topographic base from U.S. Geological Survey Gray quadrangle, scale 1:24,000 using standard U.S. Geological Survey topographic map symbols.

The use of industry, firm, or local government names on this map is for location purposes only and does not impute responsibility for any present or potential effects on the natural resources.