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Introduction

The Camden-Rockland area encompasses the Camden, Rockland, Thomaston, and West Rockport 7 1/2 minute quadrangles of the U. S. Geological Survey Atlas of Topographic Maps. Geological mapping in the Camden (Osberg), the Rockland (Guidotti), and the Thomaston (Guidotti) quadrangles is essentially complete, but work in the West Rockport quadrangle (Osberg) is still in progress.

Rocks of the Camden-Rockland area are in the east flank of the Orrington-Liberty anticlinorium and belong to an uplifted block bounded east and west by longitudinal faults (see Foreword, this volume).

A simplified geologic map of the Camden-Rockland area is presented in Figure 1. Three fault-bounded blocks are recognized, each with a separate stratigraphy. The relationships within each block are complicated by a complex structural and metamorphic history. A large granite pluton intrudes the stratified rocks at the south boundary of the map-area and smaller bodies of granite and pegmatite are common in high-grade metamorphic terrains.

Stratigraphy

Three stratigraphic sequences have been worked out within the Camden-Rockland area. These sequences are identified as the Benner Hill sequence, the Rockport sequence, and the Megunticook sequence. Within each sequence the stratigraphic order has been established on the basis of sparse graded beds. The stratigraphic sequences and lithologic descriptions are tabulated in Figure 1.

The ages of these rocks in the Camden-Rockland area are thought to be Lower Paleozoic or older. Unit 2 of the Benner Hill sequence contains highly deformed brachiopods that have been assigned to the Ordovician (Boucot et al., 1972). Thus, the upper part of the Benner Hill sequence is Lower Paleozoic. The lower stratigraphic units may be Lower Paleozoic or older.

Unit 3 of the Megunticook sequence is lithologically similar to Middle Ordovician rocks exposed at Danforth (Larrabee, 1963) or to Lower Ordovician rocks near St. Stephens, N.B. (Neuman, oral communication, 1969). If either of these correlations are correct, unit 3 is Ordovician. Because of the absence of stratigraphic breaks in the Megunticook sequence, units 1 and 2 are thought to be either lowest Ordovician or possibly Cambrian, but not Precambrian.

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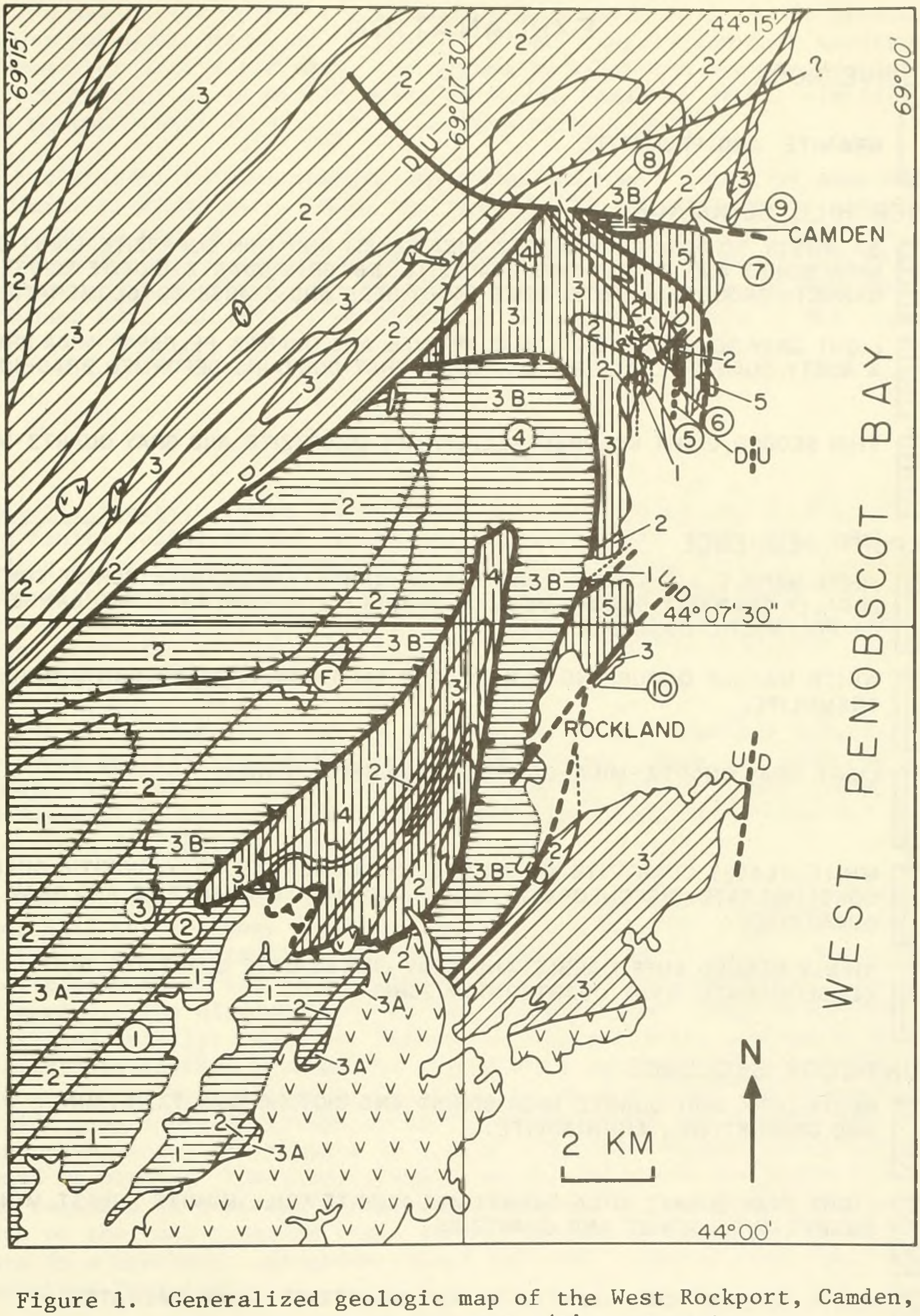

Figure 1. Generalized geologic map of the West Rockport, Camden, Thomaston, and Rockland 7 1/2' quadrangles.

EXPLANATION

INTRUSIVE ROCK

GRANITE AND PEGMATITE

BENNER HILL SEQUENCE

3A: RUSTY TO DARK GRAY QUARTZ-MICA SCHIST AND THIN QUARTZITE. LIGHT GRAY QUARTZ-MICA SCHIST AND FELDSPATHIC QUARTZITE. 3B: GRAY QUARTZ-BIOTITE SCHIST AND THIN GARNETIFEROUS QUARTZITE. SOME SANDY BEDS AND SPARSE CONGLOMERATE.

LIGHT GRAY SCHISTOSE BIOTITIC QUARTZITE AND QUARTZ FELDSPAR-MICA GRIT. CONTAINS A RUSTY QUARTZITE AT UPPER CONTACT THAT CONTAINS DEFORMED BRACHIOPODS.

THIN BEDDED, LIGHT COLORED FELDSPATHIC QUARTZITE AND GRAY QUARTZ-MICA SCHIST.

ROCKPORT SEQUENCE

WHITE MARBLE. LIGHT GRAY QUARTZ-MICA-GARNET-ANDALUSITE SCHIST CONTAINING LOCALLY COARSELY GRADED BEDS OF GRANULE CONGLOMERATE AND LARGE LENSES OF POLYMICTIC CONGLOMERATE.

WHITE MARBLE OCCURRING IN BEDS 4-12 CM. THICK, LOCALLY CONTAINING FINE GRAINED TREMOLITE.

LIGHT GRAY QUARTZ-MICA-GARNET-ANDALUSITE SCHIST.

WHITE, GLASSY QUARTZITE. QUARTZITE CONGLOMERATE. GRAY, BIOTITIC QUARTZITE AND CONGLOMERATE. DISCONFORMITY SEPARATES WHITE QUARTZITE AND GRAY BIOTITIC QUARTZITE.

THINLY BEDDED BUFF MARBLE AND GRAY LIMESILICATE QUARTZITE. BUFF LIMESTONE CONGLOMERATE. GRAY QUARTZ-MICA SCHIST.

MEGUNTICOOK SEQUENCE

RUSTY, DARK GRAY QUARTZ-MICA SCHIST AND BIOTITIC QUARTZITE. MINOR WHITE MARBLE AND GREENSTONE / AMPHIBOLITE.

LIGHT GRAY QUARTZ-MICA-GARNET-ANDALUSITE / SILLIMANITE SCHIST. MINOR RUSTY QUARTZ-MICA SCHIST AND QUARTZITE.

WHITE TO LIGHT GRAY QUARTZITE AND QUARTZITE CONGLOMERATE.

FORMATION CONTACT

THRUST FAULT

HIGH ANGLE FAULT

LINE SEPARATING PROGRADE AND RETROGRADE METAMORPHISM

(F) FOSSIL LOCALITY

(3) SCHEDULED STOPS

RKPT = TOWN OF ROCKPORT

The age of the Rockport sequence is more uncertain. It is presumed to be Lower Paleozoic or older because it is deformed by the same structural features that deform the other two sequences but which are cut by plutons that are thought to be Middle Devonian on the basis of lithic similarity to dated plutons (Faul et al., 1963; Zartman et al., 1970).

Lithic correlations between the three sequences cannot be made within the Camden-Rockland area. Both the Benner Hill and the Megunticook sequences contain units that have been assigned to the Ordovician, but the lithic aspects of these two units are different. They may represent different sedimentary facies within the same depositional basin, or, alternatively, the Benner Hill and associated Rockport sequences may bear a "Made in Africa" label.

Structural Geology

High-angle faults. Seven high-angle faults are delineated in Figure 1. These faults belong to two groups according to their ages. The east-trending fault through Camden, the northeast-trending fault that extends to the west edge of Figure 1, and the northeast-trending fault south of Rockland post-date the major folding but pre-date the prograde metamorphism and the intrusion of the large body of granite (Middle Devonian?) at the south edge of the map.

The other high-angle faults are younger. They commonly have silicified zones and slickensides associated with them. They are later than the major folding and the prograde metamorphism, and the fault at Owls Head (east of Rockland) cuts granitic intrusions (Middle Devonian?) and mafic dikes (Triassic?) as well.

The displacement on the older faults is such as to juxtapose the Benner Hill and Rockport sequences against the Megunticook sequence. Stratigraphic determinations within the Megunticook sequence constrain the displacement on the east-trending fault through Camden as is shown in Figure 1. The displacements on the other two early faults are not constrained locally. However, because of the possible continuity in stratigraphic section between the Megunticook sequence and the Silurian section of east-central Maine (see Foreword, this volume) and because of the wide geographic distribution of these sequences, the Benner Hill and Rockport sequences are thought to lie at a deeper tectonic level and are exposed as horsts. The displacements are so indicated on Figure 1. This model requires that a considerable component of right-lateral displacement exists on the east-trending fault through Camden and that the horst continues in a northeast direction toward Isleboro north of this fault (see Foreword and Trip A-6).

The displacements on the younger faults are constrained by the local stratigraphy.

Thrust faults. Two thrust faults have been mapped in the Camden-Rockland

area (Figure 1). One separates the Benner Hill sequence from the Rockport sequence, and the other divides the Rockport sequence into two parts. The thrust beneath the Benner Hill sequence is necessitated by the truncation of lithic units in both the Benner Hill and Rockport sequences along the trace of the fault. The thrust surface in a general way dips toward the west or south, but in detail is folded with northeast trends. An antiform produces a window into the Rockport sequence west of Rockland and a parallel, tight synform lies east of the window. This thrust surface is above the present erosion surface west of Rockport but again is truncated by the present surface of erosion to the north against the east-trending high-angle fault that passes through Camden.

The second thrust lies entirely within the Rockport sequence and is truncated by the thrust previously described. It places into contact unit 1 and unit 5, separating two sequences with opposite facing directions. Locally, its trace is marked by a pre-schistosity breccia. It is interpreted as a slide along the overturned limb of a recumbent anticline. The average dip of this thrust is thought to be toward the west or south, at a moderately steep angle although in detail it must be considerably contorted by later folding.

The thrust that lies entirely within the Rockport sequence is thought to be considerably older than that underlying the Benner Hill sequence. The thrust underlying the Benner Hill sequence truncates the thrust within the Rockport sequence, and it is later than the shistosity whereas the thrust within the Rockport sequence has an associated breccia that predates the schistosity.

Minor folds. Minor folds of the Camden-Rockland area have been assigned on the basis of interference characteristics and orientation to two episodes of deformation. The earliest folds deform only bedding and are moderately open to isoclinal and overturned to recumbent in style. Schistosity or segregation banding is parallel to their axial surfaces. Their plunges have a range of orientations.

Younger folds deform bedding, schistosity, segregation banding, and early folds. These folds have styles that are generally open, asymmetric, and overturned. A well developed cleavage parallels their axial surfaces and their plunges show a wide variation. Commonly their axial surfaces have fairly constant orientations, but analysis of them indicates on a regional scale that they are folded by still younger folds.

Although a third and younger set of folds can be shown to exist regionally, few minor folds can be related to them unambiguously.

Major folds. Major folds belong to three episodes of deformation - an early reclined folding, a folding of intermediate age with steeply dipping axial surfaces, and a still younger folding again with steeply dipping axial surfaces. Over much of the area the two younger sets of major folds have nearly parallel trends and cannot be separately distinguished.

An early reclined fold is delineated by the detailed stratigraphy

of unit 1 of the Rockport sequence (Fig. 1). The nose of this fold lies against the thrust fault from east of and to the northwest of Rockport. Units 1, 2, 3, and 4 of the Rockport sequence lie in its normal limb, and its inverted limb has been cut out along the thrust. This fold is thought to extend beneath the thrust sheet carrying the Benner Hill sequence, and it is present in the window west of Rockland where its axial trace is defined by unit 1 of the Rockport sequence. Units 2, 3, and 4 west of the axial trace are in the normal limb. This is corroborated in one of the pits of the Dragon Cement Company where unit 4 can be observed to overlie units 2 and 3. Unit 2 southeast of the axial trace is interpreted to be in the inverted limb.

A second reclined fold exposes unit 2 of the Megunticook sequence in the northwest part of the Camden-Rockland area, but the detailed geometry and structural relations have not yet been worked out for it.

Folds of intermediate age deform the normal limb of the early reclined fold in the vicinity of Rockport (Fig. 1). These folds have axial surfaces that dip steeply east and northeast. Their west limbs are nearly vertical and their east limbs dip gently. Plunges are generally toward the northwest. Minor folds associated with these folds have a right-handed sense on both limbs and are regarded as relics of the earlier reclined fold.

Folds in the Benner Hill sequence developed earlier than the underlying thrust and, therefore, are earlier than the folds that deform the thrust surface and are regarded as of intermediate age. These folds are overturned toward the east and have axial surfaces that strike northeast. Their plunges are also toward the northeast. The folds in the vicinity of the fossil locality indicated on Figure 1 may have an intermediate age as well.

The folds in the Rockport sequence that are exposed in the window through the Benner Hill sequence deform the early reclined fold. Their trends and styles are similar to those assigned to the intermediate folds and their geometry indicates that they were present before being overridden by the thrust. Consequently, they are assigned an intermediate age.

Other northeast-trending folds have orientations and styles consistent with the intermediate folds. The outcrop of unit 1 of the Megunticook sequence west of Camden (Fig. 1) delineates a large northeast plunging anticline. Unit 3 and the detailed stratigraphy within unit 2 delineate the same anticline to the northeast. The "canoe-shaped" outcrop of unit 3 of the Megunticook sequence west of Rockport is also consistent with the trend and style of the intermediate aged folds. Both of these structures are overturned toward the east and have northeast axial trends.

The youngest folds are unambiguously identified only in the vicinity of Rockport and in the Benner Hill thrust plate. The thrust surface beneath the Benner Hill sequence is folded into northeast trending antiforms and synforms that post-date the folds in the Benner Hill sequence. These youngest folds also deform rocks of the Rockport sequence in the vicinity of Rockport causing deflections in the attitudes of the axial surfaces of the intermediate aged folds and the early thrust. These folds, in general, are

more open than folds of intermediate age. Elsewhere the main effect of the youngest folding was to flatten preexisting folds of intermediate age.

Metamorphism

The rocks of the Camden-Rockland area have been recrystallized in a complex pattern suggesting the possibility of two different episodes of regional metamorphism. Southeast of the hatchured line in Figure 1 the rocks have abundant retrograde features, whereas to the northwest of this line, the metamorphic features are consistent with prograde recrystallization. Within the area of retrogradation a relict garnet and relict andalusite zone are recognized. The original metamorphic gradients increased toward the west and north. Within the area of progradation, a sillimanite and a K-spar + sillimanite zone are recognized. The gradients in this area increase toward the south and west.

Plutonic Rocks

The plutonic rocks of the Camden-Rockland area are of two ages. A few dikes of biotite granite, pegmatite, and gabbro have been folded by intermediate aged folds and the gabbroic dikes at least have been metamorphosed. Presumably the dikes of biotite granite and pegmatite have also been metamorphosed but the metamorphic effects are not apparent.

The large pluton of binary granite at the south edge of the map area (Fig. 1) is younger than the folding, early high-angle faulting, and prograde metamorphism, but earlier than the retrograde metamorphism. Smaller stocks, and dikes of binary granite and most pegmatites also have similar structural relationships. On the basis of lithic similarity to radiometrically dated plutons (Faul et al., 1963; Zartman et al, 1970) the younger igneous rocks are thought to have a Middle Devonian age.

Hornblende granite (not separately shown on map) at the south boundary of Figure 1 is of equivocal age. It occurs as inclusions in the binary granite, and therefore must be older than the binary granite. What these relationships mean in terms of the relative ages of the two granites is unclear.

Certain gabbroic and diabasic dikes have chilled margins and are younger than the retrograde metamorphic event. These may be as young as Triassic.

Geologic History

The Camden-Rockland area has undergone a complex series of events. Their sequence, as currently understood, is tabulated below:

1. Deposition of the Benner Hill, Rockport, and Megunticook sequences.
2. Early recumbent folding and the concomitant development of thrusts.
3. Intrusion of granite, pegmatite, and gabbroic dikes.
4. Development of folds with northeast trends.
5. Thrusting.
6. Further folding with northeast trends and flattening of earlier northeast folds.
7. Development of early high-angle faults.
8. Prograde metamorphism.
9. Intrusion of binary granite and associated dikes and pegamatites.
10. Second metamorphic event.
11. Intrusion of mafic dikes.
12. High-angle faulting.

References

Boucot, A.J., D. Brookins, W. Forbes, and C.V. Guidotti, 1972, Staurolite zone, Caradoc (Middle-Late Ordovician) age, Old World province brachiopods from Penobscot Bay, Maine: Geol. Soc. Amer. Bull., v. 83, p 1953-1960.

Faul, H., T.W. Stern, H.H. Thomas, and P.L.D. Elsmore, 1963, Ages of intrusion and metamorphism in the northern Appalachians: Am. Jour. Sci., v. 261, p 1-19.

Larrabee, D.M. and C.W. Spencer, 1963, Bedrock geology of the Danforth quadrangle, Maine: U.S. Geol. Survey GQ-221.

Zartman, R.E., P.M. Hurley, H.W. Krueger, and B.J. Giletti, 1970, A Permian disturbance of K-Ar radiometric ages in New England: its occurrence and cause: G.S.A. Bull. 81, 3359-3374.

Itinerary

Mileage

0 — Assembly point for trip is in the parking area at the Chamber-of-Commerce building, Rockland, Maine. Starting time 9:00 A.M. Drive west on Route 1 to Thomaston.

4.4 — Turn left on Wadsworth Street.

5.3 — Cross Saint George River.

8.0 — Stop 1. Park along highway. Walk through yard and approximately 950 feet along farm road.

Unit #1 of the Benner Hill Sequence. The exposure is light gray,

thinly layered quartz-feldspar granulite and quartz-feldspar-biotite schist. Dikes of early biotite granite cut the layered rocks and both layered rocks and dikes are deformed by intermediate folds. Small displacements and shears are common.

Return to cars promptly. Reverse direction and proceed north.

8.7 Turn left on side road.

9.0 Stop 2. Park along roadside. Outcrop is approximately 500 feet west in field.

Unit #2 of the Benner Hill Sequence. Small outcrop of light gray, thinly bedded quartz-feldspar-biotite granulite and quartz-mica schist. An isoclinal fold is interpreted to be an intermediate fold. A pervasive slip cleavage is parallel to the axial surface of the fold. The slip cleavage is difficult to distinguish from bedding except in the nose of the fold. Beds with sand-sized clasts may be observed in an adjacent outcrop. A north-trending late pegmatite dike cuts the structures of intermediate age.

Return to cars. Continue north on road.

9.7 Stop sign. Bear left across Route 97 onto poorly paved farm road.

10.1 Stop 3. Park in yard at farm house. Outcrop is approximately 270 feet west of house and north of road.

Unit #3A of Benner Hill sequence. Light gray to rusty thin bedded quartz-mica schist containing pseudomorphs of andalusite and incompletely altered staurolite. Interbeds are quartz-feldspar-biotite granulite, quartzite, and isolated, boudinage blocks of calcsilicate granulite. The calcsilicate granulite beds are zoned with selvages of actinolite and cores of quartz, plagioclase, and grossularite. The large synform displayed by bedding is thought to be an intermediate fold. A slip cleavage in the schist is approximately parallel to the axial surface of the fold. Some of the quartzose beds are displaced along shears that strike north and dip steeply.

Exposure to the east contains rusty to gray quartz-mica schist interbedded with thin quartzose beds. Pseudomorphs after andalusite are present in some of the schistose beds and garnet and biotite are present in some of the quartzose beds. Folds similar to those previously described are well displayed. In addition the bedding is complexly deformed by folds that predate those described above. These earlier folds may be "slump folds". The outcrop is cut by early greenstone dikes.

Return to cars and drive back to Route 97. At Route 97, turn left and drive north.

11.6 Turn right onto Route 1. Continue north on Route 1 through Thomaston.

14.8 Turn left onto Old County Road.

16.3 Quarries along road are in Unit 4 of the Rockport sequence.

18.8 Stop sign. Continue north on Old County Road across Maverick Street.

20.8 Stop sign. Rejoin Route 1 and drive north.

20.9 Turn left on South Street. Caution of traffic.

21.7 Bear right at fork in road.

22.3 Stop sign. Continue on South Street across Rockville Street.

22.8 Stop 4. Park along side of road.

Unit #3B of the Benner Hill sequence. Exposure shows medium gray quartz-biotite schist in beds 8" to 15" thick. Some beds contain pseudomorphs of andalusite and pits that suggest cordierite(?). Other beds have a sandy texture. Beds, 1/2" to 1" thick, of dark gray quartz-garnet granulite separate the schistose beds. Locally light colored amphibole also occurs in the quartzose beds. An open fold is delineated by the quartzose beds.

Ordovician brachopods have been found in a calcareous quartzite bed that occurs stratigraphically just below this unit in the northern part of the Thomaston quadrangle (see Fig. 1). Although these fossils have great potential for dating purposes, the separation by faults of the stratigraphic sequence that contains the fossils from other geologic sequences has thus far restricted their usefulness.

Return to cars and continue north on South Street.

23.6 Turn right on tar road.

25.0 Stop sign. Turn right onto Route 1.

25.1 Turn left onto Pascals Avenue.

25.2 Turn right onto School Street.

25.3 Turn left onto Spruce Street.

25.5 Turn left onto Sea Street.

25.6 Stop 5. Park behind white house and along street. Walk down gravel driveway and right onto grassy path. Outcrop is at end of path. Caution rocks are apt to be slippery!

Unit #2 of the Rockport sequence. White, glassy quartzite. Some beds contain quartzite clasts that are flattened in the surface of bedding. Small folds in bedding are intermediate structural features.

At cove to south, white, glassy quartzite and conglomerate overlie thinly bedded marble and calcsilicate quartzite of Unit #1. Minor folds at the contact have the wrong sense for the closure of the intermediate fold displayed in the cove. This exposure is interpreted to be in the normal limb of an intermediate aged anticline and the minor structures are relics of the early folding.

Return to cars. Reverse direction and proceed to north on Sea Street.

26.0 Turn right on Pascals Avenue. Continue through center of Rockport.

26.6 Bear right at triangle.

26.7 Turn right on Mechanic Street.

27.0 Continue onto dirt-road extension of Mechanic Street.

27.6 Stop 6. Park on dirt road. Walk to exposure on shore.

Unit #1 of the Rockport sequence. Eastern end of outcrop is buff weathered, light gray limestone-clast conglomerate with limestone matrix. Clasts are only slightly deformed. Western part of outcrop is interbedded marble and dark gray biotite quartzite containing limesilicate minerals. Folds with axial surfaces that vary in orientation from steep to nearly horizontal are thought to be early folds. The variation in orientation is due to folding about a younger fold axis (approximately 30° N.27°E.). Siliceous deposition along slip cleavage causes the slip cleavage to stand out in relief. The slip cleavage is parallel to the axial surfaces of intermediate folds. Small faults locally displace bedding.

Return to cars and continue east on Mechanic Street.

27.7 Turn left onto dirt road.

28.0 Turn left onto tarred road.

28.5 Stop sign. Turn right onto Chestnut Street.

29.2 Turn right onto Bayview Street.

29.8 Stop 7. Park along road. Outcrop is to north on shore. Proceed down driveway, west of house, and down steps. Please respect the property.

Unit #5 of the Rockport sequence. Exposure is light gray quartz-mica-garnet-andalusite schist. Much of the andalusite has been altered to muscovite. Andalusite is concentrated along gently northeast dipping surfaces that are interpreted as segregation banding formed along an older cleavage. Bedding is indicated by granule conglomerate grading to fine sand and pelite on the north side of outcrop. These grades suggest that stratigraphic tops are northeast. Lenses and stringers of garnet rich quartzite in the schist parallel the bedding. A late fold involving the granule conglomerate and sandstone can be seen at the top of the exposure.

Return to cars and continue along Bayview Street.

30.9 Stop sign in center of Camden. Turn right onto Route 1.

31.1 Turn left onto Route 52.

31.4 Turn right on Trim Street.

31.5 Turn left on Megunticook Street and proceed to end of street.

31.5 Stop 8. Park in parking space and walk up trail approximately 540 feet.

Unit #1 of the Megunticook sequence. Ledges of massive, glassy, white to light gray conglomeratic quartzite (Battie Formation). Clasts are quartzite or biotitic quartzite and are subrounded. They are little deformed except for some fracturing. The matrix is biotitic quartzite.

Return to cars. Reverse direction and drive east on Megunticook Street.

31.6 Turn right.

31.7 Turn left on Route 52.

32.0 Turn left on Route 1.

33.0 Turn right on Sherman Point Road.

33.7 Bear right.

33.8 Stop 9. Turn cars around and park along road. Follow driveway to shore and walk along shore to Northeast Point.

Exposures along shore are of units #2 and #3 of the Megunticook sequence. The contact between the two units is in the small cove and can be seen at low tide.

Unit #2 consists of light gray quartz-mica-garnet-andalusite schist. Commonly the andalusite is wholy or partly pseudo-

morphed by muscovite. The garnet occurs distributed throughout the rock and also as coticules. Locally beds of biotitic quartzite, as much as a foot thick, are intercalated with the schist.

Unit #3 consists of rusty, medium quartz-mica-sulfide schist, some beds of which contain pseudomorphs of andalusite. A thin unit of white marble occurs just above the base of the unit #3, and higher in the section biotitic quartzite beds become prominent. The folds in the marble are interpreted to belong to the intermediate episode of folding.

Return to cars and retrace route along Sherman Point Road.

34.6 Turn left onto Route 1. Continue on Route 1 through Camden, to Glen Cove.

41.7 Turn left onto Warrenton Street in Glen Cove.

42.3 Turn right.

42.9 Turn left onto Samoset Street and proceed to end of street.

43.5 Stop 10. Park cars in parking area. Do not block roadway. Follow path to shore and walk west along shore approximately 2000' to the second point.

Unit #3 (?) of the Megunticook sequence (?). Exposure of light gray to gray biotitic quartzite in beds 1/2" to 4" thick. A few beds contain limesilicates. Intercalated are quartz-feldspar-mica granulites that may represent metavolcanics. Also present is a prominant unit of white to gray marble. Bedding is deformed by broad, open folds the orientations of which are consistent with the intermediate generation of folds. A prominant slip cleavage is essentially parallel to the axial surfaces of these folds. The marble unit is deformed by an early recumbent fold that is overturned toward the east. This early fold is deformed by folds and cut by slip cleavage of the later deformation. Numerous small faults off-set the bedding. A basaltic dike intrudes the layered rocks and cross-cuts the slip cleavage belonging to the late deformation. The dike, however, is off-set by the small faults, thus, dating the small faults as considerably younger than the late stage of folding. Outcrops along the shore to the east of this exposure are dominantly gray, quartz-feldspar-biotite, amphibole schist containing clots of chlorite or biotite. This rock may represent a meta-andeside in unit #3. Other rock-types include biotitic quartzite and rusty, gray quartz-mica schist.

Return to cars and proceed to Orono.