1-1-1963

Geology of the southeast part of the Great Pond quadrangle, Maine

Jack McGregor

copy.

GEOLOGY OF THE SOUTHEAST PART OF THE GREAT POND QUADRANGLE, MAINE

by

Jack McGregor

November, 1963

OUTLINE

INTRODUCTION

The following is a report on a field investigation of the metamorphic rocks in the southeastern part of the Great Pond quadrangle, Maine. Field work covered a period of nine weeks during the summer of 1963. Previous work in the Ellsworth quadrangle, to the south, during the summers of 1960 and 1961 overlaps, and some information obtained from these investigations is included.

Metamorphic rocks are exposed in a belt from the south-central to the northeastern corner of the Great Pond quadrangle. Two granite masses boarder the metamorphic belt to the northwest and southeast. A gabbro mass is exposed from Parks Pond to Saddleback Mountain; the northeastern limit was not determined.

Based on lithologic similarities the metamorphic rocks are correlated with the Charlotte Group exposed in New Brunswick, Canada, and in the Calais-Robbinston area of Maine. Based on lithologic differences three major groups of rocks are recognized in the Great Pond quadrangle; these will be referred to here as the lower, middle, and upper parts of the Charlotte Group. The lower part is exposed north of Amherst; the middle and upper parts are exposed south of Amherst.

PREVIOUS WORK

The Charlotte Group was named from exposures in Charlotte County, New Brunswick, Canada (Alcock, 1946-a). The slates and impure quartzites,

constituting the Charlotte Group in New Brunswick, were first described by Matthews (1878).

Detailed studies of the Charlotte Group have been confined to Charlotte County, and to the Calais and Robbinston quadrangles, Maine. Alcock (1946, a and b) published two preliminary maps with descriptive texts covering parts of southwestern Charlotte County where abundant exposures of the Charlotte Group exist. Alcock (1946-a) recognized two divisions of the Charlotte Group, a "pale argillite division" overlain by a younger "dark argillite division". Amos (1958) studied the Charlotte Group in the Calais and Robbinston quadrangles. He recognized and retained the two divisions of the Charlotte Group identified by Alcock. He describes the "pale argillite division" as containing light-colored quartzites and schistose quartzites which grade upward into dark-colored schistose quartzites and mica schists belonging to the "dark argillite division". Calcareous quartzites and mica schists exposed in the north part of the Ellsworth quadrangle and in the southeastern part of the Great Pond quadrangle closely resemble the rocks described by him as belonging to the "dark argillite division", referred to here as the upper part of the Charlotte Group. The middle part of the Charlotte Group apparently correlates with the "light argillite division", but the lower part was not recognized by Amos (1958).

PETROGRAPHY

General.

Argillites, impure quartzites, and mica schists are the dominant lithologies. Calcareous quartzites are sporadically distributed throughout. Impure limestone layers are rare. Intermediate lithologies such as schistose quartzites are common.

The lower part of the Charlotte Group is predominantly calcareous quartzite interbedded with argillite. The middle part is predominantly impure quartzite beds ranging up to several feet in thickness separated by argillite layers a few inches thick. The upper part is prediminantly mica schist with interbedded calcareous quartzite.

Argillite.

Megascopically the argillites are dark gray to black, very fine-grained non-calcareous rocks. Bedding is difficult to recognize where interbedded quartzite is absent.

The texture suggests that the rock was a siltstone or very fine-grained argillaceous sandstone prior to low grade metamorphism.

Calcareous quartzite and impure quartzite.

Outcrops of calcareous quartzite, which have escaped contact metamorphism, occur in the Morrison Knoll area of the Ellsworth quadrangle; upper part of the Charlotte Group. Megascopically this is a light-buff, very fine-grained, massive, calcareous quartzite. Beds from one to two feet thick are separated by thinner schist layers. The calcareous quartzites have the texture and structure of a quartzite, but they are low in quartz.

Microscopically the calcareous quartzite contains predominantly calcite, quartz, plagioclase, and muscovite; magnetite, pyrite, and traces of chlorite, sphene, and zircon constitute the accessories. An estimated mode is: 45 per cent calcite, 25 per cent quartz, 20 per cent albite (An_8), 5 per cent muscovite, and 5 per cent remaining minerals. The rock is well sorted and massive, and mineral types are uniformly distributed. The average grain size is about 0.1 mm.

Equant, sub-angular, well sorted quartz grains averaging 0.2 mm in size are surrounded by a matrix averaging less than 0.1 mm. Occasional grains of

finer quartz occur in the matrix. Twinned, anhedral, calcite grains range in size from less than 0.05 to 0.2 mm and average about 0.1 mm. One refractive index is above and one below balsam, typical of pure $CaCO_3$. Albite (An_8) occurs as twinned anhedral grains ranging in size from 0.05 to 0.2 mm. Muscovite inclusions and an altered appearance characterize the grains. Muscovite flakes 0.2 mm across are scattered throughout the rock. Very fine muscovite in plagioclase and in the matrix is less than 0.05 mm across. Magnetite and pyrite occur as anhedral, irregular grains, less than 0.1 mm across, scattered throughout the rock. Pleochroic brown chlorite is localized in a few patches less than 0.2 mm across, flakes within the patches are very fine-grained. Equant granules of sphene and zircon, less than 0.1 mm across are rare.

Exposures of color-banded impure quartzite on Tannery Hill, in the Ellsworth quadrangle, consist of light gray-green layers alternating with dark lavender layers, contacts are often slightly disturbed producing a lenticular character. These rocks have probably been slightly contact metamorphosed and belong to the middle part of the Charlotte Group.

Microscopically the texture is similar to the calcareous quartzite exposed a Morrison Knoll and described above. The mineralogical composition differs from the calcareous quartzite in that calcite is absent, biotite is common in the matrix of the dark lavender layers, and epidote is common in the light gray-green layers. Quartz and plagioclase are more abundant and constitute the greater part of the rock volume.

The quartzites were originally very fine-grained calcareous and non-calcareous sandstones containing varying amounts of argillaceous material. Apparently the argillaceous material varied in composition accounting for the color-banded character.

Mica schist.

Megascopically the mica schists in the upper part of the Charlotte Group are very fine-grained and either silver-gray phyllitic, or black mica schists. The darker schist is more abundant.

Microscopically muscovite is dominant, quartz is an important minor constituent. Magnetite and pyrite are the usual opaque minerals. Limonite staining is present along microscopic fractures. Traces of biotite and unidentified feldspar are sporadically distributed.

The average grain size is less than 0.05 mm and detailed information on individual mineral types is difficult to obtain. Microscopic layers of lepidoblastically arranged muscovite are separated by massive quartz-muscovite layers. Muscovite often constitutes the greater part of a thin section with only a few tiny lenses and layers of quartz. Quartz lenses up to 0.4 by 2.0 mm contain equant, anhedral, interlocked quartz grains averaging 0.1-0.2 mm in size. Rare biotite flakes, slightly larger than muscovite or quartz, are randomly oriented to the lepidoblastic texture. Pyrite is common as tiny granules less than 0.1 mm in size. Magnetite, about 0.1 mm in size, is concentrated in patches and is often partially altered to an opaque mineral, probably limonite. Magnetite-pyrite knots up to 1.0 cm across contain grains less than 0.1 mm in size. Finely disseminated pyrite is the coloring agent that darkens the black, mica schist.

Granite of Lucerne and granite of Eastbrook.

The two granite masses delimiting the investigated area on the west and east, the granite of Lucerne and the granite of Eastbrook respectively, are similar. Neither granite was studied in detail, a single thin section from each granite was available for study, and the following description includes both granites.

Megascopically these are very coarse-grained, gray to salmon colored,

porphyritic, biotite and/or hornblende granites with euhedral K-feldspar megacrysts ranging up to one and a half inches across. Plagioclase occurs as euhedral crystals usually less than one inch across. Subhedral biotite and hornblende, and anhedral quartz grains average less than one-fourth inch in size. The megacrysts are usually abundant with the matrix constituting as little as ten per cent of the volume. Generally the structure is massive, but where the tabular megacrysts are closely packed, a poorly developed foliation is present. Within the granite of Lucerne, due west of Ellsworth, the number of K-feldspar megacrysts is at a minimum. Specimens were observed with K-feldspar megacrysts spaced up to two inches apart. This variety of granite was also observed a few hundred yards south of Spring Brook Pond in the Great Pond quadrangle near the contact with the metamorphic rocks. Not all exposures of the granite near the contact display this type of granite. Generally the matrix is finer-grained than in the usual granite of Lucerne.

In the thin sections K-feldspar, plagioclase, qua rtz, and biotite are the principal minerals. Zircon, apatite, and sphene are the important accessories.

K-feldspar megacrysts are seen to be perthite. Vein perthite is most common. Plagioclase crystals are twinned and distinctly zoned. The shells of one zoned crystal terminate against other crystals of the rock. The zoned crystal seems to be the corner and about a quarter part of a larger zoned crystal . Cores of the plagioclase grains are sericitized.

Biotite flakes contain abundant zircon inclusions. Zircon also occurs as granules throughout the rock; one zoned crystal 0.2 mm across, euhedral, and square was noted.

Apatite as euhedral prisms and anhedral granules is less than 0.1 mm in size. Quartz is interstitial and shows undulatory extinction.

The foliation and bedding of the metamorphic rocks is clearly discordant to the granite. A steep contact between the granite of Lucerne and the metamorphic rocks is suggested in the few available exposures of the contact and by the straight contact trace. The contact trace of the granite of Eastbrook is more irregular, and the contact may not be as uniformly steep. The granite of Eastbrook contains numerous inclusions of country rock near the contact; many are up to several feet wide.

Along the contact west of highway 181 in the Great Pond quadrangle the granite of Lucerne locally follows the N. 20° E. trend of the bedding for several feet in several exposures. A steeply dipping joint set strikes N. 40° W. and also serves as a contact surface. A zig-zag contact trace is visible on top of several of the peaks along this contact.

Both granites are only slightly chilled against the metamorphic rocks. K-feldspar megacrysts up to 1" across were observed in contact with the country rock; the matrix was medium- to coarse-grained.

Gabbro.

The gabbro exposed in the southwest part of the Great Pond quadrangle is a dark colored, medium-grained, biotite gabbro. Locally euhedral plagioclase crystals range up to $\frac{1}{4}$" across and the rock is porphyritic.

METAMORPHISM

The mineral assemblage of the calcareous quartzite exposed at Morrison Knoll, Ellsworth quadrangle, (calcite, quartz, plagioclase, muscovite, and traces of chlorite) suggests that the rocks of the upper part of the Charlotte Group belong to the quartz-albite-muscovite-chlorite subfacies of the greenschist facies of regional metamorphism. A lower grade of metamorphism

is indicated for the lower and middle parts of the Charlotte Group by the abundant argillite.

Contact metamorphic aureoles around the granites exceed one mile in width. The mica schists and quartzites in the upper part display distinct changes for over one mile from the granites. The rocks in the middle and lower part are relatively unaffected even at close proximity to the granites.

The mica schists in the upper part become porphyroblastic with abundant cordierite and minor andalusite porphyroblasts. Microscopically cordierite and andalusite are visible in the quartzites of the upper part. Biotite has developed in both lithologies. A dark rust-brown color characterizes the contact metamorphosed rocks of the upper part. The contact metamorphic facies represented is the albite-epidote hornfels facies.

STRUCTURE

Distinct bedding is the most obvious structural feature. Bedding plane schistosity is common in the upper part of the Charlotte Group. A fracture cleavage and small minor folds are common throughout. Graded bedding is rarely megascopically visible but is probably common on a microscopic scale. Faint textural variations across some argillite beds suggest this possibility of graded bedding on a microscopic scale. Faults constitute the remaining significant structural feature.

The bedding consists of alternating quartzite and argillite or mica schist layers. The layers rarely exceed four feet in thickness. Most exposures show alternating quartzite and argillite or mica schist layers less than a few inches in thickness. The bedding strikes in a north-northeast direction and dips are rarely less than 80°; both southeast and northwest.

Graded bedding suggests that tops are toward the southeast. Considerable work on a microscopic scale with oriented specimens must be done before tops are determined more accurately.

The fracture cleavage dips steeply and always strikes about 20° to the north of the bedding trend. Where the bedding dips southeastward the fracture cleavage dips more steeply. Where the bedding is vertical or dipping toward the northwest the fracture cleavage dips at a lower angle toward the northwest. The difference in dip is generally less than 10°.

Minor folds less than a few inches in amplitude are generally right-handed with their axial planes parallel to the fracture cleavage. The plunge is usually steep. These may have developed during a nearly horizontal slip parallel to the fracture cleavage planes with the northwest side moving northeast relative to the southeast side.

Graded bedding in a coarse-grained quartzite is visible along the west side of the road at the junction of routes numbered 180 and 181 in the Ellsworth quadrangle. Tops are indicated to be toward the southeast.

REFERENCES

Alcock, F. J., 1946-a, Preliminary Map of Saint Stephen, New Brunswick, Geol. Sur. Paper 46-2, Geol. Sur. Canada.

Alcock, F. J., 1946-b, Preliminary Map of Honeydale, New Brunswick, Geol. Sur. Paper 46-3, Geol. Sur. Canada.

Amos, D. H., 1958, The Calais and Robbinston Quadrangles, Maine, unpublished Ph. D. thesis, Univ. Ill.

Matthews, G. F., 1878, Report on the Slate Formations of the Northern Part of Charlotte Co., New Brunswick, Geol. Sur. Prog. Rpt., 1876-1877, Geol. Sur. Canada.


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF MAINE
PUBLIC UTILITIES COMMISSION
GREAT POND QUADRANGLE
MAINE
15 MINUTE SERIES (TOPOGRAPHIC)
LEGEND
85 DIP AND STRIKE OF BEDDING
VERTICAL BEDDING
INFERRED CONTACTS
A = VERY COARSE-GRAINED BIOTITE AND/OR HORNBLENDE PORPHYRITIC GRANITE.
B = MEDIUM-GRAINED BIOTITE GABBRO.
C = CORDIERITE PORPHYROBLASTIC MICA SCHIST AND DARK FINE-GRAINED QUARTZITE.
D = LIGHT GRAY-GREEN AND DARK VERY FINE-GRAINED QUARTZITE. BLACK ARGILLITE IN THIN LAYERS
E = BLACK ARGILLITE AND DARK VERY FINE-GRAINED CALCAREOUS QUARTZITE.
Ignore three digit numbers!
Great Pond
PLANTATION NO 33
GREENFIELD
T 32 MD
AMHERST
AURORA
MARIAVILLE
OSBORN
CLIFTON
OTIS
Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography by planetable surveys 1928-1929. Culture revised 1957
Polyconic projection. 1927 North American datum
10,000-foot grid based on Maine coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 19, shown in blue
SCALE 1:62500
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
APPROXIMATE MEAN DECLINATION, 1957
FOR SALE BY U. S. GEOLOGICAL SURVEY, WASHINGTON 25, D. C.
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
ROAD CLASSIFICATION
Medium-duty
Light-duty
Unimproved dirt
State Route
QUADRANGLE LOCATION
GREAT POND, MAINE
N4445—W6815/15
1957