CANADA
DEPARTMENT
OF
MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PRELIMINARY SERIES

LEGEND

PALAEOZOIC

PENNSYLVANIAN

12 CLIFTON FORMATION; grey sandstone, grey-green siltstone; minor olive-green and red shale.

11 BATHURST FORMATION; red conglomerate and grit, at base; red sandstone, siltstone, shale

DEVONIAN (?)

10 Pink, coarse- to medium-grained biotite granite, granodiorite, granite porphyry; 10a, gneissic granite to quartz diorite

9 Diabasic gabbro, diorite; sills and dykes; 9a, serpentinite

SILURIAN
MIDDLE SILURIAN
CHALEUR BAY GROUP (6-8)

8 Limy slate, subgreywacke, limestone; minor basalt

7 Volcanic rocks; minor interbedded sedimentary rocks: 7a, mainly basalt, some trachyte; 7b, mainly trachyte

6 Sedimentary rocks: 6a, green and red conglomerate; 6b, limy shale, slate, greywacke

ORDOVICIAN
MIDDLE ORDOVICIAN
TETAGOUCHE GROUP (1-5)

5 Grey, black, green, and red slate, greywacke, conglomerate; graphitic schist; minor limestone, basic volcanic rocks

4 Basic volcanic rocks; interbedded slate, graphitic schist, iron-formation; 4a, basic tuff, in places occurs with unit 1

3 Quartz-feldspar porphyry; minor layers of rhyolite, chlorite quartzite and chlorite schist

2 Acid to intermediate lava and tuff; derived quartz-sericite schist; 2a, locally abundant agglomerate and breccia with elongated fragments; minor sedimentary and porphyritic layers

1 Metasedimentary rocks: feldspathic quartzite, quartz-chlorite and quartz-sericite schist; interbedded slate

Contact metamorphic aureoles around bodies of 10; biotite hornfels, quartz-biotite gneiss . . . A
Drift-covered area
Geological boundary (defined, approximate, assumed)
Limit of geological mapping
Bedding (horizontal, inclined, vertical, overturned)
Bedding (upper side of bed faces as indicated, direction of dip unknown)
Schistosity, cleavage (inclined, vertical, dip unknown)
Fault (assumed)
Anticlinal axis (assumed)
Synclinal axis (assumed)
Glacial striae (direction of ice movement known, unknown)
Esker
Fossil locality . . . Ⓕ
Open pit
Mineral prospect or occurrence . . . × Cu
Shaft

MINERAL SYMBOLS

Antimony	Sb	Lead	Pb
Arsenic	As	Manganese	Mn
Copper	Cu	Molybdenum	Mo
Gold	Au	Silver	Ag
Iron	Fe	Zinc	Zn

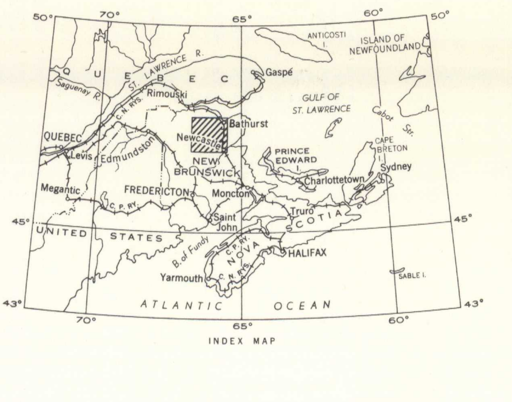
Geology by E. W. Shaw (1935), R. Skinner (1949-54), J. D. McAlary (1950), I. C. Brown (1954), C. H. Stockwell (1955-56), Charles H. Smith (1955-56), F. D. Anderson (1956), K. R. Dawson (1956), Geological Survey of Canada; A. L. McAllister, J. Smith (1955-56), New Brunswick Department of Lands and Mines. Geological compilation by Charles H. Smith.

Main highway
Other roads
Power line
County boundary
Parish boundary
Indian Reserve boundary
Intermittent stream

Approximate magnetic declination, 24° 06' West

Cartography by the Geological Cartography Unit 1957

Air photographs covering this map area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario



DESCRIPTIVE NOTES

The map-area lies in the northern part of a belt of deformed early Palaeozoic sedimentary and volcanic rocks, cut by granite batholiths, that extends southwesterly from Bathurst to the Maine border.

The rocks of the district are divisible into three structural units.

1. Pre-Silurian sedimentary and volcanic beds that have undergone intense dynamic metamorphism form the core of the area.
2. Less deformed Silurian and Devonian strata that overlie these unconformably on the north.
3. Flat-lying Carboniferous rocks that lie unconformably on 1 and 2.

The pre-Silurian rocks are subdivided on a lithological and, partly, on a structural basis. The only dated fossil locality in this group is near the mouth of the Tetagouche River, north of Bathurst, where graptolites of Middle Ordovician age are found in argillaceous rocks (5).

Metasedimentary rocks (1) cover a wide area in the south and southwest parts of the map-area. They underlie the siliceous volcanic rocks (2) along the Northwest Miramichi River south of South Little River Lake. They also underlie, and are interlayered with quartz-feldspar porphyry (3) south and north of Little Bald Mountain. Some areas mapped as unit 1, such as the Heath Steele ore-bearing horizons, may be metamorphosed equivalents of unit 5.

The siliceous volcanic rocks (2) are grey to white weathering, blue, green, or buff aphanitic rocks. These rocks are generally schistose. In thin section they are seen to be composed of ragged feldspar phenocrysts with or without embayed, brecciated quartz phenocrysts, in a fine, schistose groundmass of quartz, feldspar, chlorite, and sericite. In many places it is difficult to determine whether the schistose acid rocks are sheared flows or tuffs. In some places the phenocrysts in the above rocks are particularly large and abundant and there the rock is mapped as part of the quartz-feldspar porphyry unit (3).

Quartz-feldspar porphyry (3) has assumed great importance in the district because of its spatial relation to ore deposits. Porphyritic rocks behave locally as normal stratigraphic units, but on a regional scale they occur in various stratigraphic positions, either above, below, or interbedded with, the main body of volcanic rocks (2) and for this reason they cannot be directly correlated throughout the district. More than one rock type is called 'porphyry' locally. The type that is represented by most of unit 3 is a close associate of unit 2. It is a light grey rock with quartz and/or feldspar phenocrysts up to 1/2 inch long in a microcrystalline or schistose matrix of quartz, feldspar, sericite, and chlorite. As the size and abundance of phenocrysts decrease it grades into 'porphyritic rhyolite'; both rocks having much the same origin. East of California Lake in particular a large porphyry belt passes southward into an area of porphyritic acid volcanic rocks. This type of porphyry forms conformable layers in the volcanic rocks, and probably occurs as shallow sills and flows both derived from the same magma. They are folded with the volcanic rocks and are considered to be contemporaneous with them.

A second type of porphyry forms dykes that cut across the Ordovician and Silurian rocks, e.g. at Nigadoo Mines, Limited. It is younger and less common than the normal pre-Silurian quartz-feldspar porphyry, and is possibly related to the granite intrusions. A third rock type that resembles porphyry in places is actually an arkose, or tuffaceous rock. Such rocks are found, for example, in the belt of porphyry containing the Heath Steele and Brunswick No. 12 (Anacon) ore deposits. In outcrop they resemble a sheared igneous porphyry with quartz and feldspar grains standing out in relief, but differ from a true porphyry in having a fine-grained rather than microcrystalline groundmass and occasional rock fragments. In thin section the clastic origin is apparent for the quartz and feldspar grains are angular in contrast to the normal subhedral and embayed phenocrysts of the true porphyry. A fourth rock type, possibly rather rare resembles a porphyry. It contains blue quartz eyes in a groundmass of sedimentary origin. There is uncertainty as to whether the eyes are of primary sedimentary, or metasomatic derivation.

Basic volcanic rocks (4) overlie and are interlayered with the acid volcanic rocks (2). They are brown weathering, dark green, schistose, fine-grained to aphanitic rocks with rare megascopic structures, such as pillows and amygdules. They consist entirely of secondary mafic minerals, calcite, and magnetite. Layers of red and graphitic slate are probably numerous but these soft rocks rarely outcrop in interstream areas. Layers of jasper and magnetite-bearing chert occur with the volcanic rocks and cause high magnetic anomalies.

The upper sedimentary unit of the Tetagouche group (5) consists chiefly of argillaceous rocks. The slates have a well-developed cleavage and are crumpled, and in places contain secondary quartz veins and disseminated pyrite. Electromagnetic surveys show that thin graphite layers are common. Basic volcanic rocks (4) are interlayered with members of this unit, but only the larger are shown on the map. Lithologically similar rocks also occur interlayered or infolded with the acid volcanic complex (2, 3).

The sedimentary rocks of the Chaleur Bay group are predominantly fossiliferous, greenish grey limy slates and greywacke. They are divided into two map units (6 and 8) separated by a volcanic unit 7, although the older (6) is largely interbedded with the volcanic rocks. The lower unit contains a distinctive green conglomerate member (6a). The volcanic rocks vary from dark red or greenish grey, fine-grained basalt (7a) to dark red, orange or grey trachyte (7b). Alcock (1941) considered these rocks to be of early Devonian age on the basis of fossils collected north of the area. The only diagnostic fossils collected within the area are trilobites and brachiopods from Gambol Brook west of the Tetagouche Lakes, and these are considered to be of middle Silurian age. As these fossils occur in the upper sedimentary unit (8) the entire group is assigned to the middle Silurian, although infolded Devonian beds may be present.

The basic sills and dykes (9) are grey or green, medium-grained rocks with a diabasic fabric, and are composed of clinopyroxene, altered plagioclase, secondary ferromagnesian minerals, and magnetite. A distinctive petrologic type is found near the Fraser Lumber Company road northeast of Goodwin Lake and also west of Popple Depot. It is banded and contains olivine. It resembles the basic to ultrabasic rocks found near St. Stephen in southern New Brunswick and carries nickel-bearing sulphides. Small bodies of serpentinite (9a) occur along the Rocky Book-Millstream 'break' south of the Nicholas Denys granite body. The basic intrusions cut both the pre-Silurian and Silurian rocks. They are most abundant near areas of basic volcanic rocks and, because of this association, there may thus be basic dykes of two ages -- some related to the Ordovician basic volcanism and some related to Silurian-Devonian basic volcanism. In the absence of good field evidence they can be difficult to distinguish from the more altered flows. The principal criteria are the coarser grain size, ophitic texture, and massive appearance.

The granitic rocks (10) occur as two distinct types. Gneissic varities (10a) found near South Little River Lake and Sevogle River were emplaced during deformation of the area; massive varieties, which occur in stocks near Bathurst, Nicholas Denys, and south of Popple Depot, cut across the folded rocks of the area and were emplaced after the major period of deformation. The latter cuts middle Silurian rocks and is overlain unconformably by Pennsylvanian conglomerate.

Many of the biotite granite bodies are surrounded by a distinctive thermal metamorphic aureole (A) characterized by the development of biotite in both sedimentary and volcanic host rocks. Contact metamorphic effects may extend to as far as a mile or more from the nearest granite outcrop. Near the granite the sedimentary rocks are altered to a fine-grained, rusty weathering, purplish biotite hornfels carrying cordierite and andalusite. In places, quartz-biotite gneiss is formed. The quartz-feldspar porphyry (3), west of Little Bald mountain, is altered to a gneissic biotite-quartz-feldspar rock resembling a granite gneiss.

Nearly flat-lying beds of Pennsylvanian age (11, 12) unconformably overlie the granite and older rocks along the east boundary of the area, and form small outliers near Tetagouche Lakes, north of Bathurst, and on Clearwater Stream. The Clifton formation is conformable with the Bathurst formation, but is dominantly grey in colour. It contains detrital plant remains and thin coal seams.

The structural pattern of the pre-Silurian rocks may be separated into two distinct units by a line running north-northwesterly from North Little River Lake. Northeast of this line, the dominant structures are two major anticlinoria, one south of the Tetagouche Lakes and the other west of the Bathurst granite body, separated by a synclinorium south of California Lake. These are complex folds with steep plunges to the southwest and northeast, but are interpreted as plunging regionally to the northeast. In the Tetagouche group rocks west of Bathurst these major folds are lost in a series of smaller anticlines and synclines. The acid volcanic rocks in the cores of the anticlinoria are strongly schistose. The schistosity parallels the limbs of the folds, but cuts across the nose of the fold south of California Lake. Along the major structural axis extending north-northwesterly from North Little River Lake, north-northwesterly trending cleavage is well developed, in places cutting and in other places parallel with the bedding. The belts of rock extending from the northeast are deflected to the southeast near the axis. The zone of shearing along this axis may mark the presence of a major fault zone but it is rather diffuse and cannot be traced continuously across the district. North-northwesterly trending faults parallel this zone to the west. In the southwestern part of the area the rocks are also folded along northeasterly axes, with plunges to the northeast or southwest, but these folds do not appear to be counterparts of those on the other side of the structural axis. Horizontal cleavage is more common in this area, and may reflect recumbent folding or thrust faulting. These structures are cut off to the west by large granite intrusions and by the Devonian rocks that overlap the Ordovician rocks west of Popple Depot. On the north, the Rocky Brook-Millstream 'break' separates the complex from the Silurian rocks. These are not as intensely folded as the older rocks, but the folds have the same northeast plunge.

In the pre-Silurian rocks, large zinc-lead-copper replacement deposits occur in sedimentary beds surrounding or included in the acid volcanic-porphyry complex. These deposits are found at different stratigraphic horizons throughout the district. The larger deposits discovered to date, such as the Brunswick Nos. 6 and 12, Heath Steele, Middle River, etc., occur with sedimentary beds and porphyry, and this association has been used successfully as a prospecting guide. Sulphide minerals are later than the porphyry, and it is probable that the prophyry bodies acted as competent members among the incompetent sedimentary beds and that ore-bearing solutions took advantage of the channels so formed. Numerous small fracture-filling and replacement deposits containing copper, lead, and zinc are found along or near the Rocky Book-Millstream 'break' in places remote from any porphyry, and in places in the younger Silurian rocks.

Two distinct mineral associations are found in the replacement deposits -- an earlier (?) pyrrhotite-chalcopyrite type, commonly associated with dark green, massive, chlorite wall-rock alteration and a later (?) pyrite-galena-sphalerite type. The deposits are in places deeply weathered, and pieces of gossan or abnormal rust colours in the soil may be the only visible surface expression. Iron leached from sulphide minerals has cemented glacial till and stream gravel near certain deposits and may be a guide in prospecting.

Aeromagnetic maps are available for the entire district (see below) and are invaluable for structural studies. The magnetic background of the district is about 3,200 to 3,300 gammas, over areas of sedimentary and acid volcanic rocks. Basic volcanic rocks and dykes cause anomalies up to 3,500 gammas. Linear anomalies between 3,800 and 6,000 gammas coincide with magnetite-bearing sedimentary rocks (iron-formation, ferruginous cherts), which are generally associated with basic volcanic rocks. Pyrrhotite-chalcopyrite deposits are of economic importance in the district, but cause aeromagnetic anomalies in the order of a few tens of gammas only, which are generally masked by higher anomalies caused by variations in magnetite content unrelated to economic mineralization. Small aeromagnetic closures when associated with electromagnetic or geochemical anomalies may, however, be indicative of these deposits.

Additional References

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MAP 1-1957
BATHURST-NEWCASTLE AREA
NORTHUMBERLAND, RESTIGOUCHE, AND GLOUCESTER COUNTIES
NEW BRUNSWICK

Scale: One Inch to Two Miles = $\frac{1}{126,720}$

Miles 2 1 0 2 4 6

MAP 1-1957
BATHURST-NEWCASTLE AREA
NEW BRUNSWICK