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DEPARTMENT OF ENERGY, MINES AND RESOURCES

GEOLOGICAL SURVEY OF CANADA

COPPER OCCURRENCES IN LOWER CARBONIFEROUS SEDIMENTARY ROCKS OF THE MARITIME PROVINCES

BY

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CONTENTS

ABSTRACT

The occurrence of trace amounts of copper mineralization at the contact of the basal Windsor limestone and an underlying clastic unit, commonly the Horton Group, was reported as early as 1884. During the summers of 1973 and 1974, the author visited many of the Lower Carboniferous outcrops in the Maritime Provinces in an effort to outline the lateral and vertical distribution of base-metal sulphides about the Windsor-Horton, or equivalent, contact. This open file is the basic documentation arising from the field work. It provides the location, access, and a short description of all Lower Carboniferous outcrops visited by the author. Although the outcrops contain only minor amounts of base-metals; zones of chalcocite, chalcopyrite, galena, pyrite, and iron and manganese oxides could be delineated.

COPPER OCCURRENCE IN LOWER CARBONIFEROUS SEDIMENTARY ROCKS OF THE ATLANTIC PROVINCES

INTRODUCTION

In 1973 a program was initiated to study the distribution of copper in basal Windsor limestone and immediately underlying clastic rocks, mostly the Horton Group (Binney and Kirkham, 1974, 1975). These Lower Carboniferous sedimentary strata were chosen for study because copper minerals had been noted along their contact at several localities by previous workers, including Fletcher (1884), Williams (1914), Smith (1956) and Oldale (1967), and because Kirkham (1971) thought the mineralization might be similar to that found in the Kupferschiefer of Europe. The 1973 field program dealt with Carboniferous sedimentary basins in Cape Breton Island and northern mainland Nova Scotia, whereas, the 1974 program dealt with Carboniferous sedimentary basins in New Brunswick and Newfoundland as well as Nova Scotia.

The occurrences and outcrop localities described in this open file are those visited by the author in the course of his field work during the summers of 1973 and 1974. The main purpose of this report is to describe the localities and give their detailed location so that other workers interested in examining these outcrops will not have to go through the effort that the author and many previous workers have to locate the exposures. As most of the outcrops are located on private land, care should be taken to obtain the permission of the landowners before visiting the occurrences.

As more drilling is carried out by mineral exploration companies detailed stratigraphic and mineralogical information will become available in some areas of poor surface outcrop not covered in this report. Chemical, petrographic, and mineralogical analysis of samples is continuing at this time (May, 1975) in an effort to determine metal, mineral and environmental associations governing the distribution of base-metal sulphides.

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to many geologists, companies and the governments of New Brunswick and Nova Scotia who made this study possible with their open information and advice on outcrop locations and access, and permission to log and sample drill core. Special thanks are due to Dallas Davis, Mark Connell, and John Hamilton (N.B. Dept. of Mines), Danny Murray and Frank Shea (N.S. Dept. of Mines), Steve Forgeron (Kaiser Celestite Mining Ltd.), Pat Hannon and Mary-Clare Ward (Imperial Oil), Avard Hudgins (Cuvier Mines), Bruce MacDonald (AMAX), Chris Morrissey (Northgate), 'Nick' Oldale (N.S. Technical Institute), Al Sangster (St. Joe), and Bob Shewman (Rio Tinto).

Valuable information and ideas on Lower Carboniferous stratigraphy and outcrop locations were also provided by Dr. D.G. Benson, Dr. W.H. Poole and Dr. M.J. Copeland of the Geological Survey of Canada. Dr. R.V. Kirkham of the Geological Survey of Canada provided information and moral support at all stages of this project and read the final manuscript.

The many farmers and landowners the author came in contact with were also extremely helpful in locating specific showings, filling in historical details and generally dispensing 'down home' hospitality.

REGIONAL GEOLOGY

The primary concern of this study is the contact of the Windsor Group and an underlying clastic unit, usually the Horton Group (Table 1).

The Windsor Group for the most part consists of red shale and siltstone, gypsum, anhydrite, salt, and minor limestone and dolomite. Bell (1929) designated five subzones (A to E) of the Windsor Group based on the fossil assemblages found in the limestone units. Although thin, some of the limestone beds can be correlated on lithological and paleontological grounds throughout the Carboniferous basins. The A_1 limestone (also referred to as the Macumber, sandy laminated or basal limestone) is the oldest marine carbonate unit in the Windsor Group, and in many areas forms the base of the Group. It is a dark grey, sandy, laminated, fine-grained limestone, usually unfossiliferous (see Schenck, 1969) and commonly containing fine-grained sulphides erratically disseminated along the laminae.

The Windsor Group is usually underlain by a thick section of continental red conglomerate, sandstone and siltstone. These Middle Devonian to Lower Carboniferous clastic rocks (Hacquebard, 1971) are generally part of the Horton Group in Nova Scotia, the Moncton Group in New Brunswick, and the Anguille Group in Newfoundland. The various formations and groups are

TABLE 1. SUBDIVISIONS OF THE HORTON AND ANGUILLE GROUPS, (after Kelley, 1970, p. 289).

Rock-stratigraphic unit		Lithology	Thickness (feet)
		NEW BRUNSWICK (Moncton Basin)	
Moncton Formation	Hillsborough Member	Red sandstone and conglomerate; basal ash bed?	±2,900
	Weldon Member	Red siltstone, shale, sandstone, and conglomerate	±5,000
Albert Formation		Dark grey, in part bituminous, shale and sandstone; oil shale; some limestone and salt	±5,500
Memramcook Formation		Red shale, sandstone, and conglomerate	±7,000
		CAPE BRETON ISLAND (Antigonish–Mabou Basin)	
Strathlorne–Ainslie Formation	Ainslie Member	Red and grey sandstone, siltstone, conglomerate; minor limestone and intraformational conglomerate	340–1,820
	Strathlorne Member	Grey sandstone, siltstone, shale; minor limestone	75–1,690
Craignish Formation		Grey arkosic sandstone and conglomerate, red siltstone, sandstone, and conglomerate; minor grey siltstone and sandstone	±65–8,000
Fisset Brook Formation		Andesite and minor rhyolitic rocks; red siltstone; minor conglomerate, and sandstone	800–1,500
		WESTERN NEWFOUNDLAND (St. George's Basin)	
Seacliffs Formation		Grey massive, feldspathic sandstone; grey thinly bedded, siltstone and shale; red and grey arkose; red siltstone	±1,700–4,000
Snakes Bight Formation		Thinly laminated, black, fine-grained argillaceous siltstone and dense, grey sandstone	±1,500
Cape John Formation		Grey siltstone, sandstone, and conglomerate; red siltstone	>1,500

outlined in table 1. At some locations the Windsor Group rests directly on Pre-Carboniferous basement rocks with only a thin (0 to 10 feet) clastic unit over the basement.

Copper mineralization occurs at the contact of the A_1 Windsor limestone and the underlying clastic unit, either in the clastic rocks and/or in the basal limestone. Lead and zinc sulphides occur in some outcrops, either at the limestone-conglomerate contact, or within the limestone.

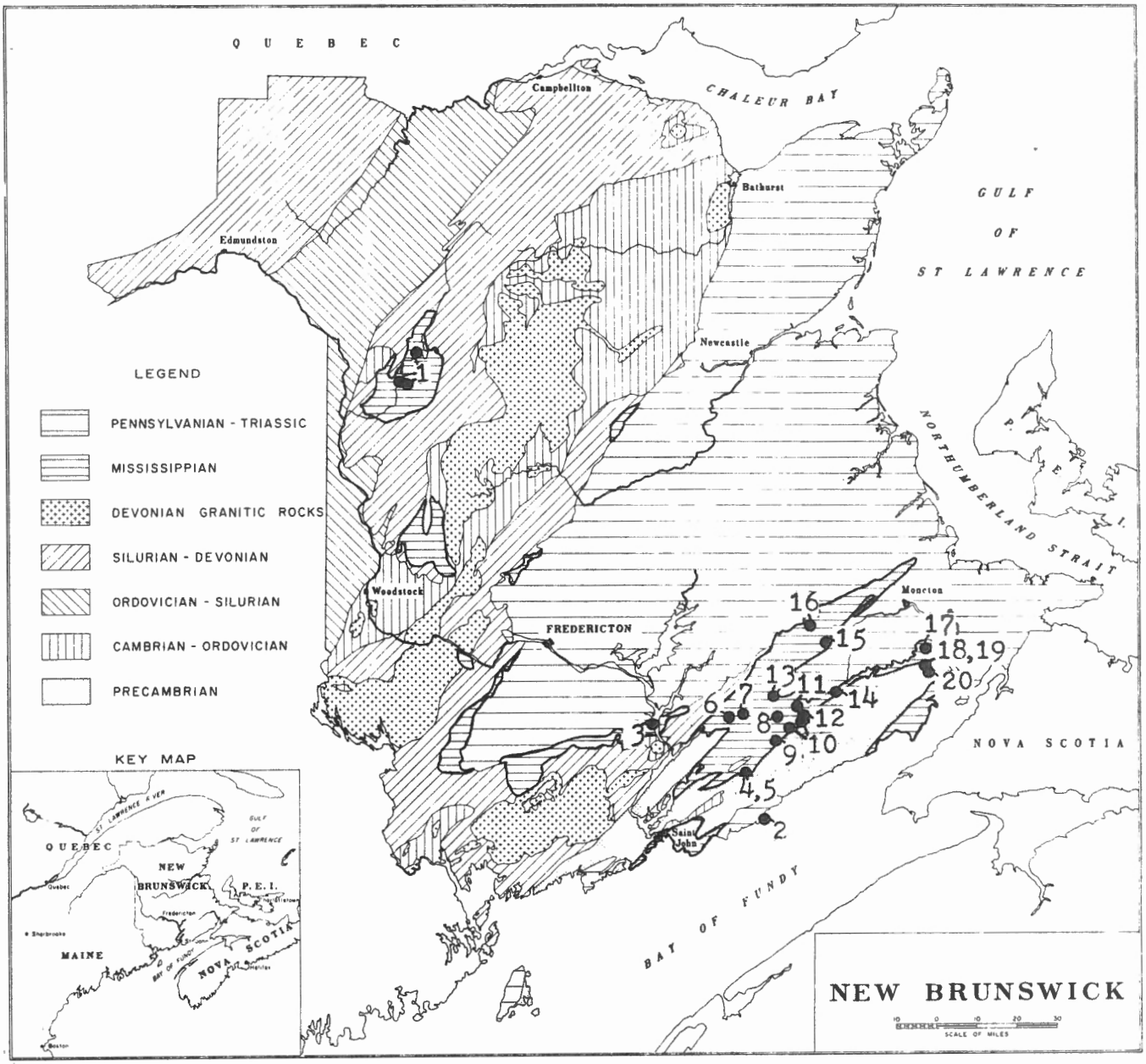

Figure 1. Location Map for New Brunswick.

1) NEW BRUNSWICK

INTRODUCTION

The Windsor limestones in New Brunswick tend to be recrystallized, white to red in colour, and contain little organic or sulphide material. Laminated, dark grey limestone, similar to the A_1 of Nova Scotia, outcrops at Upham on the Hammond River, however, at this location no copper mineralization was observed. Malachite occurs in the Moncton conglomerate (Horton equivalent) in the Hillsborough - Albert Mines area and at Goshen. At the former location, the malachite is near the contact of the conglomerate with an overlying bed of light grey, partially recrystallized, Windsor limestone. However, at Goshen, the mineralization is within the conglomerate, an unknown distance below the Windsor limestone. Figure 1 shows the localities examined in New Brunswick.

KEY TO LOCATIONS IN NEW BRUNSWICK

1 - Plaster Rock, N.B.

1A - Oxbow Lake

lat. 47°00'10" long. 67°19'21"

1B - Plaster Rock Station

lat. 46°53'21" long. 67°23'42"

1C - Wapske

lat. 46°53'44" long. 67°22'29"

Three locations were visited in the Plaster Rock area of New Brunswick (figure 2).

Oxbow Lake is located about 10 miles north of Plaster Rock. The lake is to the north of the house opposite the gasoline station at Oxbow Lake. On the south shore of the lake there is an old lime quarry and crusher site. The original pits are overgrown, but blocks of mottled red and green, massive, crystalline limestone can be found along the shore.

About 0.25 miles southeast along the CN railway from Plaster Rock Station, 3 feet of green, massive, crystalline, limestone overlies red, coarse, quartz sandstone. The limestone is recrystallized and appears 'lumpy' which may indicate a stromatolitic origin. Minor green mottling occurs in the clastic unit, however, there is no continuous green zone beneath the limestone. Although parts of the limestone are iron-stained, no sulphide minerals were observed.

In a roadcut, just north of the town of Wapske, there is a good exposure of interbedded gypsum and red and green shale of the Windsor Group.

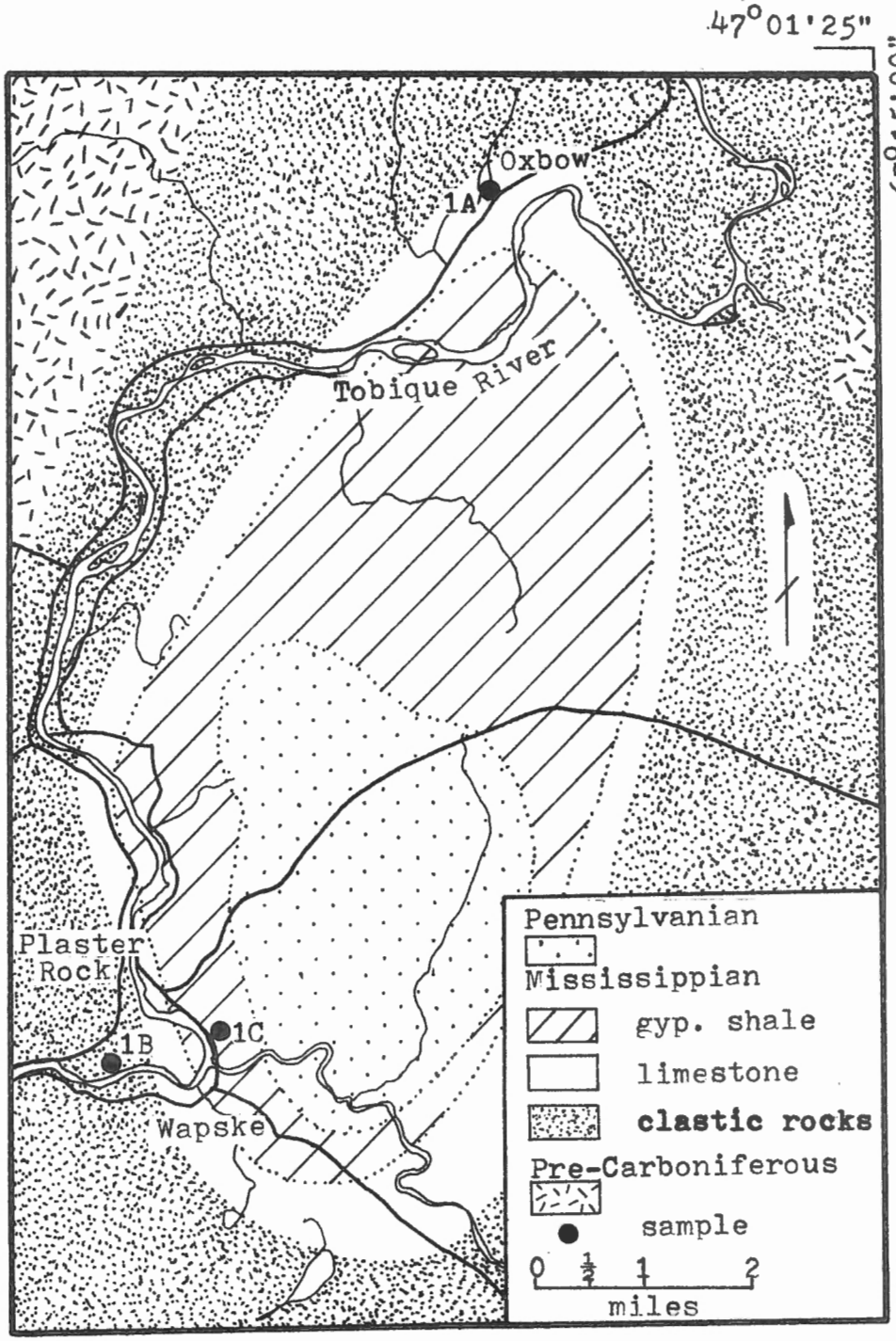

Figure 2.
Geology of the Plaster Rock area, N.B.
(from Hamilton, 1965).

2 - Quaco Head, N.B.

lat. 45°16'34" long. 65°30'45"

Outcrops of Windsor limestone occur on the beach north of Quaco Head (figure 3). They are reached by an old road and trail that branches off the lighthouse road. It is possible to descend the sea cliffs and examine the outcrops at low tide.

Massive, fine-grained, crystalline, red and white Windsor limestone unconformably overlies Pre-Carboniferous volcanic basement rocks in the beach outcrops. Only 100 feet of limestone is exposed and then there is a fault contact with red conglomerate of Pennsylvanian age. The limestone does not appear to correlate with the A_1 of Nova Scotia, but is similar to the limestone at Havelock and other New Brunswick locations.

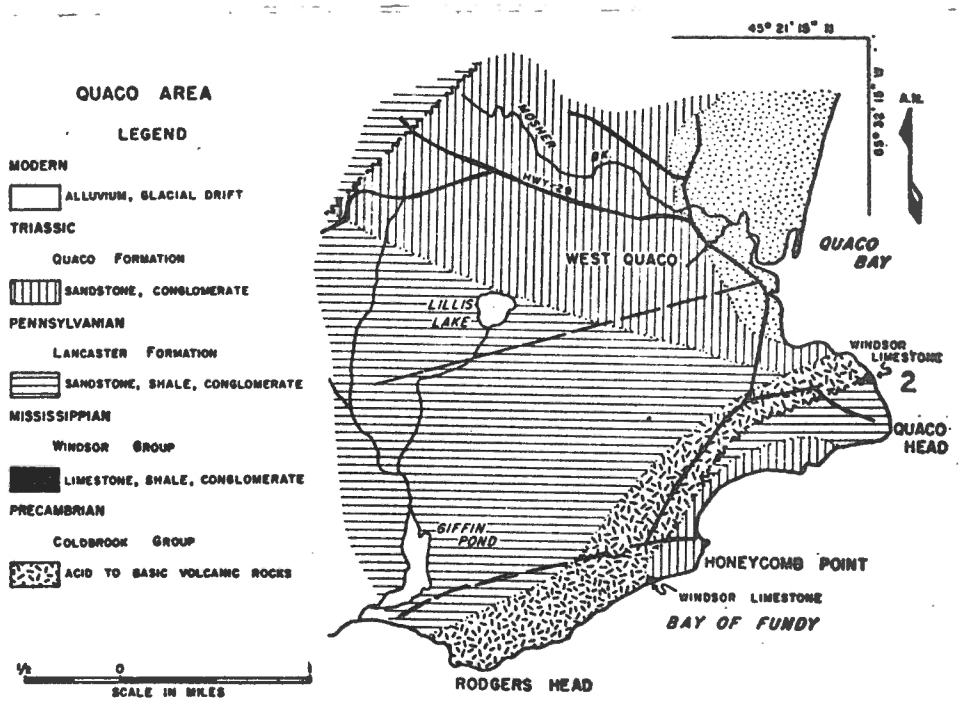

Figure 3.
Geology of the Quaco area, N.B.
(from Hamilton, 1965)

3 - Queenstown, N.B.

lat. 45°40'42" long. 66°06'00"

Eight-tenth mile south of Queenstown, on the west side of the St. John River, Windsor limestone overlies rhyolitic tuff of the Moncton Group. The outcrops occur in a railway cut and in a series of pits between the railway and the river.

The limestone is massive, grey to red tinted, and crystalline, similar to other New Brunswick occurrences. It conformably overlies light pink, feldspathic rhyolitic tuff. No sulphide minerals were visible in either rock unit.

At one time, the limestone was quarried by a St. John company for use as ornamental stone and terrazo chips. The old pits are overgrown and there has been no quarrying for some time.

4 - Upham, N.B. - town

lat. 45°29'17" long. 65°39'53"

Windsor limestone interfingers with sandstone and abruply abutts igneous basement rock on the south bank of the Hammond River at Upham. The outcrop can be reached by parking at the church and walking south to an abandoned railway line. The Hammond River is crossed by a suspension bridge on the railway right-of-way, the outcrops occurring about 100 feet downstream from the bridge, on the south bank of the river (figure 4).

At the west end of the outcrop granitic basement rock (Germaine Granite) is exposed. These rocks abutt an undetermined thickness of feldspathic sandstone which contains a few large boulders of basement rock. This clastic unit grades upward and laterally into a limy sandstone which might be equivalent to the basal Windsor limestone. In most parts of the exposed section about 50% of the 'limestone' is composed of sand and small pebbles. It is suggested that this outcrop represents an extreme marginal position in the basin, and that clastic sedimentation from the highland areas was continuous throughout limestone deposition.

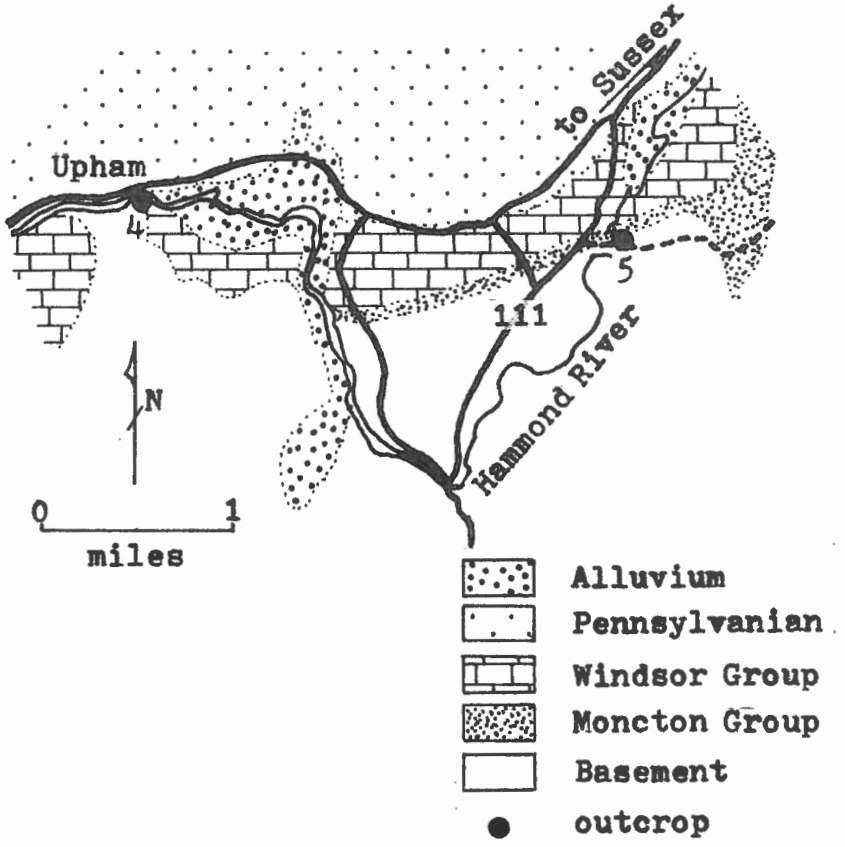

Figure 4.
GEOLOGY OF THE UPHAM AREA, N.B.

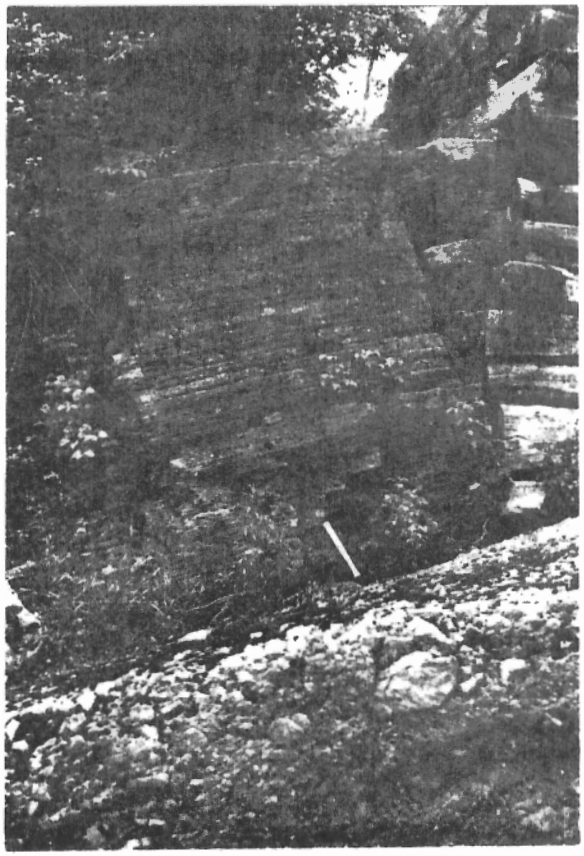

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Figure 5. Laminated Windsor limestone overlying Moncton conglomerate on the Hammond River at Upham, N.B.

5 - Upham, N.B. - Hammond River Bridge

lat. 45°29'10" long. 65°36'57"

Six-tenths of a mile south of the Upham turnoff, on highway 111, there is a small wood road branching to the east. Where this road crosses the Hammond River there is an excellent outcrop of Windsor limestone and Moncton conglomerate (figure 4) beneath a covered bridge.

At the base of the stratigraphic section there is 20 to 30 feet of red pebble to boulder conglomerate. The conglomerate is somewhat lighter in colour in the upper 1 to 2 feet but no green mottling was observed. Seven feet of medium to dark grey, laminated micritic limestone conformably overlies the red conglomerate (figure 5). This limestone is very similar to the A_1 limestone of northern Nova Scotia, the only observable differences being that it contains less carbonaceous matter and there is no visible copper mineralization at the basal contact with the underlying clastic rocks. Trace amounts of pyrite were observed in the upper part of the limestone.

6 - Case, N.B.

lat. 45°42'15" long. 65°41'27"

Along a small stream 2.8 miles east-north-east of Case there are intermittent exposures of the complete Windsor Group, as well as the underlying Moncton Group and the overlying Hopewell Group (figure 6).

Red matrix pebble conglomerate of the Moncton Group outcrops 150 feet downstream from the road bridge. This conglomerate has a coarse sandy matrix and contains subangular to subround, elongate clasts, averaging 1 to 2 inches in length. There is no green conglomerate beneath the limestone, instead, the red conglomerate grades into the limestone over 0.5 feet of section with conglomerate clasts in a carbonate matrix. A massive, crystalline, grey to red limestone forms the base of the Windsor Group. It is overlain by a series of massive, micritic to crystalline, red to grey limestones. No gypsum or anhydrite is observed. One to five percent pyrite occurs in a thin-bedded grey limestone which outcrops about 35 feet above the base of the section (figure 6). Red sandstone and conglomerate of the Hopewell Group occurs near the road bridge.

The thin section of Windsor limestone with similar conglomerates both above and below indicate that this locality was probably very close to the margin of the Windsor basin.

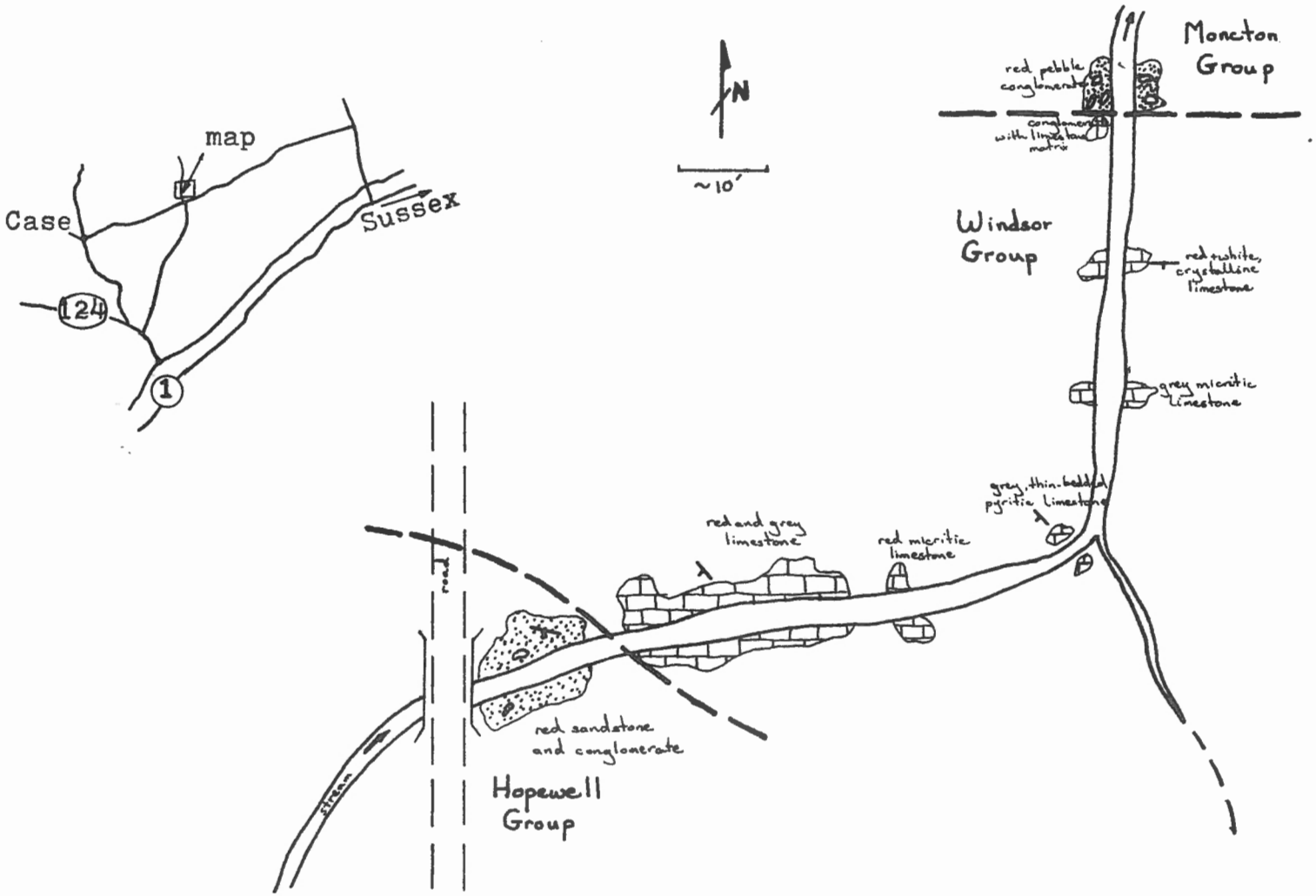

Figure 6. SKETCH MAP OF THE OUTCROPS NEAR CASE, N.B.

7 - Peekaboo Corner, N.B.

lat. 45°39'15" long. 65°43'07"

Windsor limestone does not outcrop in the Peekaboo Corner area, however, 0.35 miles northwest of the Corner, mineralized blocks of limestone can be found as float. These limestone blocks occur near an abandoned railway line and a sideroad off highway 124 (figure 7).

The massive, light grey, micritic limestone contains minor galena mineralization. Pre-Carboniferous volcanic rocks exposed on a hill less than 100 feet from the float blocks suggest that the Windsor-Basement contact is in the immediate area of the occurrence.

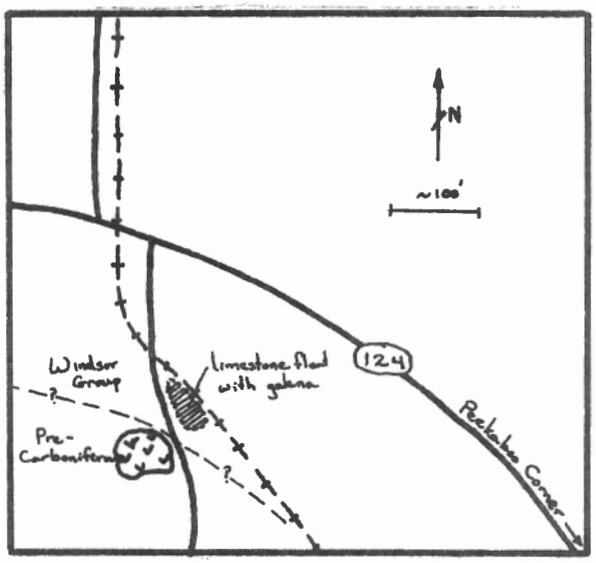

Figure 7. SKETCH MAP OF THE PEEKABOO CORNER AREA, N.B.

8 - Trout Creek, N.B.

lat. 45°42'32" long. 65°28'05"

The contact of the basal Windsor limestone and the Moncton conglomerate is exposed on a ridge north of Trout Creek, about 0.7 miles east of Sussex Corner (map 829A, Evans and Alcock, 1945). The outcrops are in the back of a farmyard.

The Windsor Group at this location consists of laminated, micritic, light grey limestone and interbedded buff-coloured dolomite. No carbonaceous matter or sulphide minerals occur in the limestone or the underlying red pebble conglomerate of the Moncton Group. The limestone is highly folded (figure 8), however, there is no visible deformation in the underlying conglomerate. Windsor evaporites are quarried about 0.25 miles north of this limestone ridge, suggesting the sedimentary sequence, conglomerate - limestone - gypsum.

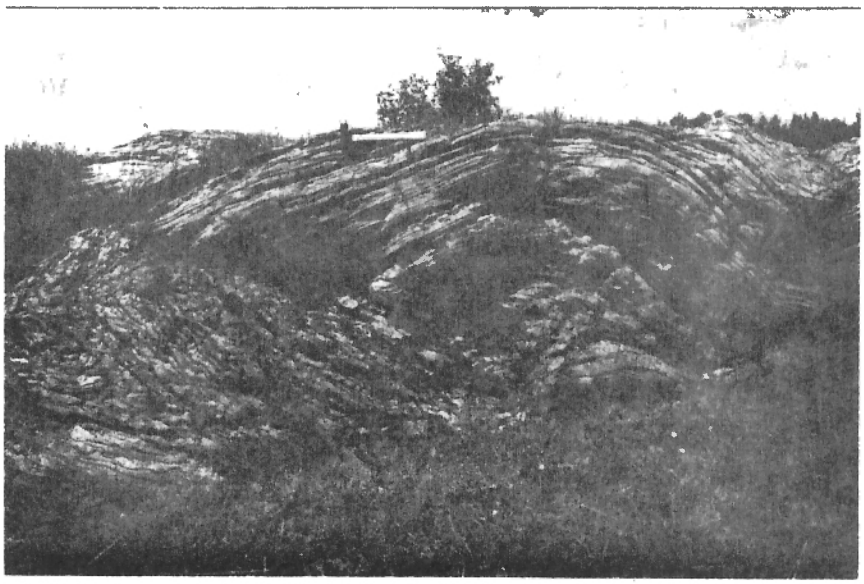

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Figure 8. View, looking north, of highly folded basal Windsor limestone at Trout Creek, N.B.

9 - Hammondvale, N.B.

9A - 1.9 miles east, on stream

lat. 45°35'19" long. 65°28'59"

9B - roadcut

lat. 45°33'48" long. 65°31'03"

9C - cave

lat. 45°33'27" long. 65°31'41"

The Windsor Group is observed at several locations in the Hammondvale area (figure 9).

One and nine-tenth miles northeast of the road junction at Hammondvale, a small stream exposes 10 feet of blue-grey weathering, laminated limestone. This limestone overlies, apparently conformably, the red pebble conglomerate of the Moncton Group which is exposed further upstream. Only 50 feet of conglomerate outcrops between the limestone and Pre-Carboniferous igneous basement rocks. Both the upper and lower contacts of the conglomerate are covered. The limestone at this location is not carbonaceous and contains no visible sulphide mineralization.

Eight-tenth miles southeast of Hammondvale, Windsor limestone containing barite and fluorite is exposed in a roadcut on Highway 111. The limestone is porous, massive, and unfossiliferous. It is not similar to other basal Windsor limestones, and is quite different in lithology from the limestone exposed 1.9 miles northeast of Hammondvale. The base of the limestone is not exposed at this location, or on the Hammond River, 1.5 miles southwest of Hammondvale, where a similar limestone outcrops in a cave near the river.

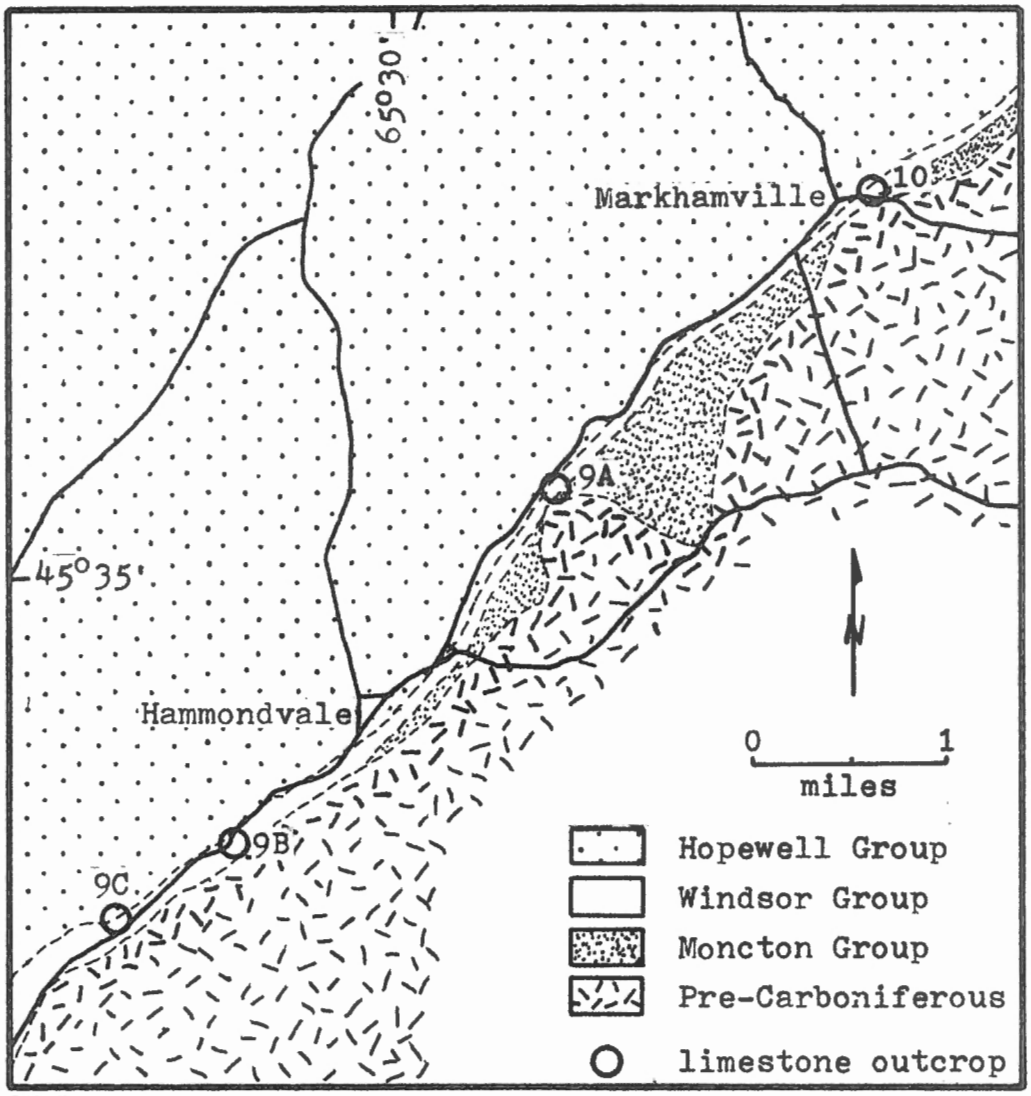


Figure 9.

GEOLOGY OF THE HAMMONDVALE AREA, N.B.
(after Evans and Alcock, 1945, and Alcock and MacKenzie, 1946)

10 - Markhamville Mine (Mn), N.B.

lat. 45°36'47" long. 65°26'50"

Old dumps and adits of the Markhamville mine are located just south of Markhamville (figure 9).

The rock exposed in the adits is light grey to red, crystalline, unlaminated limestone. Massive pyrolusite occurs on the dumps but no sulphides were observed in any of the limestone blocks examined. The limestone occurs an unknown distance above the Moncton Group of clastic rocks.

11 - Piccadilly Road, N.B.

lat. 45°43'14" long. 65°22'17"

Five feet of dark grey, laminated Windsor limestone outcrops to the north of the road, 1.6 miles east of Piccadilly (map 829A, Evans and Alcock, 1945).

The limestone contains red tinted areas, some red laminae, and no visible sulphide mineralization. The contact of the Windsor and Moncton Groups is not exposed at this location.

12 - Waterford, N.B.

12A - back of church

lat. 45°40'52" long. 65°21'57"

12B - Parlee Brook

lat. 45°39'07" long. 65°24'35"

Beside the church in Waterford a ridge with sink holes marks the position of the Windsor limestone. The limestone exposed in these sink holes is laminated, grey weathering, and red tinted on fresh surfaces, similar to the limestone outcrops on the Piccadilly Road. To the south of the ridge, conglomerate of the Moncton Group outcrops in a stream bed and a field. The contact of the Windsor and Moncton Groups is not exposed at this location.

On Parlee Brook, 2.8 miles southeast of Waterford, both the Windsor limestone and the underlying Moncton conglomerate are exposed, although the contact is covered. At the base of the stratigraphic section there is a red conglomerate, overlain by about 1 foot of green sandstone. Above a 5-10 foot covered interval, higher in the bank, there is 10 feet of massive, crystalline, brown limestone, with no obvious sulphide content.

13 - Smith Creek, N.B.

lat. 45°46'46" long. 65°27'51"

Windsor limestone outcrops 0.9 miles east of Smith Creek, on the Plumwesweep to Mt. Pisguh road. This small outcrop is on the west side of the road, about 1500 feet south of the junction with the road to Smith Creek (map 643A, Stewart, 1941).

Red to grey, sandy, laminated limestone is exposed at this location. Although there is a 50 to 100 foot covered interval, the limestone appears to overlie red sandy pebble conglomerate of the Moncton Group which is visible in the road ditch to the north.

The laminated and sandy character of the limestone suggests a similarity to the A_1 limestone of northern Nova Scotia, however, the red colour is typical of many New Brunswick limestones, and not the ones in northern Nova Scotia.

14 - Goshen, N.B.

lat. 45°46'38" long. 65°10'30"

A copper prospect is located 0.7 miles south of the village of Goshen. It is reached by a wood road that branches from the Elgin - Goshen road about 0.9 miles southwest of the village of Goshen (map 642A, Stewart, 1941).

Copper mineralization, in the form of malachite, chalcocite, and covellite, occurs in the matrix, and coating clasts, of a green fanglomerate of the Moncton Group an unknown distance below the Windsor Group. The fanglomerate is exposed in trenches and overgrown pits remaining from an exploration program by Oakwood Mines Ltd. in 1956.

This exploration program, the subject of a thesis by Hawkins (1958), was concluded when it was decided that the high copper grades on surface result from secondary enrichment of subeconomic primary chalcopyrite mineralization. The drilling is reported by Hawkins (1958) as indicating 25,000 tons grading 2.25% copper.

15 - Intervale, N.B.

lat. 45°56'28" long. 65°13'09"

Windsor limestone outcrops on the Petitcodiac - Glenvale road, 2.3 miles from Petitcodiac.

The dense, unlaminated, red and grey tinted Windsor limestone is similar in appearance to the limestone at Havelock. No sulphides were observed in these rocks. Massive gypsum is exposed in a quarry to the south of the limestone ridge (figure 10).

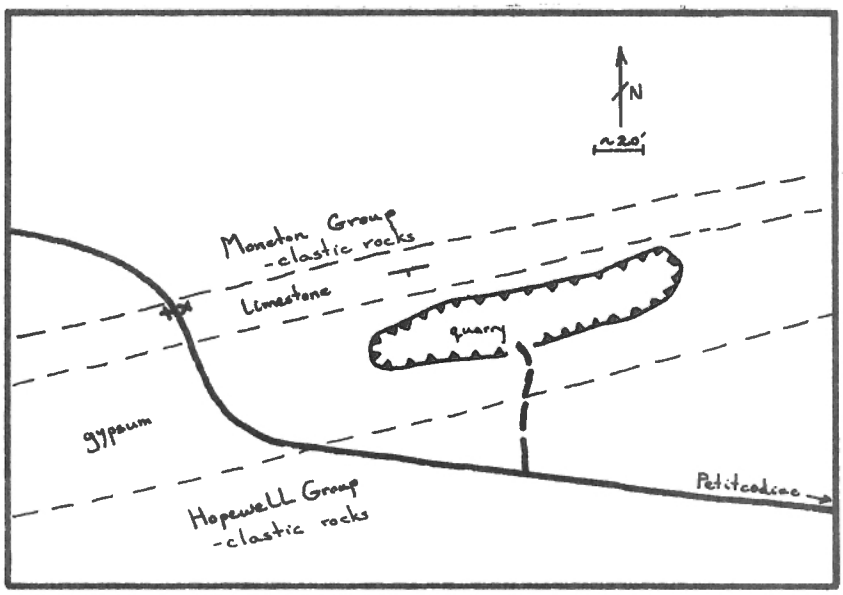


Figure 10. SKETCH MAP OF THE GEOLOGY OF THE INTERVALE LIMESTONE OUTCROPS.

16 - Havelock Lime Works, N.B.

16A - Havelock Quarry

lat. 45°59'53" long. 65°18'25"

16B - Samphill Quarry

lat. 45°59'14" long. 65°22'53"

The Havelock Lime Works operates two quarries in the Havelock area of New Brunswick.

An exposure of the Windsor-Moncton contact in the old quarry at Havelock was reported by Hamilton (1965). However, when the quarry was visited by the author in the summer of 1974, large unbroken blocks of limestone were piled in this area and the contact could not be observed. In general, the limestone in the old quarry is grey to red mottled, fine-grained, and recrystallized. Minor sporadic pyrite was the only sulphide mineral observed in the rocks.

At the Samphill quarry, only massive limestone, similar to that exposed at Havelock, was observed. A partial stratigraphic section in the vicinity of the Samphill quarry can be obtained from drill core.

drill hole HLW 74-4

Windsor Group

? - 106' dolomite, massive, styolitic, light brown colour.

- 112' massive dark grey limestone.

- 113' dark grey calcareous siltstone.

- 115' dark grey massive limestone; minor laminations and a crude stromatolitic appearance in a few sections; in the basal few inches there are scattered pebbles similar in lithology to those in the underlying conglomerate; no sulphides are visible.

Moncton Group

- 117' green friable sandy pebble conglomerate.

17 - Grey Brook - Quarry Road, N.B.

lat. 45°54'37" long. 64°39'40"

The contact of the Windsor and Moncton Groups is exposed on Grey Brook, 50 feet downstream from Quarry Road, 1.3 miles southwest of Hillsborough (map 647A, Norman, 1941).

Green pebble conglomerate occurs upstream, at the base of the stratigraphic section. Sparse malachite is visible at the top of the conglomerate, which is overlain by 7 feet of laminated, grey, micritic Windsor limestone. No sulphide mineralization was observed in the limestone.

The rocks at this location are similar in lithology to the A_1 limestone and the Horton conglomerate of northern Nova Scotia and Cape Breton Island.

18 - Albert Mines, N.B., Demoiselle Creek

lat. 45°52'40" long. 64°40'14"

Laminated limestone outcrops on Demoiselle Creek, within the town of Albert Mines (figure 11). The limestone occurrence is reached by a laneway which turns west, just to the south of the church. Fifteen feet downstream from the bridge over Demoiselle Creek there is a small outcrop of laminated, crystalline, red-tinted limestone. No sulphides are visible in the limestone, and the Windsor-Moncton contact is not exposed at this location.

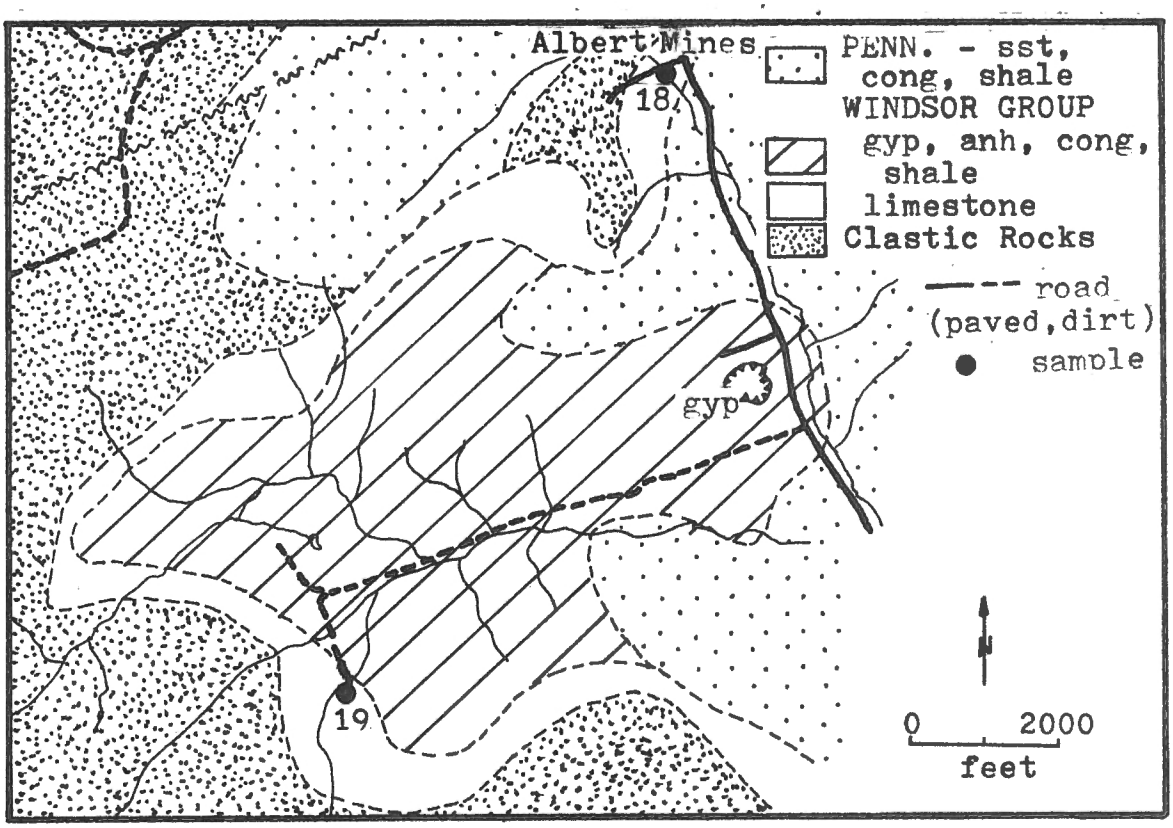


Figure 11.
GEOLOGY OF THE ALBERT MINES AREA, N.B.
(after Hamilton and Barnette, 1970)

19 - Albert Mines, N.B. - Wilson Brook

lat. 45°51'29" long. 64°41'50"

Windsor limestone overlies Pre-Carboniferous igneous basement rocks in an abandoned quarry, 1.9 miles southwest of Albert Mines. The access to this location is outlined on the adjoining geological map (figure 11).

The stratigraphic interval exposed in the quarry is less than 15 feet, however, the section shows great lithological variation. From the top to the base, the generalized stratigraphic section is as follows:

Windsor Group

1) greater than 2 feet of porous, white-weathering, stromatolitic limestone containing viscous liquid hydrocarbons.

2) 7 feet of brown-grey weathering, laminated limestone; at the base of the unit the limestone is micritic and has a red tint on fresh surfaces; towards the top of the unit crystalline patches are visible in the limestone which is grey in colour; small columnar stromatolites occur about 5 feet above the base of the unit; very minor malachite, chalcocite, and chalcopyrite are visible on joint surfaces in the basal 2 feet of the unit.

3) 0 to 2 feet of coarse angular conglomerate composed of basement blocks in a lime matrix; the conglomerate occurs in depressions in the basement.

Pre-Carboniferous

4) unknown thickness of igneous basement rocks, including andesite and sheared granitic rock; minor amounts of malachite occur on joint surfaces near the contact with the overlying Windsor limestone.

Although it is partly recrystallized, and contains columnar stromatolites, the basal portion /of the limestone section appears/ somewhat similar to the A_1 limestone.

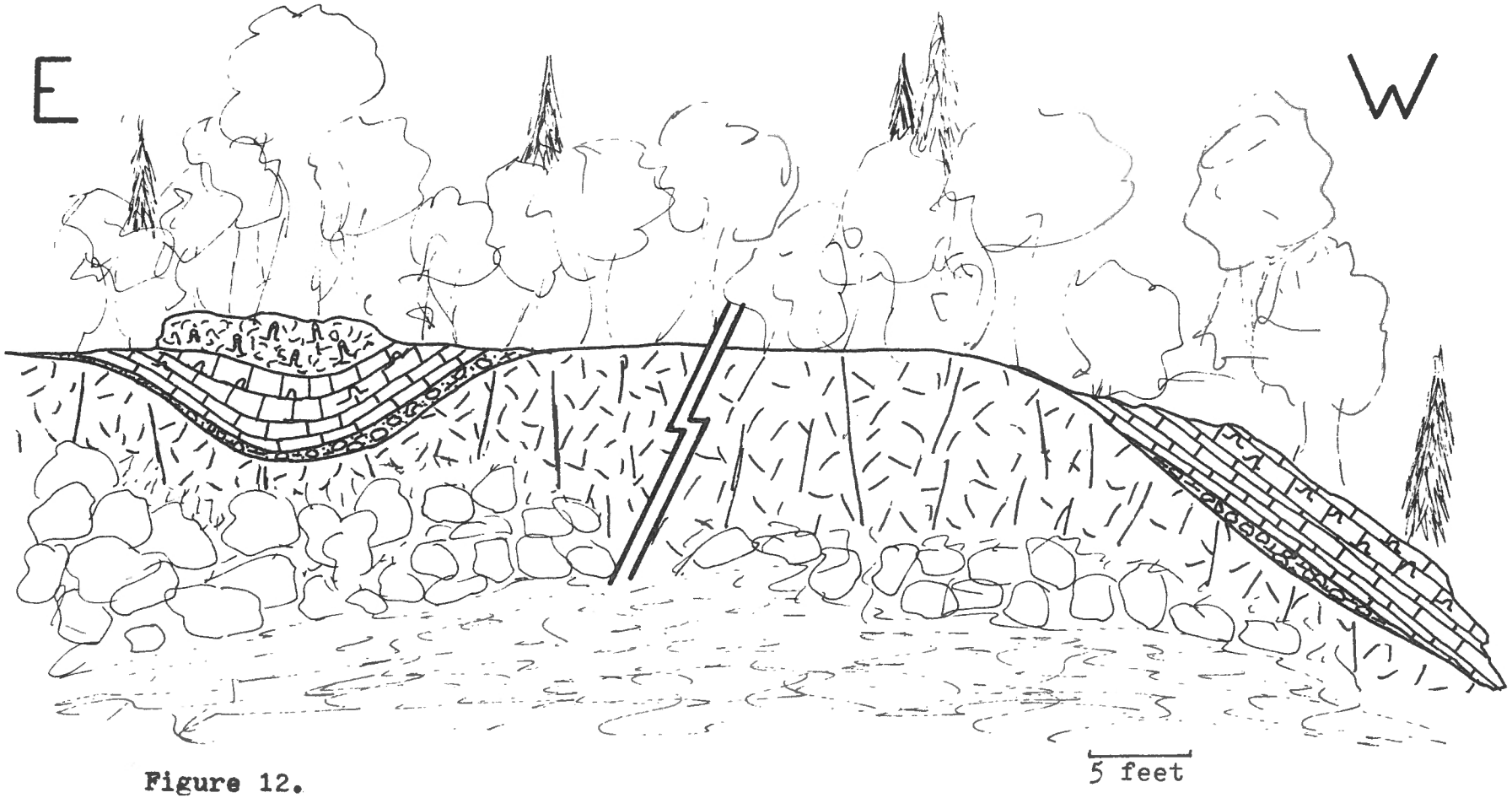


Figure 12.
VIEW OF QUARRY AT WILSON BROOK IN THE ALBERT MINES SYNCLINE, ALBERT MINES, N.B.

20 - McHenry Brook, N.B.

lat. 45°50'55" long. 64°39'08"

Two and one-tenth miles south of Albert Mines, on McHenry Brook, there is a small outcrop of Windsor limestone (map 647A, Norman, 1941). This outcrop can be reached by walking one-quarter mile up McHenry Brook from the Albert Mines - Cape Station road.

The massive, red, medium grained crystalline limestone exposed at this location is not typical A_1 limestone but is similar to limestone occurring at Havelock. The limestone unconformably overlies Pre-Carboniferous granitic basement rock.

2) WINDSOR-TRURO, NOVA SCOTIA

INTRODUCTION Liston p. 38

This area is characterized by very poor outcrop and great lithological variation in the A_1 limestone. At Brookfield, near Truro, the A_1 (Macumber) is a black, carbonaceous limestone which contains 0.2% copper as chalcopyrite in the basal one foot of the section. However, at Windsor, the A_1 is a red to light grey, microcrystalline limestone with no visible sulphide content.

The Windsor-Horton contact outcrops at Johnson Cove and White Head, near Cheverie, Latties Brook, and Brookfield, south of Truro. A_1 limestone is exposed at several other localities, including Selmah, South Maitland, and Moose Brook, however, the basal contact with Horton clastic rocks was not observed at these outcrops.

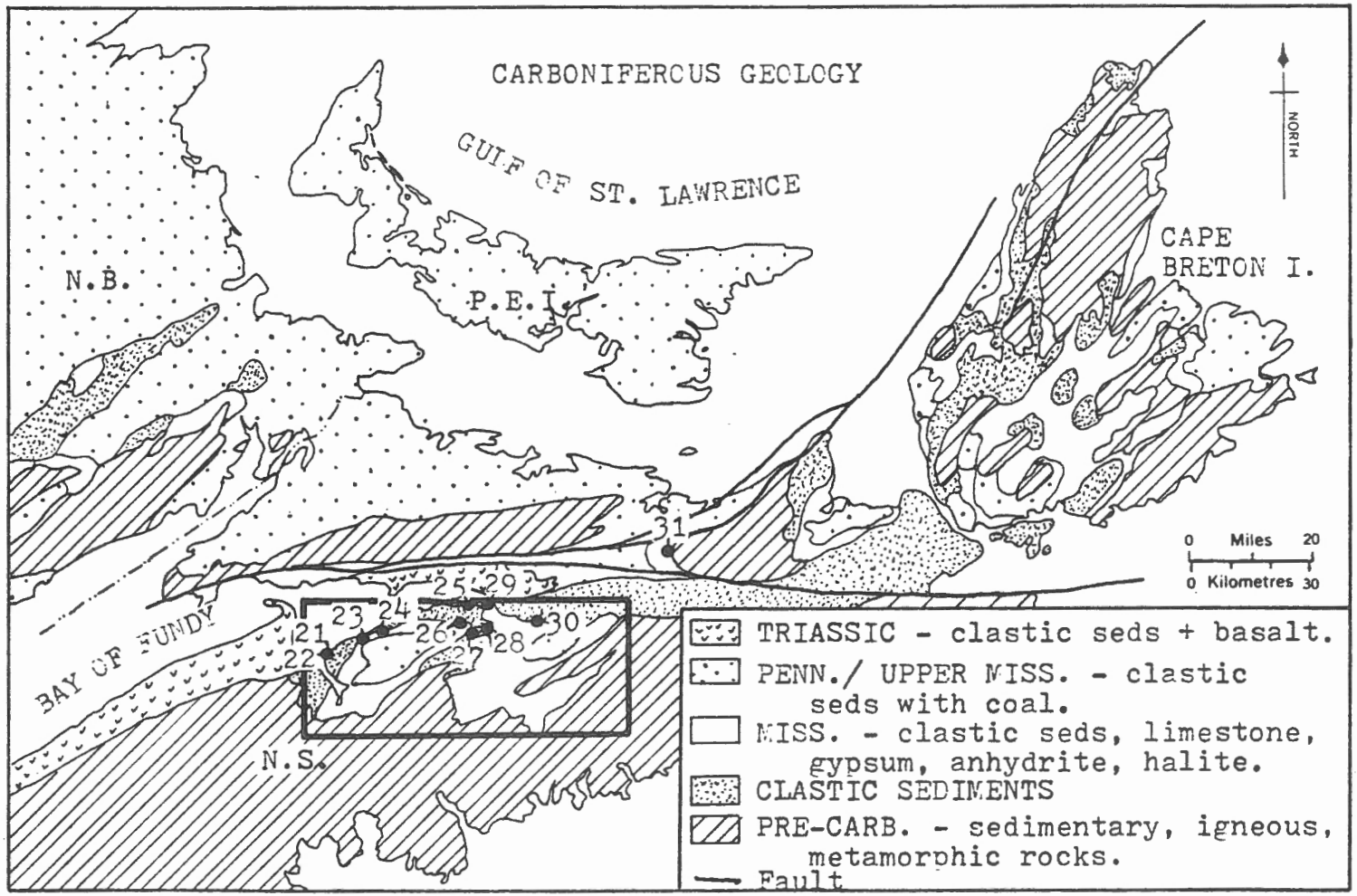


Figure 13. Location Map for the Windsor - Truro Area, N.S.

KEY TO LOCATIONS IN THE WINDSOR-TRURO AREA, N.S.
AREA, N.S.

21 - White Head, N.S.

lat. 45°09'20" long. 64°11'18"

The Windsor-Horton contact is exposed one mile southwest of Cheverie, at White Head (figure 14). The outcrops can be reached by walking across the tidal flats at low tide from the abandoned wharf at Cheverie.

The Horton Group at this location comprises red siltstone with ripple marks and tree stumps, red sandstone, and minor pebble conglomerate. Ten feet of white and red streaked quartz sandstone occurs at the top of the Horton Group. This is overlain by 15 to 20 feet of red weathering, fissile, laminated, A_1 limestone. Above the A_1 limestone is the Pembroke Formation, which at this location consists of fragments of A_1 limestone in a lime matrix. Higher in the stratigraphic section, massive gypsum is exposed near the wharf at Cheverie.

No sulphide minerals occur in the red, hematitic A_1 limestone or the Horton clastic rocks at White Head. Crosby (1962) noted pyrolusite occurring along fractures in the limestone.

The rocks exposed at White Head are identical in lithology and mineralization to those at Johnson Cove.

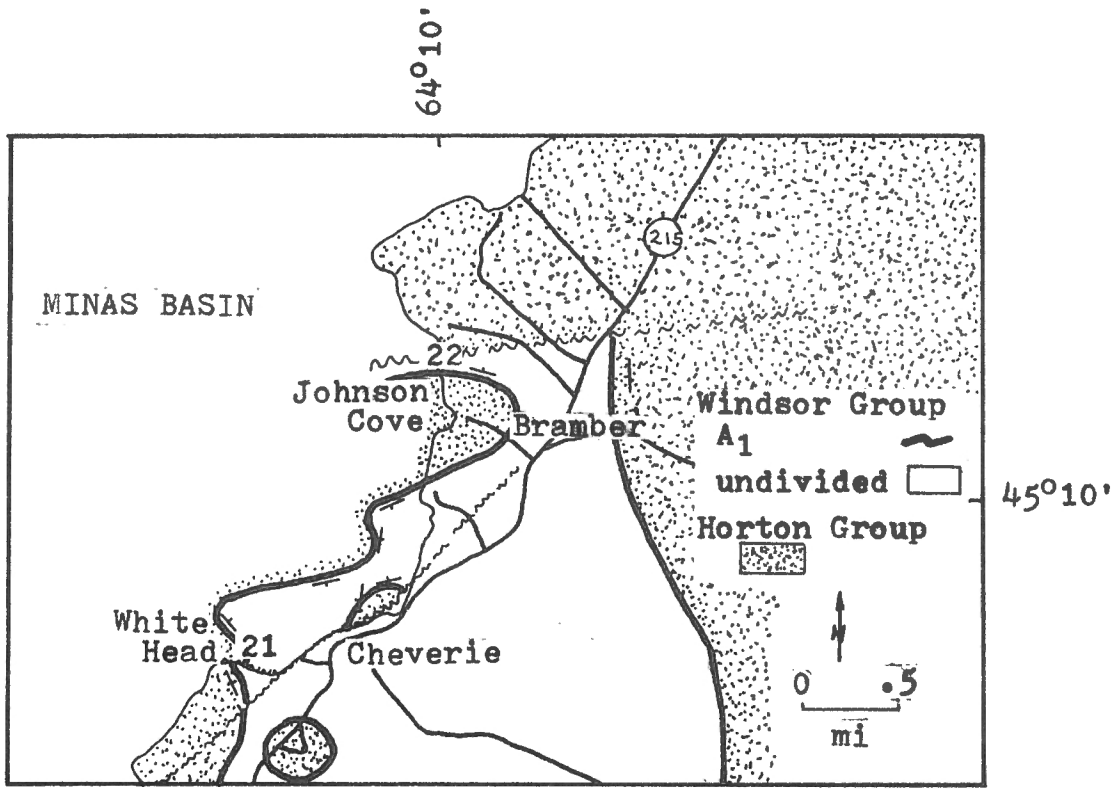


Figure 14.
GEOLOGY OF THE CHEVERIE AREA, N.S.
(after Crosby, 1962)

22 - Johnson Cove, N.S.

lat. 45°10'40" long. 64°09'57"

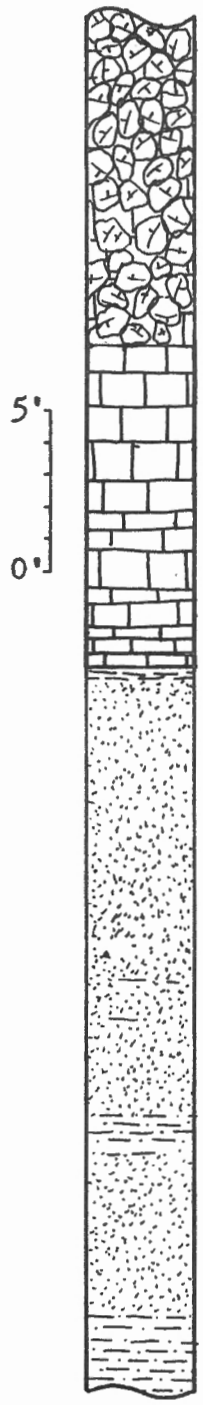
The Windsor-Horton contact is exposed at Johnson Cove, west of Bramber and 0.25 miles north of the mouth of Mill Brook (figure 14).

The outcrops are on the north limb of an east-plunging anticline. At the base of the stratigraphic section (figure 15) are red siltstones and sandstones of the Horton Group. Twenty feet of white and red-streaked quartz sandstone occurs at the top of the Horton Group. Ten feet of fissile, laminated, fine-grained A_1 limestone conformably overlies the Horton Group. This limestone weathers red, however, on fresh surfaces it is medium grey with red laminae. Two to three inches of red clay occurs at the contact of the Windsor and Horton Groups. Overlying the A_1 limestone is 15 feet of white-weathering, brecciated limestone which is part of the Pembroke Formation.

No sulphides were observed in the limestone or the underlying sandstone. Pyrolusite occurs on joint faces in the limestone.

The A_1 limestone at Johnson Cove is similar to the A_1 at other locations except that it is red or light grey in colour, tends to be crystalline rather than micritic, and contains no visible sulphides, but rather oxide mineralization such as hematite and pyrolusite.

Figure 15a.
PARTIAL STRATIGRAPHIC COLUMN,
JOHNSON COVE, N.S.



Windsor Group

Pembroke Formation - white weathering, brecciated limestone.

A_1 limestone - red weathering, fissile, red to grey, laminated limestone.

Horton Group

white and red streaked quartz sandstone.

red siltstone and sandstone with minor conglomeratic interbeds.

R.V.K. 4-8-74

Figure 15b. Laminated A_1 limestone overlying Horton sandstone at Johnson Cove, near Windsor, N.S.

23 - Walton Mine, N.S.

lat. 45°12'19" long. 64°02'27"

Barite, and for a time base-metals, were mined from the Walton Mine presently owned by Dresser Minerals. The mine, located 2.5 miles southwest of Walton, N.S., was visited in an attempt to view the Horton-Windsor contact. The contact is not exposed in the open pit, and no typical A_1 limestone was observed in the drill core. A summary of the history, mineralogy and geochemistry of the Walton mine was given by Boyle (1972).

24 - Moose Brook, N.S.

lat. 45°15'48" long. 63°50'09"

An attempt was made to locate several old manganese prospects in the area of Moose Brook (map 867A, Weeks, 1946).

Due to the heavy overgrowth the old Faulkner Manganese Mine could not be located.

The Scott Manganese Mine can be reached by walking back a bush road for 0.6 miles from the side road out of Minasville. There is a sugarcamp at the site of the old pits. Both of the pits are overgrown, however, a few blocks of reddish limestone containing pyrolusite were located. Although sandstone blocks can also be found, there does not appear to be much chance of uncovering the Windsor-Horton contact at this location due to the poor outcrop and the deterioration of the old pits.

25 - Selmah, N.S.

lat. 45°19'06" long. 63°32'46"

About 0.5 miles west of Selmah, on the north side of the highway, there is an old lime pit and at least one lime kiln (map 874A, Weeks, 1946).

Blocks of medium to light grey, laminated, A_1 limestone occur in the pit. The limestone can be traced through to the shore since it stands as a ridge, however, no outcrops were seen, and the contact with the Horton Group is not exposed. No sulphides are visible in the limestone which occurs in the lime pit.

26 - Latties Brook, N.S.

lat. 45°15'10" long. 63°34'43"

Small outcrops of Windsor and Horton rocks occur 1.6 miles north of Latties Brook, on a small stream (map 874A, Weeks, 1946).

Horton Group red and grey mottled siltstone occurs upstream from the Windsor-Horton contact. Immediately beneath the A_1 Windsor limestone there is a grey sandstone containing plant trash, but no visible sulphides. The five feet of dark grey, laminated, A_1 limestone exposed at this location is lithologically similar to the A_1 in other parts of Nova Scotia, however, the rock contains no visible sulphides.

27 - Fivemile River, N.S.

27A - west of Burtons

lat. 45°13'40" long. 63°34'27"

27B - Burtons

lat. 45°14'05" long. 63°33'31"

27C - gravel pit

lat. 45°14'43" long. 63°31'10"

Several sections along Fivemile River were visited in an attempt to find the Windsor-Horton contact. When the author visited the location listed above no contacts could be found.

Immediately west of Burtons, on a small stream, massive grey limestone with very minor sulphide mineralization outcrops. Quartz sandstone of the Horton Group is also observed in the same stream valley, however, the Windsor-Horton contact does not outcrop.

One-half mile east of Burtons it was possible to observe massive gypsum and the underlying quartz sandstone of the Horton Group, however, the A_1 limestone was not exposed.

No outcrops could be found downstream from the gravel pit.

28 - South Maitland, N.S.

lat. 45°15'09" long. 63°29'13"

Windsor and Horton rocks are exposed on Fivemile River near South Maitland. The outcrops (figure 16) are reached by walking west along the CP railway for 0.55 miles from South Maitland.

Grey, quartz sandstone of the Horton Group occurs at the base of the stratigraphic section. The contact of the Horton Group with the red weathering, red to grey, laminated, fine-grained A_1 limestone is not exposed in these outcrops. The folded A_1 limestone is overlain by a limestone-conglomerate breccia which is correlative with the Pembroke Formation.

The limestone exposed at this location is lithologically similar to that in the Windsor area, but is quite different from the dark, carbonaceous limestone which outcrops at Brookfield and Black Rock.

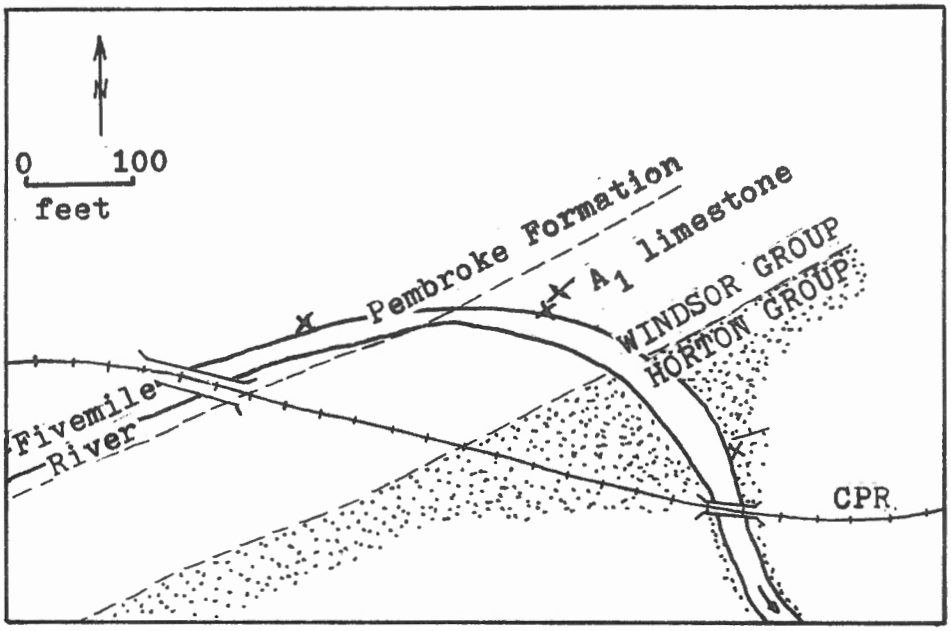


Figure 16.
SKETCH MAP OF AN AREA 0.55 miles WEST OF SOUTH MAITLAND, N.S.

29 - Black Rock, N.S.

lat. 45°19'02" long. 63°28'42"

At Black Rock, located 10 miles west-south-west of Truro, on the Bay of Fundy, there is an excellent exposure of the A_1 limestone and the overlying Pembroke Formation. Access to the area is from the east via Old Barns since the road from Princeport in the south is no longer used and is impassible (Stevenson, 1958).

Gently folded, dark grey, laminated A_1 limestone is exposed on the sea cliffs at low tide. At the base of the exposed section, the limestone is micritic and contains trace amounts of pyrite, however, towards the top of the section the limestone is crystalline and no sulphides are visible. The contact with the overlying limestone breccia of the Pembroke Formation is exposed, however, the underlying Horton clastic rocks could not be seen, even at low tide.

Manganese has been noted in the limestone at this location (Stevenson, 1958).

These outcrops can only be observed at low tide and care should be exercised due to the rapid rise and fall of the tides and the high tidal range.

30 - Brookfield, N.S.

lat. 45°16'32" long. 63°13'07"

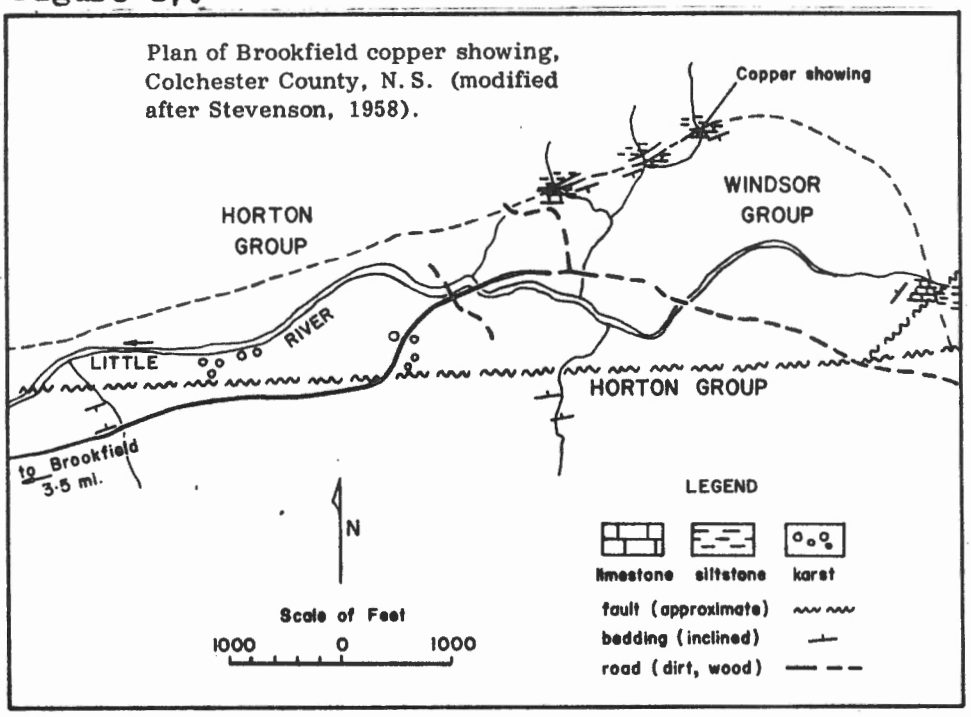
The copper showing is located four miles northeast of Brookfield and 1.8 miles east of the Brookfield barite deposit (Stevenson, 1958). Access to the area is by a dirt road that branches off the Brookfield to Middle Stewiake highway a mile east of Brookfield.

Basal Windsor limestone and underlying Horton clastic rocks outcrop along all three tributaries of a stream which crosses the main bush road (figure 17). However, only on the easternmost tributary could the contact be exposed by digging in the valley wall.

At the base of the stratigraphic section there is an unknown thickness of red siltstone and fine-grained sandstone. These red beds are overlain by about 10 feet of green-grey, fine-grained sandstone. Above this is 25 feet of typical dark, fine-grained, laminated, carbonaceous A_1 limestone.

On the easternmost tributary, the basal foot of the limestone is very carbonaceous and contains abundant disseminated chalcopyrite. Analyses indicate that it contains about 0.2% copper but negligible amounts of lead, zinc and silver. Specks of chalcopyrite were also seen in the lowermost exposed limestone in the middle tributary, suggesting that the mineralization is continuous from one outcrop to the next and could possibly be exposed in the middle and west tributaries by trenching.

Figure 17.



At the time of the author's visit (June, 1974) there was no evidence to indicate that this copper occurrence had been exposed or sampled previously.

31 - Springville, N.S.

lat. 45°27'39" long. 62°36'39"

On Holmes Brook, near Springville, Windsor limestone overlies Pre-Carboniferous basement rocks. Access to the outcrops is by a dirt road for 0.55 miles east from the main highway and then 150 feet north to Holmes Brook (map 1215A, Benson, 1967).

Upstream from the limestone outcrops there is Pre-Carboniferous schistose calcareous siltstone (figure 16). This is unconformably overlain by Windsor limestone. Most of the limestone exposed at this location is massive, grey, brecciated, and veined by calcite and possibly iron-carbonate and/or barite Pyrite occurs disseminated in the limestone and in minor amounts in the calcite veins. Close to its contact with the basement rocks, the limestone is almost totally replaced, and the high specific gravity of the rocks suggest the presence of barite. The brecciated nature of the limestone suggests that it may be in fault contact with the Pre-Carboniferous basement. Immediately downstream from these outcrops there is a thin section of black, laminated, micritic, limestone, containing abundant pyrite and minor chalcopyrite. This limestone is similar in appearance to typical A_1 limestone.

The outcrop is atypical and as suggested above, may be Windsor limestone in fault contact with Pre-Carboniferous rocks.

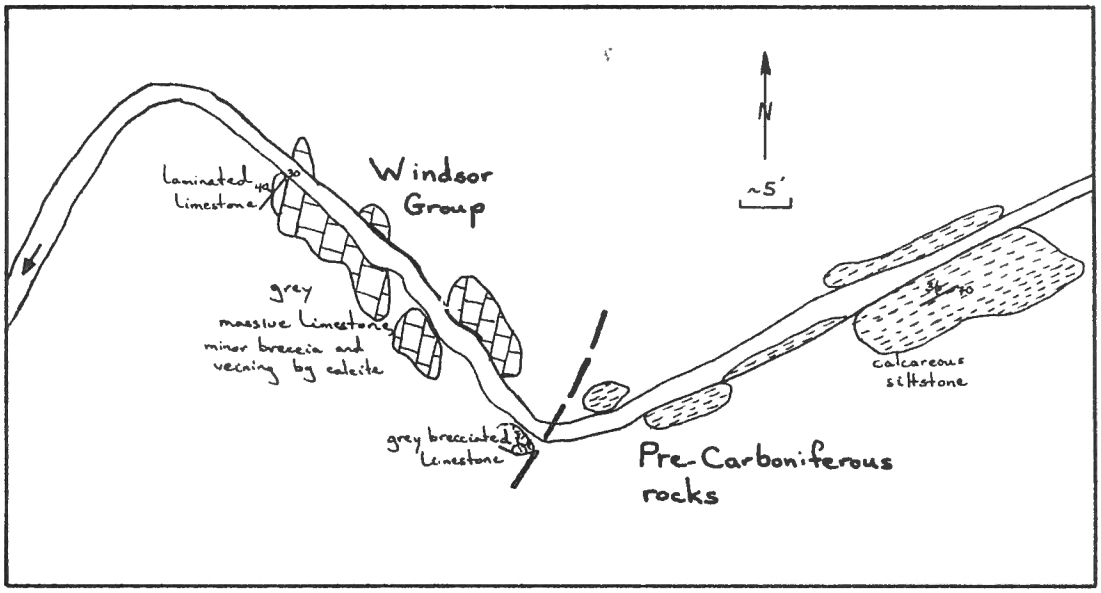


Figure 18.

SKETCH MAP OF THE GEOLOGY ON HOLMES BROOK, NEAR SPRINGVILLE, N.S.

3) ANTIGONISH — STRAIT OF CANSO AREA

Many excellent outcrops of the Windsor-Horton contact occur in the Antigonish to Strait of Canso area. The most common stratigraphic configuration consists of A_1 limestone conformably overlying conglomerate, siltstone, or sandstone of the Horton Group. The upper part of the clastic section, immediately underlying the limestone is green in colour, the remainder of the clastic section being predominantly red. Contacts of this type occur at Big Marsh, Brierly Brook, Rights River, Sylvan Valley, Cape Jack and many other locations. At Lakevale and Crystal Cliffs, A_1 limestone conformably overlies green conglomerate which unconsormably overlies red and white Horton sandstones.

Most outcrops in the Antigonish - Strait of Canso area contain, in the basal A_1 limestone or the upper Horton clastic rocks, copper mineralization as chalcocite or chalcopyrite, and/or malachite. Copper contents of up to 0.65% have been recorded from grab samples at the Rights River showings, and outcrops on the northwest margin of the Antigonish Basin commonly contain 0.1 to 0.3% copper over one foot at the Windsor-Horton contact.

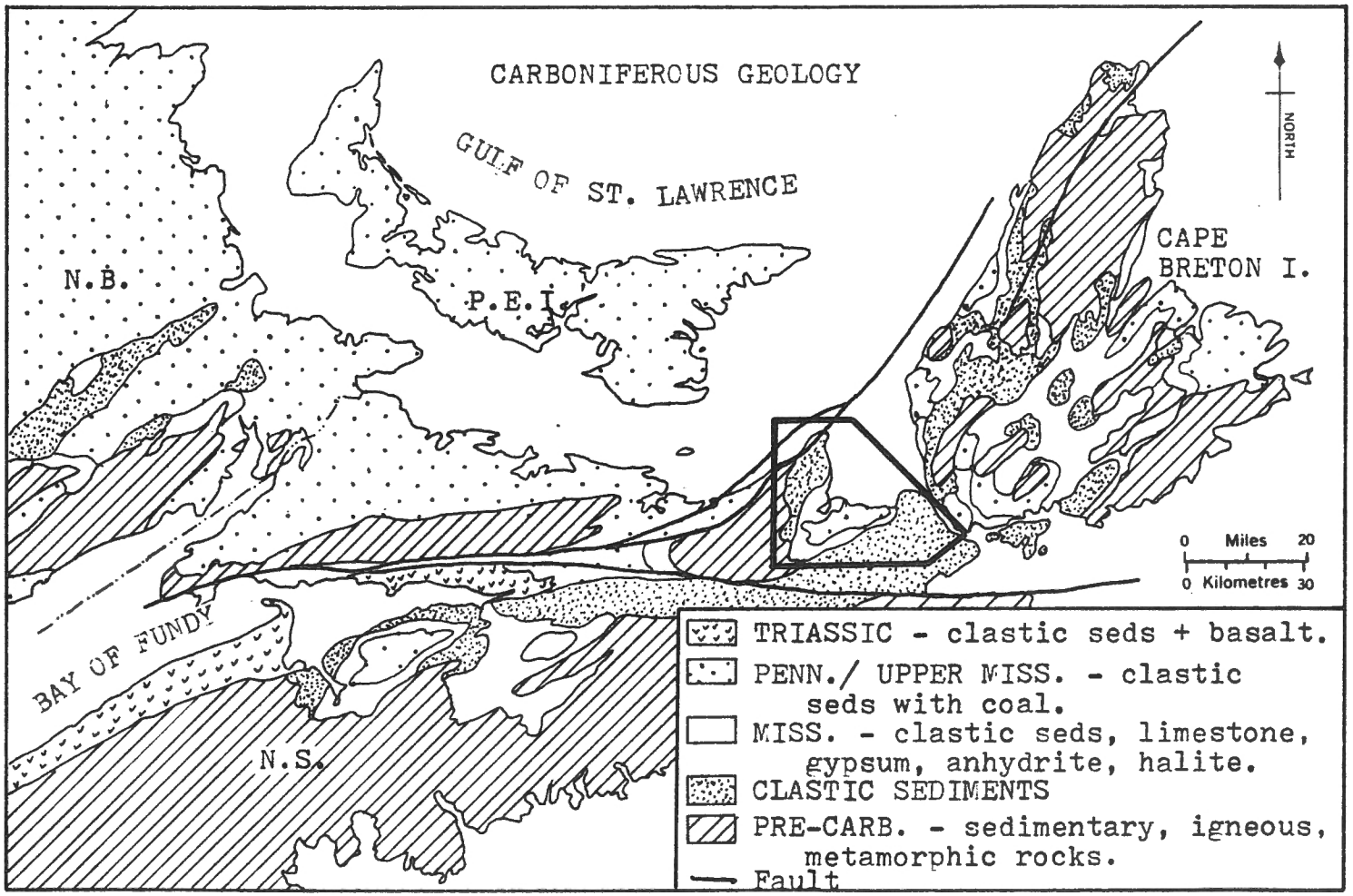


Figure 19. Antigonish - Strait of Canso area, Nova Scotia.

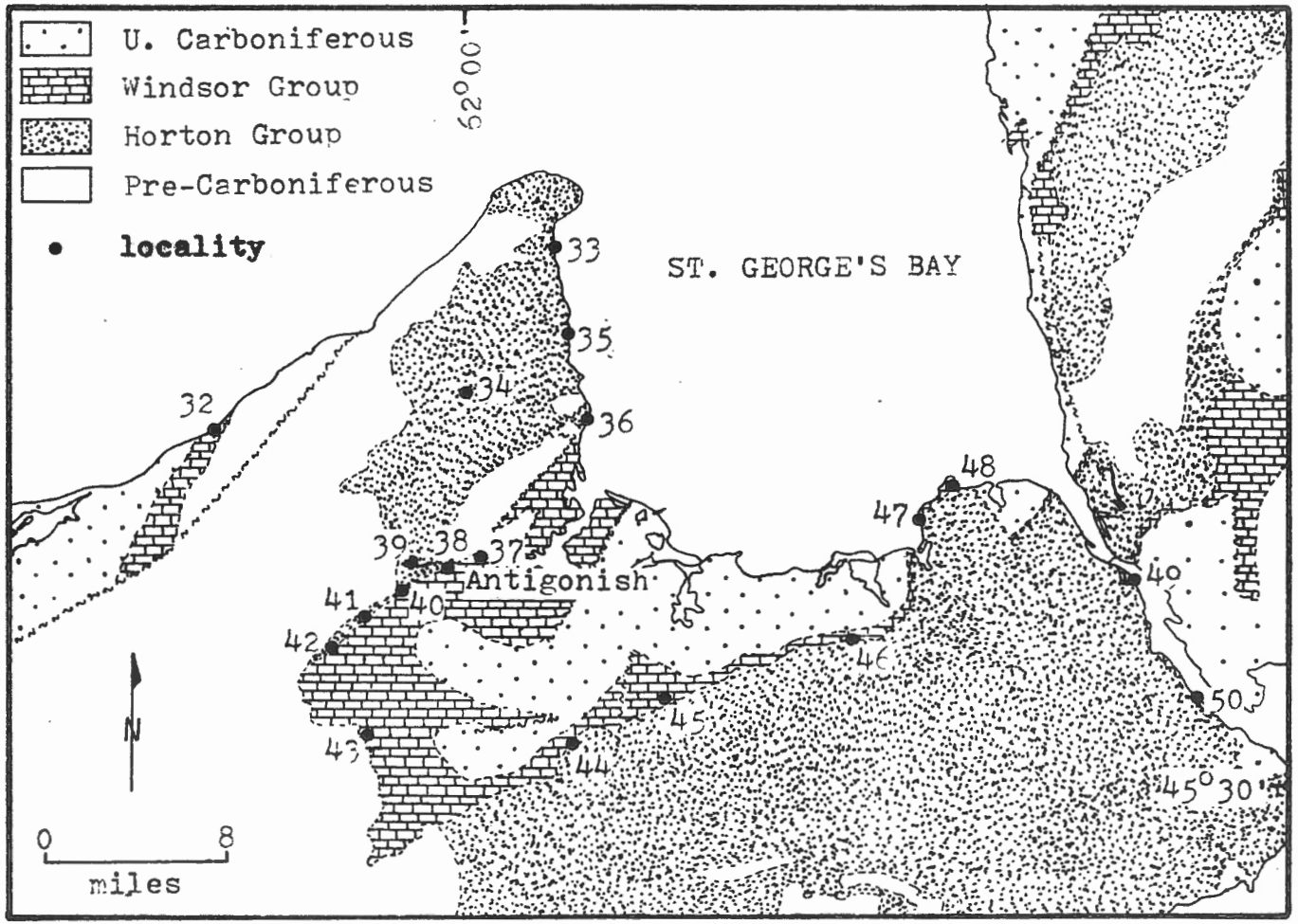


Figure 20. GEOLOGY OF THE ANTIGONISH - STRAIT OF CANSO AREA AND LOCALITIES EXAMINED (modified after N.S. Dept. of Mines, 1965).

KEY TO LOCATIONS IN THE ANTIGONISH - STRAIT OF CANSO AREA, N.S.

32 - Knoydart Point, N.S.

lat. 45°43'37" long. 62°13'26"

Windsor and Horton rocks are well exposed on the shore between Knoydart and Moydart Points, north of Antigonish (Benson, 1974).

The Horton Group immediately beneath the Windsor-Horton contact consists of red siltstone. These red beds are unconformably overlain by 15 to 20 feet of massive or shaly limestone of the Windsor Group. In some parts of the outcrop the base of the Windsor Group is a massive, dark grey limestone. In other areas there is 2 to 5 feet of shaly limestone between the first massive carbonate unit and the underlying red beds.

The limestone of the Windsor Group at this location contains some brachiopods and this, combined with the unlaminated appearance, suggests that this is not the A_1 limestone.

The only sulphide mineral observed at this location is pyrite which occurs as scattered 1 to 2 mm cubes in the massive limestone unit .

33 - Ballantynes Cove, N.S.

lat. 45°50'46" long. 61°55'06"

Windsor and Horton rocks outcrop on a beach, 1 mile south of the town of Ballantynes Cove (Benson, 1970). Access to the beach is through the back of a farm 1 mile south of the town.

At the base of the stratigraphic section (the south end of the beach), there are red pebble conglomerates and interbedded sandstones of the Horton Group. Immediately beneath the Windsor Group there is a 0.5 foot thick bed of green pebble conglomerate with minor malachite staining and a few rare specks of chalcopyrite. The basal carbonate unit of the Windsor Group is a 2-5 foot thick, sandy, laminated, buff to yellow dolomite. This unit, which appears to be similar to the A_2 limestone, is overlain by a porous, massive, buff to yellow carbonate unit containing casts of large gypsum crystals. It is suggested that the sulphate crystals were pseudomorphically replaced by calcite which is weathered out to produce a porous rock. No sulphides are visible in either carbonate unit.

To the north on the beach, there is a fault and amygdaloidal basalts of the Horton Group are exposed. These basalts form a headland and restrict access to the north.

34 - Big Marsh, N.S.

lat. 45°44'22" long. 62°00'21"

The Windsor-Horton contact is exposed at the junction of a small tributary and Wallace Brook, about 0.7 miles northeast of Big Marsh (Benson, 1974).

The stratigraphic section (figures 21 and 22), includes, from the top to the base:-

Windsor Group

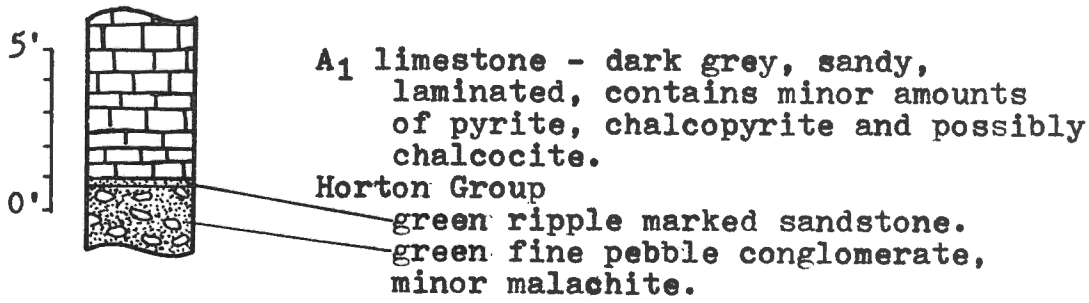
1) 5 feet of dark grey, sandy, laminated A_1 limestone; towards the top of the section the limestone is lighter in colour and pelletal; minor amounts of pyrite, chalcopyrite, and possibly chalcocite occur disseminated along laminae in the limestone.

Horton Group

2) 2 inches of green ripple-marked sandstone containing minor amounts of sulphide minerals.

3) greater than 2 feet of green, malachite-stained, fine pebble conglomerate.

Figure 21.
STRATIGRAPHIC SECTION,
BIG MARSH, N.S.



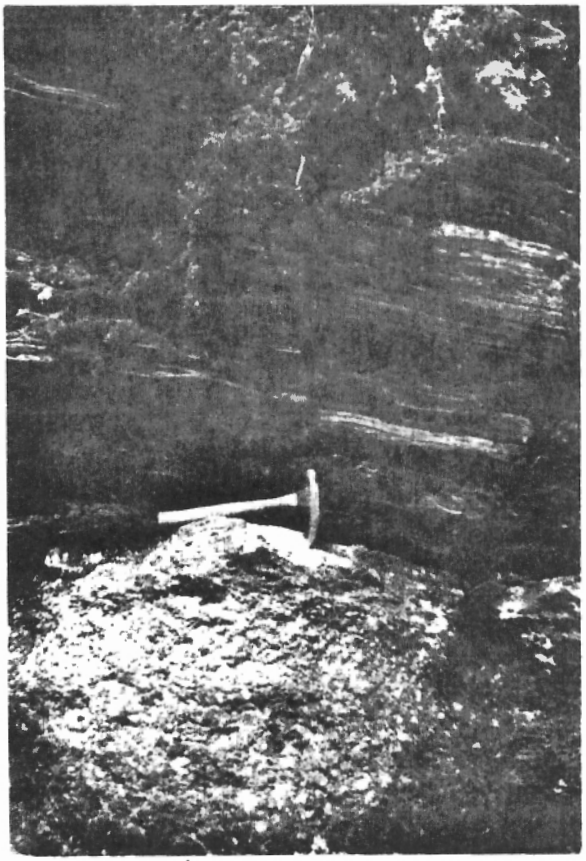


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Figure 22. Typical laminated M_1 limestone overlying Horton green pebble conglomerate at Big Marsh, N.S.

35 - **Lakevale, N.S.**

lat. 45°47'12" long. 61°54'38"

A small private lane immediately north of the church in Lakevale leads east to the beach and sea-cliff exposures of Horton and Windsor rocks.

The stratigraphic section (figures 23 and 24) from the top to the base consists of:-

Windsor Group

1) 20 feet of grey to black, laminated, A_1 limestone; minor chalcocite, chalcopyrite and pyrite were observed in the basal part of the unit; there is minor thrust faulting within the unit.

Horton Group

2) 4 to 5 feet of grey-green, pebble conglomerate; about 70% of the rock is composed of silt-size material, the remainder being subangular to subround, 0.5 to 2 inch size clasts; no mineralization was observed in these clastic rocks.

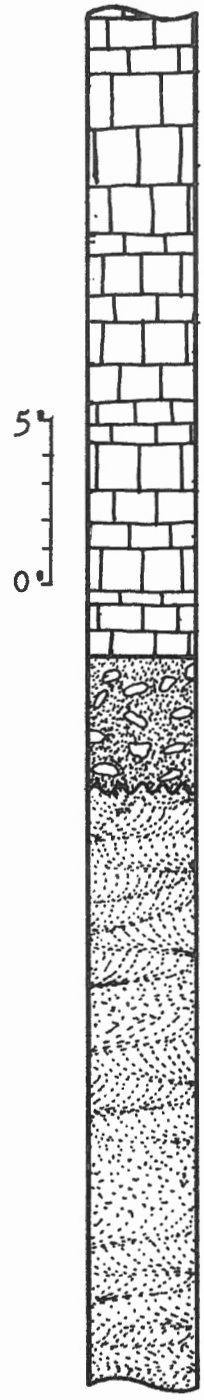
--unconformity--

3) 20 to 50 feet of variegated red and grey, cross-bedded quartz sandstone grading into underlying red, fine-grained arkosic sandstone; greater than 100 feet of red clastics are exposed on the sea cliffs; minor green mottling and reduction spheres occur in the red unit.

The stratigraphic section is atypical because of the green conglomerate that is conformable with the overlying Windsor limestone but not with the underlying Horton sandstone.

A similar section is exposed at McIsaac Point, 3.6 miles to the south.

Figure 23.
STRATIGRAPHIC SECTION,
LAKEVALE, N.S.

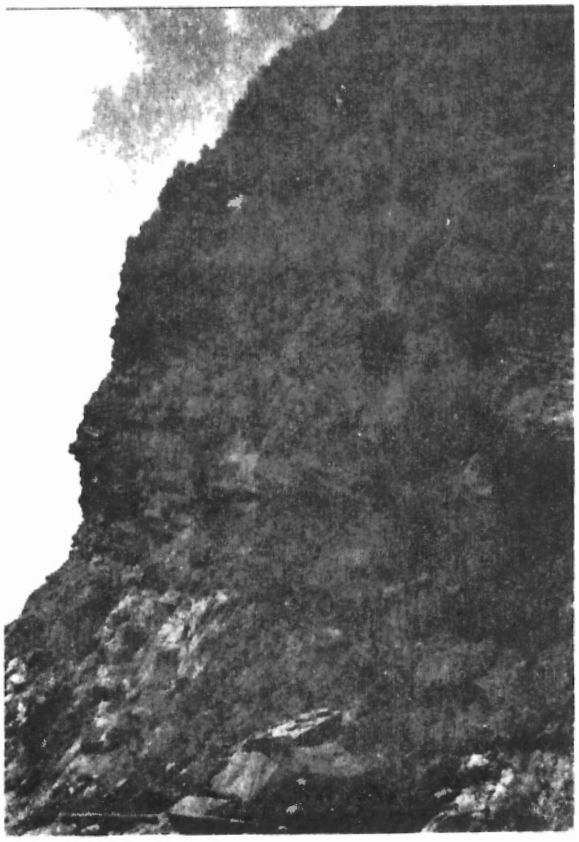


A_1 limestone - black, laminated, contains minor chalcocite, chalcopyrite and pyrite.

Horton Group
green silty pebble conglomerate.

unconformity

variegated red and grey, cross-bedded quartz sandstone underlain by red arkosic sandstone.



R.V.K. 9-11-74

Figure 24. Typical laminated, micritic A_1 limestone conformably overlying green pebble conglomerate which in turn unconformably overlies red and white sandstone of the Horton Group. Lakevale, N.S.

36 - Crystal Cliffs, N.S.

lat. 45°44'13" long. 61°53'25"

The Windsor-Horton contact is exposed at McIsaac Point, approximately 1 mile north of Crystal Cliffs (Benson, 1970).

The A_1 limestone outcrops on three small points, the middle of the three outcrops showing the best contact with the underlying Horton Group. At the base of the stratigraphic section there are red and white sandstones. These are unconformably overlain by 1 to 2 feet of green pebble conglomerate with subangular to angular, less than 2 inch long, volcanic clasts. No copper mineralization is observed in this conglomerate. It is conformably overlain by 10 feet of laminated, A_1 limestone. The limestone is grey-green in colour and contains minor pyrite at the base, however, about 7 feet above the base, the limestone is red-mottled, microcrystalline, and contains no sulphides. At this location the A_1 limestone is also gently folded and cut by several small thrust faults.

This outcrop is similar to the section at Lakevale, further to the north on the coast, where a conglomerate also occurs intermediate between the Horton sandstone and the A_1 limestone.

37 - Lower North Grant, N.S.

lat. 45°38'49" long. 61°59'26"

One and three-tenth miles north of the CN railway crossing on the road to Lower North Grant, there is an outcrop of A_1 limestone. The rock exposures are in a stream valley to the east of the road.

The Horton rocks exposed at this location comprise 10 feet of green pebble conglomerate. This conglomerate is conformably overlain by 10 to 15 feet of black, laminated, A_1 limestone. Minor chalcocite occurs in the basal few feet of the limestone.

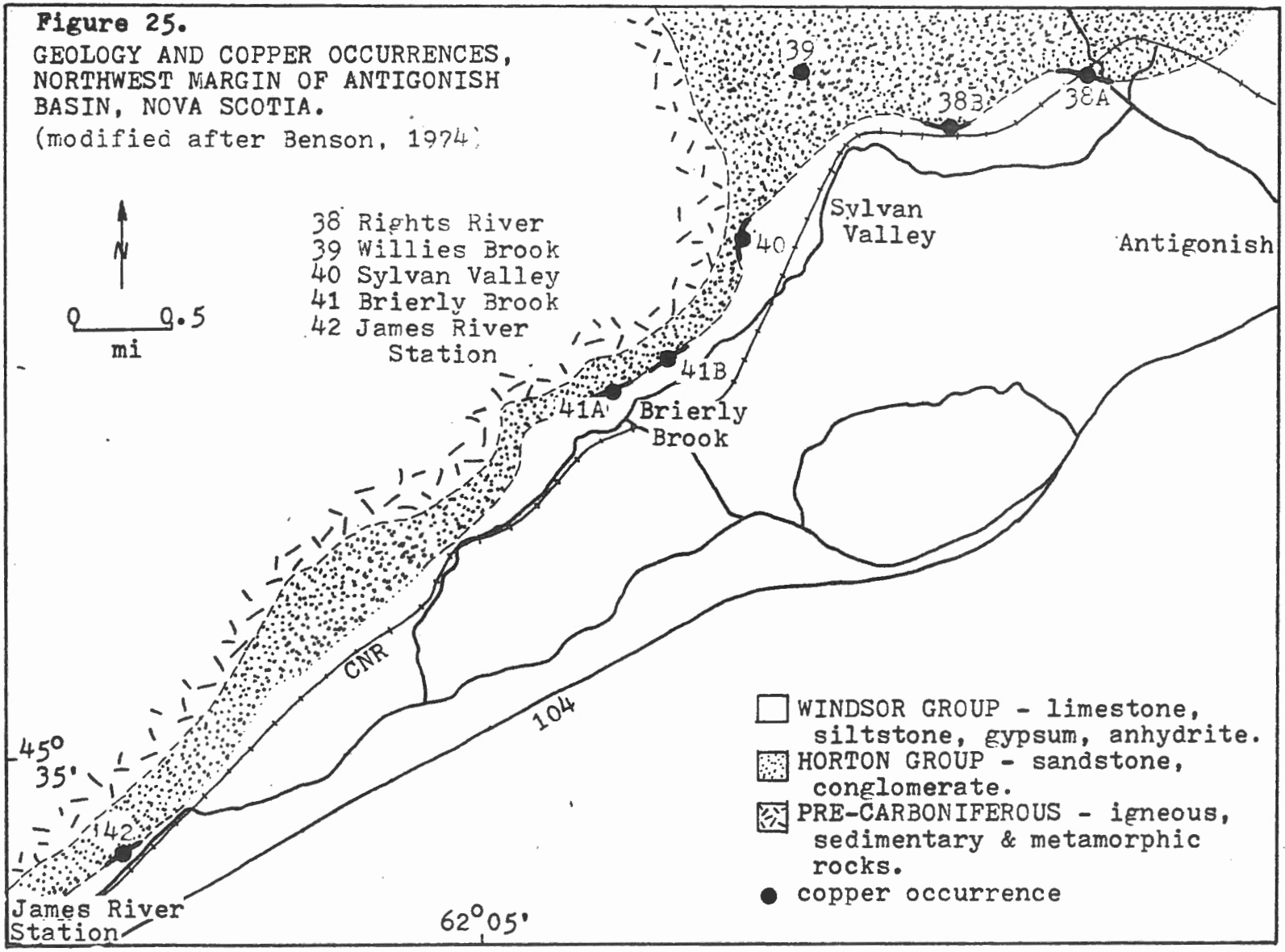


Figure 25.
GEOLOGY AND COPPER OCCURRENCES, NORTHWEST MARGIN OF ANTIGONISH BASIN, NOVA SCOTIA.
(modified after Benson, 1974)
N
0 0.5
mi
38 Rights River
39 Willies Brook
40 Sylvan Valley
41 Brierly Brook
42 James River Station
39
38B
38A
40
Sylvan Valley
Antigonish
41B
41A
Brierly Brook
CNR
104
45° 35'
42
James River Station
62°05'
WINDSOR GROUP - limestone, siltstone, gypsum, anhydrite.
HORTON GROUP - sandstone, conglomerate.
PRE-CARBONIFEROUS - igneous, sedimentary & metamorphic rocks.
copper occurrence

38 - Rights River, N.S.

38A - main showing in river

lat. 45°38'00" long. 62°01'13"

38B - showing on railway

lat. 45°37'46" long. 62°02'01"

These showings are located on the South Rights River, about 1.5 miles northwest of Antigonish (figure 25).

At low water, the basal part of the A_1 limestone is exposed about 200 feet upstream from where the Antigonish to North Grant road crosses the river. Eighteen inches of typical dark grey, laminated limestone underlain by five feet of green conglomerate and a thick section of poorly sorted red conglomerate occur in the bed of the river.

Visible chalcocite and malachite occur in both the green conglomerate and the limestone. In the limestone, chalcocite is erratically disseminated along the bedding laminae with minor chalcocite and trace amounts of chalcopyrite occurring in small carbonate veins. Analyses of this limestone showed that there is about 0.4 to 0.6% copper over 18 inches.

One-half mile west of the main showing, on a hill to the north of the CN railway, there is an outcrop of A_1 limestone overlying grey conglomerate. Malachite and chalcocite occur in the conglomerate while only minor amounts of chalcocite are observed in the limestone.

During 1973, Imperial Oil drilled two holes about 1,000 feet east and 2,000 feet southeast of the main river showing. Assays of these cores indicate only minor copper along this contact.

39 - Willies Brook, N. S.

lat. 45°38'02" long. 62°03'01"

Chalcocite mineralization is visible in a grey Horton conglomerate, exposed on Willies Brook northwest of Antigonish (figure 25). The chalcocite occurs in pods, along fractures, and finely disseminated throughout the conglomerate. Red beds of the Horton Group are visible both above and below the grey conglomerate.

This is not a Windsor-Horton contact occurrence like the other copper showings described in the Antigonish area.

40 - Sylvan Valley, N.S.

lat. 45°37'20" long. 62°03'22"

There is a good exposure of the Windsor-Horton contact at Sylvan Valley (figure 25). The outcrops occur along a small stream on the first farm east of the railway crossing at Sylvan Valley.

The stratigraphic section at this location, from the top (downstream) to the base (upstream), consists of:-

Windsor Group

1) 6 feet of dark, laminated, sandy, micritic A_1 limestone; the limestone is carbonaceous and smells petroliferous when freshly broken; chalcocite is sparse and erratically disseminated in the basal limestone beds, while slightly higher in the section pyrite and chalcopyrite predominate.

Horton Group

2) 0 to 3 inches of green quartz sandstone with minor chalcocite.

3) 5 to 10 feet of green pebble conglomerate with subangular to subround, elongate clasts, up to 1 inch in size; no sulphides are visible in the conglomerate, although it is stained with malachite near its upper contact with the A_1 limestone or sand bed.

4) unknown thickness of red conglomerate.

41 - Brierly Brook, N.S.

41A - Brierly Brook

lat. 45°36'39" long. 62°04'10"

41B - stream and pit, 2,000 feet east of Brierly Brook

lat. 45°36'44" long. 62°03'46"

The Windsor-Horton contact is exposed at Brierly Brook and in a stream valley and pit, 2,000 feet east of Brierly Brook (figure 25).

The most complete stratigraphic section, that at Brierly Brook, comprises (figure 24) from the top to the base;

Windsor Group

1) 5 to 7 feet of dark grey, laminated, calcite-veined, A_1 limestone; in the basal 5 inches of the section chalcocite is the dominant copper mineral while slightly higher in the section (5 - 12 inches), chalcopyrite dominates; pyrite and minor chalcocite and chalcopyrite occur higher in the limestone section.

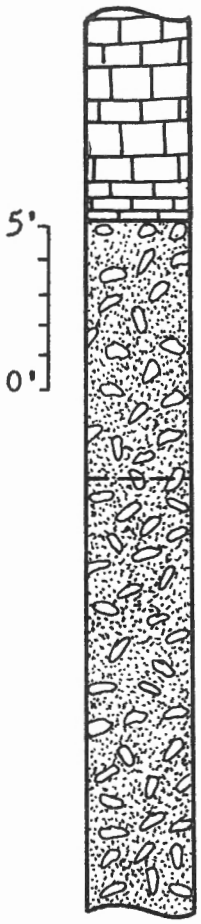
Horton Group

2) 5 to 10 feet of green pebble conglomerate; the rocks are malachite stained and directly beneath the A_1 limestone contain chalcocite.

3) unknown thickness (greater than 20 feet) of poorly sorted red pebble to cobble conglomerate.

The section exposed 2,000 feet east of Brierly Brook is similar in lithology to the section described above. The copper minerals observed include chalcocite, malachite, and very minor azurite. The malachite and azurite occur on joint faces in the limestone.

Figure 26.
PARTIAL STRATIGRAPHIC SECTION,
BRIERLY BROOK, N.S.



A_1 limestone - dark grey, laminated, veined by calcite, contains minor disseminated chalcocite, chalcopyrite, and pyrite.

Horton Group
green pebble conglomerate with minor chalcocite and malachite.

red pebble conglomerate

42 - James River Station, N.S.

lat. 45°34'40" long. 62°07'15"

At James River Station, in the western end of the Antigonish Basin (figure 25), mineralized Horton and Windsor rocks occur in small outcrops. The outcrops are about 700 feet north of the old highway on a small intermittent stream, 0.8 miles east of James River Station. This area has been mapped by Benson (1974) as being part of the Horton Group.

In the bank of the stream typical dark grey, laminated A_1 limestone overlies green sandy pebble conglomerate. Malachite and chalcocite occur in the conglomerate, while minor amounts of chalcocite and chalcopyrite can be observed in the limestone.

43 - St. Josephs, N. S.

lat. 45°32'04" long. 62°05'34"

Horton and Windsor rocks are exposed on the south branch of Frasers Brook, west of St. Josephs. About 0.25 miles upstream from the road (Benson, 1974) there is typical, dark grey, laminated A_1 limestone containing minor chalcopyrite and pyrite. Red pebble to boulder conglomerate outcrops further upstream past a short covered interval. No upper green zone was observed and there is no malachite staining in the conglomerate.

44 - McPherson, N.S.

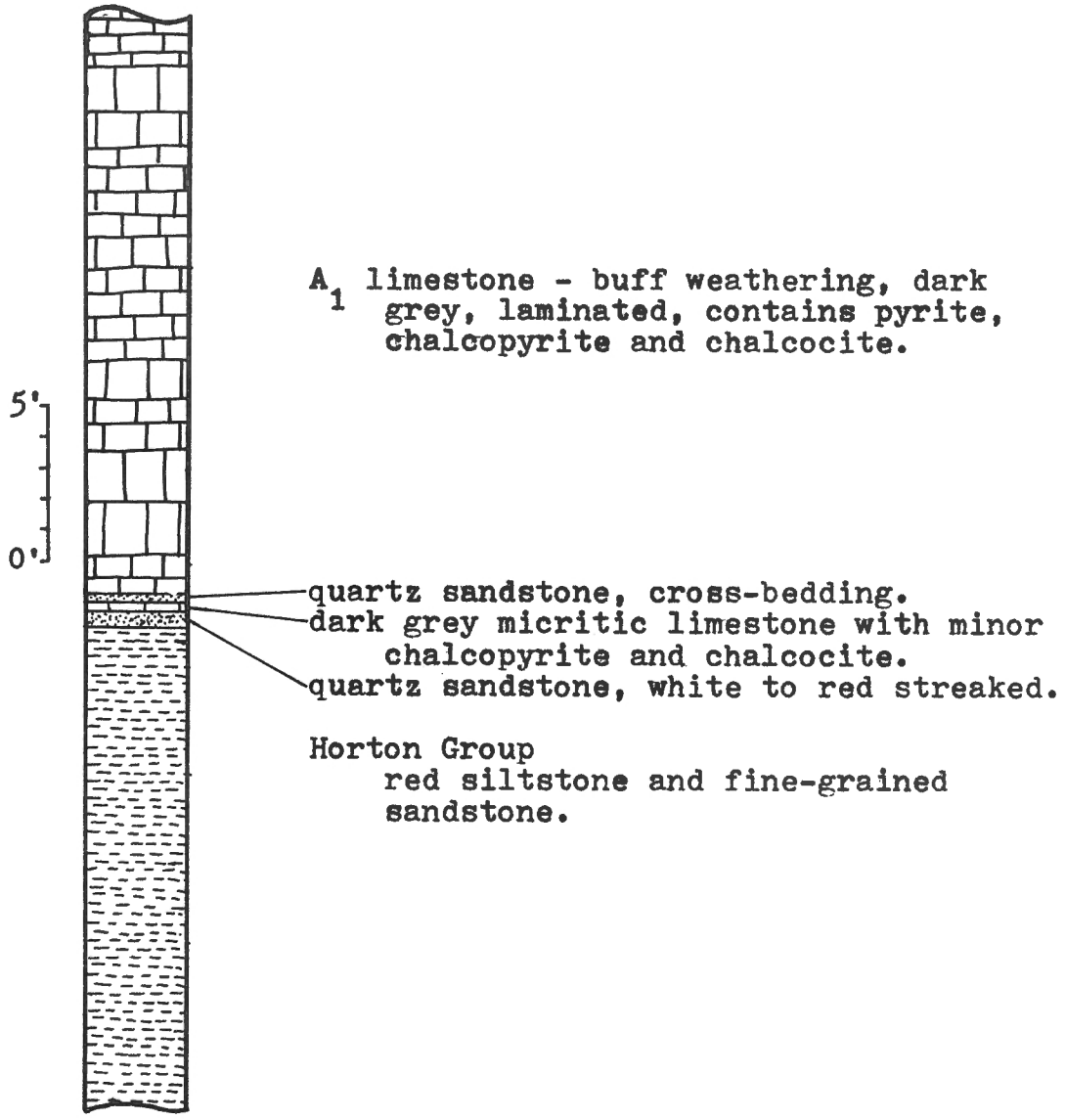
lat. 45°31'42" long. 61°54'26"

The Windsor-Horton contact outcrops 2 miles south of St. Andrews on a tributary of South River (Benson, 1970). The best access to these outcrops is to walk down the tributary from where it crosses the Lower Springfield road, 0.5 miles east of the St. Andrews to McPherson road.

Upstream from the contact a thick section of red siltstone and fine-grained sandstone of the Horton Group is exposed. Immediately beneath the A_1 limestone, and at the top of the Horton section, there is a 0.5 foot thick bed of white to red streaked quartz sandstone (figure 27). Overlying this sandstone is a 0.3 foot thick bed of grey micritic limestone. The top of this limestone shows erosional 'rip-up' features beneath a 1 to 2 inch thick bed of quartz sandstone. This sand bed contains cross-bedding, plane-bedding, and soft sediment deformation, which in conjunction with the 'rip-up' of the underlying limestone suggests a short period of active erosion followed by clastic deposition. Overlying these basal beds, there is 30 feet of buff-weathered, light to dark grey, laminated, A_1 limestone.

Minor chalcopyrite and possibly chalcocite occur in the basal limestone beds while pyrite is visible throughout the limestone section at this location.

Figure 27.
PARTIAL STRATIGRAPHIC SECTION,
MCPHERSON, N.S.



45 - Meadow Green, N.S.

lat. 45°33'04" long. 61°48'55"

The steeply dipping Windsor-Horton contact is exposed on the Pomquet River at Meadow Green, 10 feet south of the Black Avon to St. Andrews road bridge (Benson, 1970).

Upstream from the contact there is a thick section of red siltstone and sandstone of the Horton Group. No green leached zone occurs at the top of the clastic section, which is conformably overlain by 10 feet of dark grey, laminated, micritic A_1 limestone. Minor chalcopyrite, pyrite and possibly chalcocite occur in the basal few inches of the limestone.

46 - Monastery Brook, N.S.

lat. 45°35'46" long. 61°38'42"

Horton and Windsor rocks outcrop on Monastery Brook, 0.8 miles upstream from the Monastery (Benson, 1970).

The Horton Group at this location includes red siltstone and sandstone. Downstream from the clastic rocks, there is dark grey to black, laminated A_1 limestone. Calcite veins and minor fluorite occur in the limestone, however, only very minor pyrite was observed. There is 10 to 15 feet of cover in the vicinity of the Windsor-Horton contact. Further downstream, there are scattered outcrops of red Windsor Group clastic rocks.

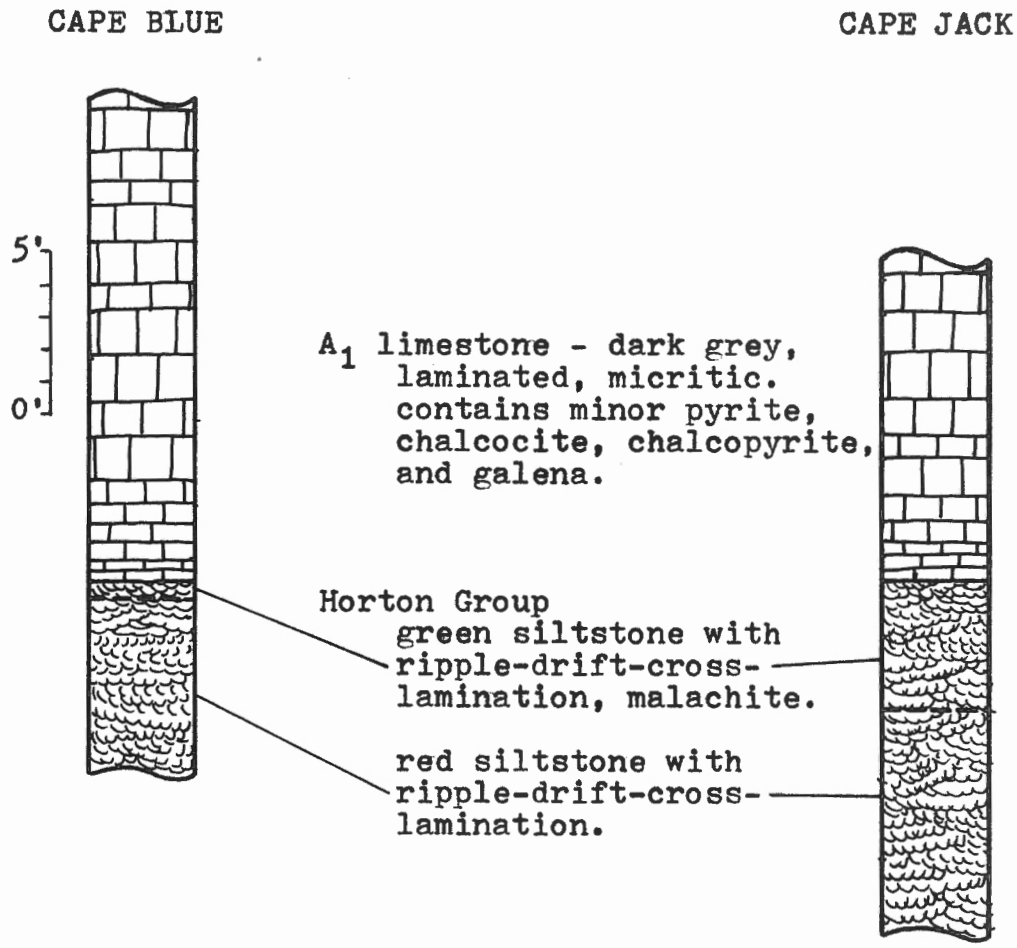
47- Cape Blue, N. S.

lat. 45°40'08" long. 61°35'32"

The Windsor-Horton contact is exposed at Cape Blue, 1.5 miles north of Linwood, N. S. The outcrops can be reached by walking north on a lane, now blocked by a concrete barrier, to an abandoned fishing village (map 2-1970, Benson, 1970).

The Horton Group at this location is well exposed and consists of a thick section of red siltstone and fine grained sandstone (figure ~~2~~). At the top of the Horton Group, immediately underlying the A_1 limestone, there is a green, malachite-stained siltstone (figure ~~2~~). Fifteen feet of typical, dark grey, laminated A_1 limestone conformably overlies the Horton clastic rocks. Minor visible chalcocite, pyrite and very minor galena occur disseminated throughout the basal three feet of the limestone section.

Figure 28.
PARTIAL STRATIGRAPHIC SECTIONS,
CAPE BLUE AND CAPE JACK, N.S.



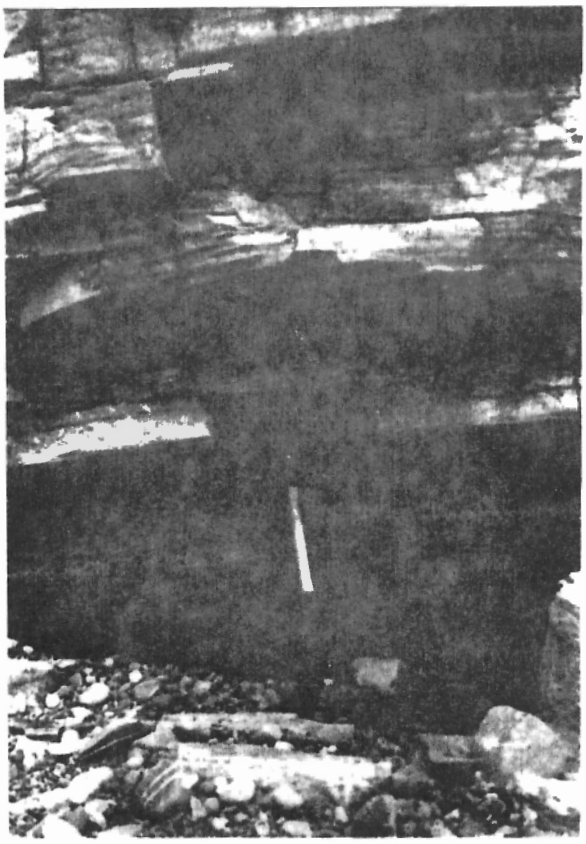


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Figure 29. Laminated A_1 limestone overlying green and red siltstone of the Horton Group at Cape Blue, N.S. The green reduced zone immediately beneath the limestone is visible in the photograph.

48 - Cape Jack, N.S.

lat. 45°41'20" long. 61°33'44"

The Windsor-Horton contact outcrops on the coast to the north of the town of Cape Jack, 2 miles northeast of a similar outcrop at Cape Blue (figure 26). Access is through the back of a farm just north of Cape Pond (map 2-1970, Benson, 1970).

The Horton rocks at this location are red, ripple-drift-cross-laminated siltstone and fine-grained sandstone. At the top of the clastic section there is a 4 foot thick bed of green siltstone and fine-grained sandstone, which has a mottled boundary with the underlying red units. This green unit is ripple-drift-cross-laminated and other than its colour, is lithologically similar to the red beds. The Horton Group is conformably overlain by 10 feet of dark grey to black, laminated, micritic, A_1 limestone.

Malachite is observed in the upper part of the green siltstone and sandstone unit. Pyrite, chalcopyrite, and very minor chalcocite occur in the basal 1 foot of the A_1 limestone.

This area appears to be transitional from the Antigonish area where chalcocite is the dominant sulphide, to Cape Breton Island where only chalcopyrite and very rare bornite occurs.

49 - Keaton Point, N.S.

lat. 45°37'35" long. 61°23'22"

Windsor, Horton, and Pre-Carboniferous basement rocks are exposed in a stream valley at Keaton Point, 0.7 miles north of Mulgrave. Access is by the shore road north from Mulgrave and then from the end of this road, 200 feet along the beach to the small stream where the outcrops occur (map 995A, Ferguson and Weeks, 1950).

Upstream, at the base of the stratigraphic section, there is Pre-Carboniferous granitic basement rock. Unconformably overlying the igneous basement is clean quartz sandstone of the Horton Group. The clastic rocks are conformably overlain by the Windsor Group. The base of the Windsor Group is a massive, dark grey, limestone. Above this, there is dark grey, laminated, A_1 limestone which contains minor chalcopyrite. Due to slumping in the stream banks, the contacts of the rock units are not exposed. Therefore, the thicknesses of the units are not known, and the relationship of the massive limestone to the overlying laminated limestone could not be established.

50 - Steep Creek, N. S.

Lat. 45°33'58" long. 61°21'17"

The Windsor-Horton contact outcrops at Steep Creek, on the southwestern shore of the Strait of Canso (map 995A, Ferguson and Weeks, 1950). The exposures occur on the shore and in a roadcut (figure 30).

At the base of the stratigraphic section there are several hundred feet of green pebble conglomerate and sandstone of the Horton Group. Very minor malachite occurs in the clastic rocks immediately beneath the dark grey, laminated A_1 limestone. Twenty feet of limestone is observed in the roadcut, while on the shore, due to thrust faulting and folding there is over 100 feet of limestone. Sparse chalcopyrite occurs in the limestone at this location.

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Figure 30. Faulted and calcite veined A_1 limestone conformably overlying a thick section of green Horton conglomerate and sandstone, Steep Creek, N.S.

4) CAPE BRETON ISLAND

INTRODUCTION

Due to the great diversity in the stratigraphy and mineralization observed at the Windsor-Horton contact, Cape Breton Island has been divided into three sub-areas (figures 31 and 32).

a) Western Cape Breton Island

In western Cape Breton Island, typical A_1 limestone was observed overlying Horton clastic rocks at many locations, including Gillisdale, Hillsborough, Judique North, Margaree, McEachern Mills,and Miramichi. Although these exposures are lithologically similar to many others in northern mainland Nova Scotia and Cape Breton Island, they are poorly mineralized and mainly pyritic (figure 33).

An interesting and unique outcrop occurs at Finlay Beach, on the west coast of Cape Breton Island. Here, laminated, crystalline A_1 limestone and 0 to 6 inches of green pebble to cobble conglomerate unconformably overlie red, sandy conglomerate of the Horton Group. Rare specks of malachite, chalcopyrite, and bornite are found in the thin green conglomerate beneath the A_1 limestone. The outcrops are otherwise barren of sulphide mineralization.

b) Central Cape Breton Island

Mineralization in the A_1 limestone and underlying Horton pebble to boulder conglomerate can be observed throughout much of central Cape Breton Island. Chalcopyrite and malachite

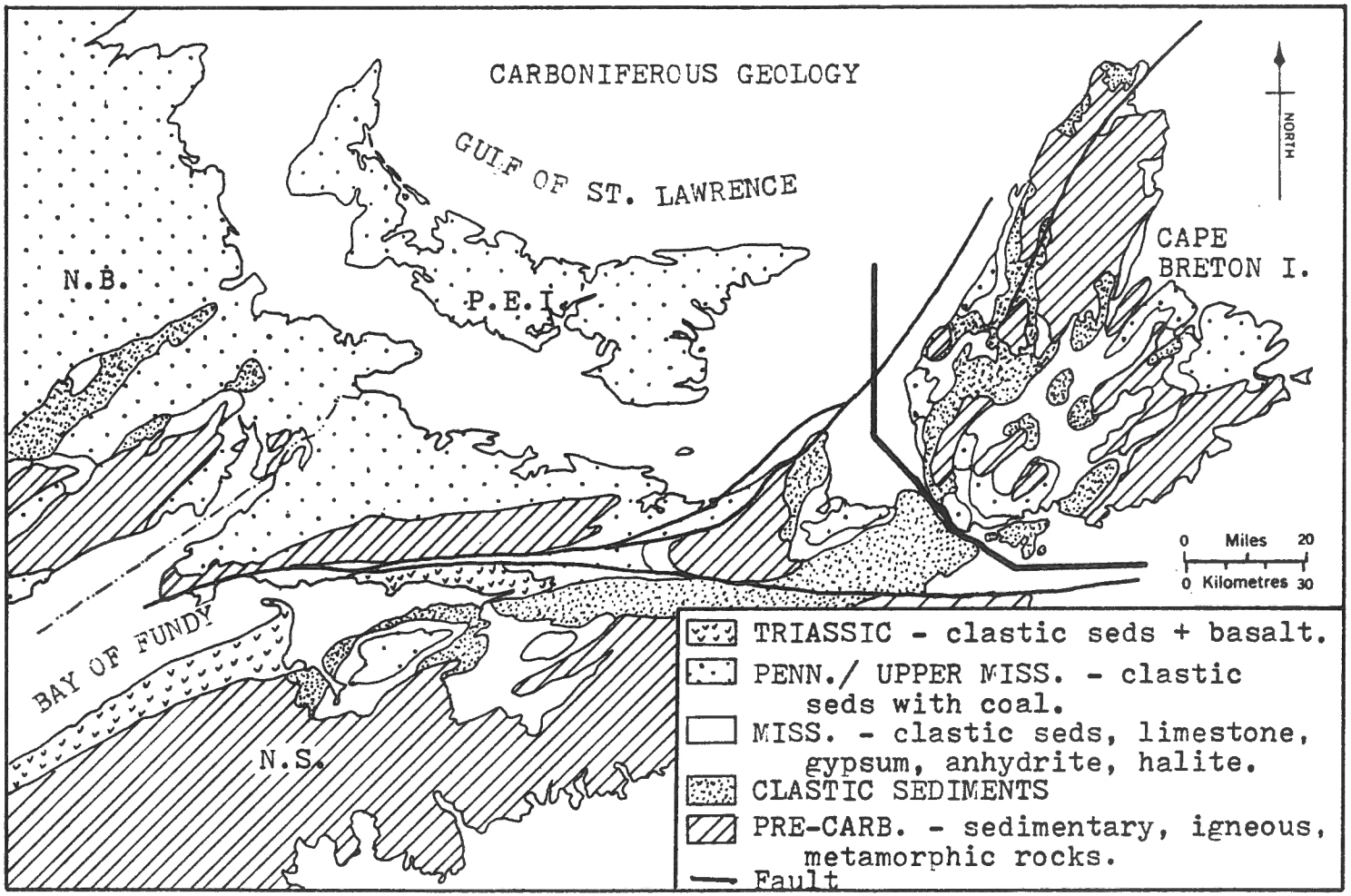


Figure 31. Cape Breton Island, N.S.

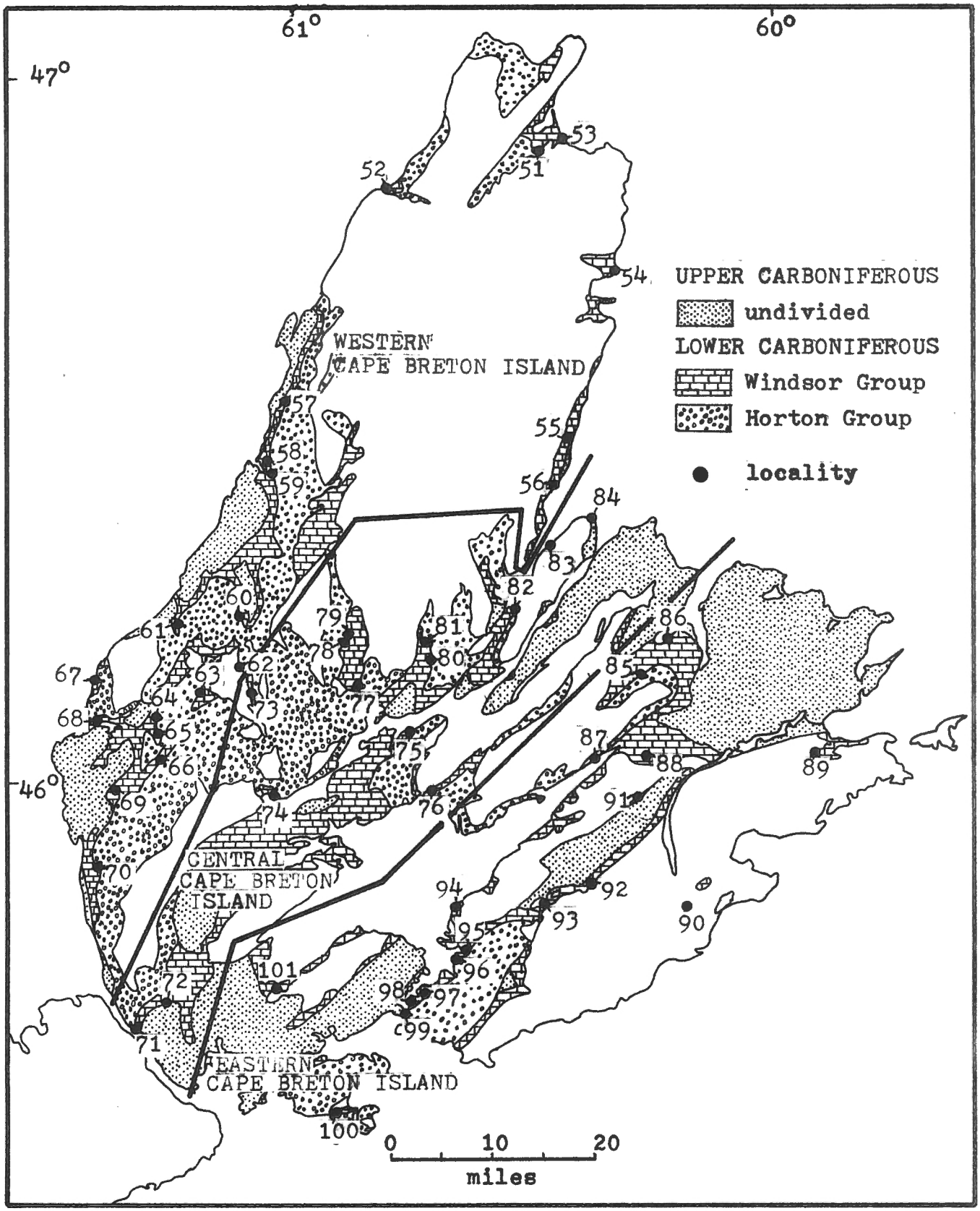


Figure 32. CARBONIFEROUS GEOLOGY OF CAPE BRETON ISLAND (mainly after N.S. Dept. of Mines, 1965)

KEY TO LOCATIONS ON CAPE BRETON ISLAND, N.S.

WESTERN CAPE BRETON ISLAND

CENTRAL CAPE BRETON ISLAND

EASTERN CAPE BRETON ISLAND

EASTERN CAPE BRETON ISLAND (continued)

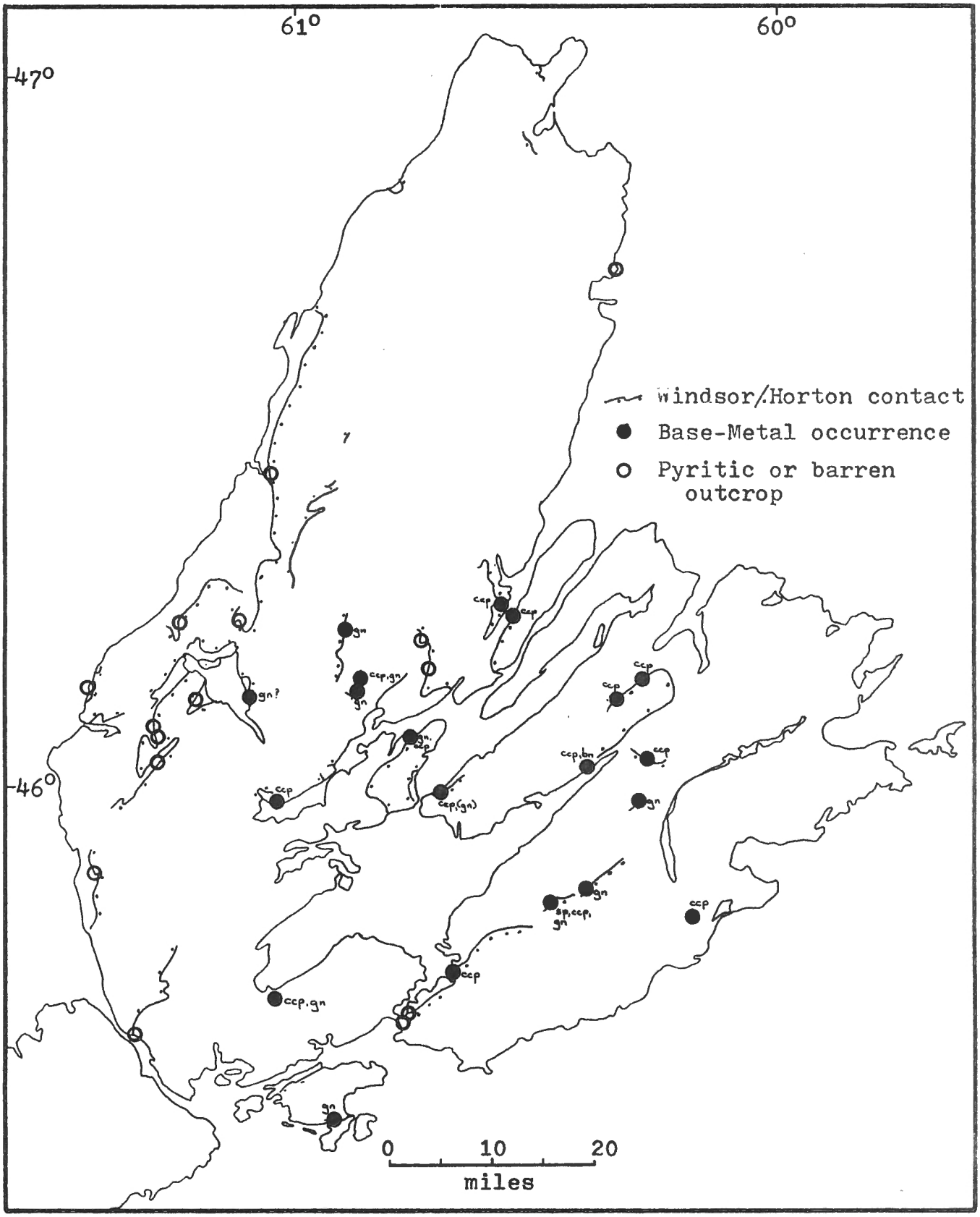


Figure 33. Mineral localities at the Windsor-Horton and/or Grantmire contact in Cape Breton Island.

occur on the Windsor-Horton contact at Christmas Island, St. Ann's, Washabuck, and Whycocomagh. Galena is observed in similar rocks in the Upper Middle River area, and at Trout River. Only in the south, near Port Hastings, are the outcrops pyritic.

c) Eastern Cape Breton Island

Much of the limestone in eastern Cape Breton Island is porous and fossiliferous, definitely part of the B or higher subzones of the Windsor Group. However, sandy laminated limestone does occur at several locations, including Coxheath Hills, East Bay, Glen Morrison, and Lake Enon. Similar to the A_1-Horton contact, the basal Windsor limestone and its immediately underlying clastic rocks of the Grantmine Formation (Bell & Goranson, 1938a) contain chalcopyrite, malachite, and at East Bay, bornite. At Lake Enon, significant concentrations (0.1 - 1%) of lead and zinc also occur in the basal Windsor limestone.

Undisputed examples of A_1 limestone occur at McNab's Cove, Soldier Cove North, St. Peters, and Arichat in southeastern Cape Breton Island. Chalcopyrite is observed in the basal limestone at Soldier Cove North while lead has been reportedin the limestone at Arichat (Weeks, 1964).

From the above summary, it is noted that pyritic A_1 limestone outcrops in western Cape Breton Island, copper and lead bearing A_1 limestone outcrops in central Cape Breton Island, and cupriferous limestone, lithologically similar to the A_1 limestone, outcrops in eastern Cape Breton Island.

4a) LOCALITIES IN WESTERN CAPE BRETON ISLAND

51 - Cape North, N.S.

lat. 46°52'37" long. 60°30'08"

A_1 limestone has been reported at several localities in the Cape North area (Neal, 1963b).

The only reported location visited by the author was on South Aspy River, near the Cape North garbage dump. Although an exposure of black schistose basement rocks appears similar to the A_1 limestone when viewed from a distance, there is no limestone at this location.

52 - Pleasant Bay, N.S.

lat. 46°49'24" long. 60°49'48"

It was reported to the author (A. Hudgins, 1974, personal communication) that the Windsor limestone outcropped at the foot of MacKenzie Mountain, on the beach.

To verify this, a traverse was run along the beach at the foot of MacKenzie Mountain. The rocks at this location are quartz sandstones and pebble conglomerates of the Horton Group (Neale, 1963a) which contain pyrite. Fluorite and galena occur in the underlying granodiorite (Neale, 1963a) No limestone was found at this location.

53 - Yellow Head, N.S.

lat. 46°52'34" long. 60°25'32"

Limestone of the B subzone of the Windsor Group outcrops at Yellow Head, 2.6 miles southeast of Dingwall (Neale, 1963b) No A_1 limestone or Horton clastic rocks were observed at this location.

54 - Bear Cove, N.S.

lat. 45°41'40" long. 60°21'22"

Lower Carboniferous clastic and carbonate rocks are exposed at Bear Cove, north of Ingonish. The cove is reached by walking north along the shore from the Ingonish wharf (MacLaren, 1956).

At the base of the exposed section, there is brown, coarse-grained, cross-bedded sandstone and thin wedges of interbedded boulder conglomerate. This clastic unit, although it lacks the typical red and green colouration, is correlated with the Horton Group on the basis of lithology. Overlying the clastic unit there is 3 feet of dark grey to black, thin bedded limestone. Pyrite and minor chalcopyrite are visible in the limestone and the upper clastic units. About 20 feet of porous, buff-weathering limestone and dolomite overlie the basal limestone. This upper limestone probably correlates with the B subzone of the Windsor Group.

The location is of interest since sulphides are observed at the limestone-sandstone contact even though the A_1 limestone is absent.

55 - Skir Dhu, N.S.

lat. 46°29'29" long. 60°27'10"

Only two outcrops of Carboniferous rocks were visible on a short traverse of the French River at Skir Dhu. About 0.12 miles west of the highway, massive gypsum outcrops in the bank of the river. One-quarter mile west of the highway there is an outcrop of red pebble conglomerate, similar in lithology to the Grantmire Formation. Although some massive brown/limestone blocks do occur in the riverbed, no in situ limestone was observed between the conglomerate and gypsum outcrops.

56 - North Shore, N.S.

lat. 46°24'34" long. 60°28'39"

The shoreline was traversed for about one mile south from the small provincial picnic park at North Shore. Bell and Goranson (1938) indicate that the contact of the Grantmire Formation and the overlying Windsor limestone and gypsum should occur in this area.

Massive outcrops of gypsum occur on the shore near the picnic park. Further to the south, red siltstone, probably of Windsor age, is exposed. However, no limestone or Grantmire conglomerate is visible along the shore.

57 - St. Joseph du-Moine, N.S.

lat. 46°30'58" long. 61°02'47"

The area where the Windsor-Horton contact was located by Cameron (1948) is heavily overgrown and no outcrops could be found.

58 - Belle Cote, N.S.

lat. 46°26'12" long. 61°05'18"

A search for the basal Windsor limestone was made in the Belle Cote area, near the mouth of the Margaree River. The area is one of low relief and no outcrops could be found. Further to the south, on some of the tributaries of the Margaree River, there may be a possibility of finding the Windsor-Horton contact.

59 - Margaree, N.S.

lat. 46°23'24" long. 61°04'19"

Windsor and Horton rocks outcrop on a tributary of the Margaree River, 0.6 miles south of the town of Margaree (map 48-11A, Cameron, 1948).

Red siltstone and sandstone (Horton Group) outcrop in a quarry to the south of the stream. Grey sandstone occurs towards the top of the Horton Group. Above a 25 foot covered interval there is 10 feet of dark grey, laminated, micritic A_1 limestone. Pyrite is disseminated along laminae in the basal part of the limestone section.

60 - Gillisdale, N.S.

lat. 46°13'43" long. 61°08'54"

The Windsor-Horton contact outcrops in the bank of a laneway, 0.7 miles southwest of Gillisdale, (map 282A, Norman, 1935).

At the base of the outcrop, there is a thin section of yellowish-green pebble conglomerate. Ten feet of laminated, micritic, A_1 limestone overlies the conglomerate. Pyrite is common throughout the limestone, however, only very minor amounts of chalcopyrite occur in the calcite-veined basal part of the section.

61 - McEachern Mills, N.S.

lat. 46°14'47" long. 61°14'39"

Access to McEachern Mills is by the Campbellton Road which branches east from the main highway, 3.1 miles north of Inverness.

The Windsor-Horton contact occurs upstream from McEachern Mills, on McEachern Brook (map 282A, Norman, 1935). Upstream, at the base of the section, there is red shale, siltstone, and sandstone of the Horton Group. Five feet of green sandstone at the top of the Horton Group is conformably overlain by 15 to 20 feet of dark grey, laminated, micritic, A_1 limestone. The limestone is veined by calcite, the highest density of veins occurring 8 to 10 feet above the base of the unit. Minor pyrite is disseminated throughout the limestone, however, it is not common in the calcite veins.

62 - Kirkwood, N.S.

lat. 46°14'58" long. 61°09'33"

A_1 limestone outcrops at Kirkwood, on the east shore of Lake Ainslie (map 282A, Norman, 1935).

The medium grey, laminated, microcrystalline limestone contains a few grains of pyrite, however, the contact of the Windsor and Horton Groups is not exposed at this location.

63 - Hay River, N.S.

lat. 46°06'27" long. 61°15'33"

At Hay River, Windsor and Horton rocks are exposed in a roadcut and river valley (Norman, 1935).

About 10 feet of fissile, dark grey, laminated A_1 limestone outcrops in a roadcut. The lower micritic part of the limestone outcrop contains minor pyrite, however, to the top of the outcrop where the limestone is crystalline, no sulphides were observed. Green cross-bedded sandstone of the Horton Group is exposed 100 feet north (about 70 feet lower stratigraphically) of the roadcut in a stream valley. The contact of the Windsor limestone and the Horton clastics is not exposed at this location.

64 - Glendyer, N.S.

lat. 46°05'19" long. 61°20'19"

A_1 limestone outcrops 0.5 miles east of the road on a small brook at Glendyer, N.S.

Traversing east along the brook, the first rock exposed is grey laminated limestone which correlates with the A_1. Fifteen feet of this limestone outcrops and then further upstream, past a 20 foot covered interval, there is grey sandstone and minor red shale of the Horton Group. Minor amounts of pyrite and possibly galena or sphalerite were observed in the limestone at this location.

65 - Hillsborough, N.S.

65A - roadcut

lat. 46°03'43" long. 61°20'03"

65B - stream

lat. 46°03'53" long. 61°19'49"

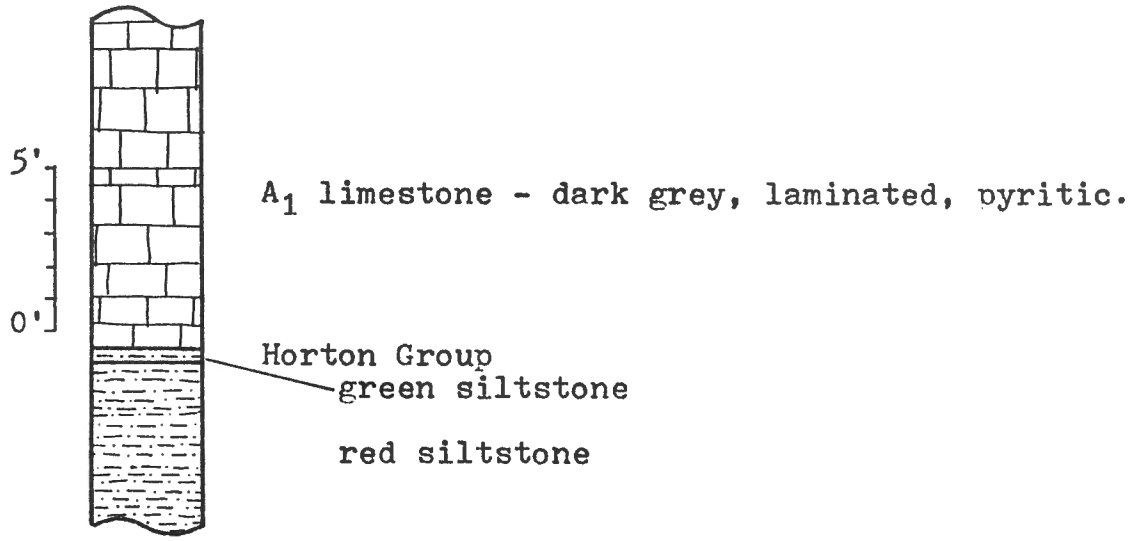
One-half mile south of the church at Hillsborough, Windsor limestone and Horton clastic rocks outcrop in a roadcut and to the east of the highway along a small stream (Norman, 1935).

A_1 limestone and massive Horton sandstone outcrops in the stream valley, however, the contact is not exposed.

The most complete stratigraphic section is in the roadcut (figure 34). Five feet of red siltstone, overlain by 0.5 feet of green siltstone occur at the base of the section. Above this there is 10 feet of grey, laminated A_1 limestone. Minor pyrite occurs in the basal portion of the limestone section, while towards the top there are ½ to 3/4 inch sperical masses of pyrite. No copper was found at this locality. The contact of the limestone and the siltstone was exposed by digging in the small talus slope at the base of the limestone outcrop.

Figure 34.

STRATIGRAPHIC SECTION
HILLSBOROUGH, N.S.



66 - Miramichi, N.S.

lat. 46°01'43" long. 61°18'54"

Windsor and Horton rocks are exposed on the Southeast Mabou River at Miramichi (map 282A, Norman, 1935). The outcrops of interest are about 100 feet upstream from the road bridge.

The Windsor-Horton contact does not outcrop, but it can be inferred from slumped limestone blocks in the bank of the stream. Upstream from the 'contact', red and green shale, siltstone, and sandstone of the Horton Group is exposed. A one foot thick bed of green shale occurs directly beneath 15 feet of typical grey, laminated, micritic A_1 limestone.

No copper mineralization was observed, and only minor amounts of pyrite occur disseminated along laminae in the limestone.

67 - Finlay Beach, N.S.

67A - beach outcrops

lat. 46°07'53" long. 61°27'38"

67B - road outcrop

lat. 46°08'04" long. 61°27'28"

Excellent exposures of both Lower and Upper Carboniferous rocks occur along the beach at Finlay Point (figure 35). This is one of the few outcrops in Nova Scotia where the Windsor Group unconformably overlies the Horton Group.

At the base of the stratigraphic section, 15 feet vertically (greater than 100 stratigraphically) of red matrix sandy pebble conglomerate and coarse sandstone of the Horton Group is exposed. These clastic beds, which dip northwest at 35° and strike 40°, are unconformably overlain by limestone dipping northwest at 20° and striking 50°. The rocks are slightly faulted and folded so these exact strikes and dips are not representative of the whole section but just one area in the north. Two to three feet of light grey, laminated, crystalline limestone forms the base of the Windsor Group. This limestone is correlated with the A_1 (Norman, 1935). In some areas there is 0 to 6 inches of green pebble and cobble conglomerate between the limestone and the underlying red beds (figure 36). This conglomerate is conformable with the overlying limestone and locally contains trace amounts of malachite and chalcopyrite. Overlying the A_1 limestone is a sandy and conglomeratic breccia with minor bands of brecciated limestone. Further to the south there is an outcrop of massive gypsum. On the extreme south end of the beach, faulted against this

unit, are coal seams and sandstones of Upper Carboniferous age.

A small outcrop of Windsor limestone and the underlying Horton conglomerate occurs to the east of the road to Finlay Beach in a small stream.

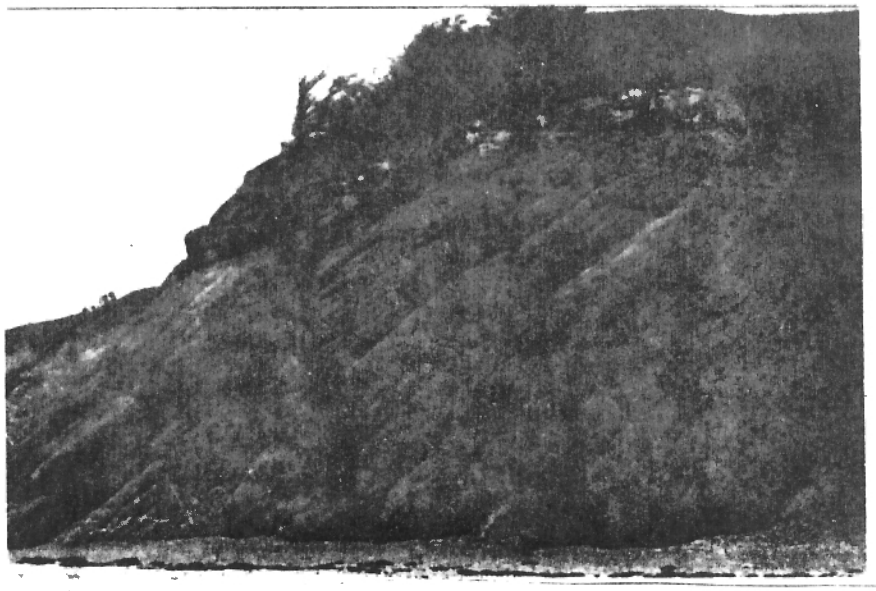


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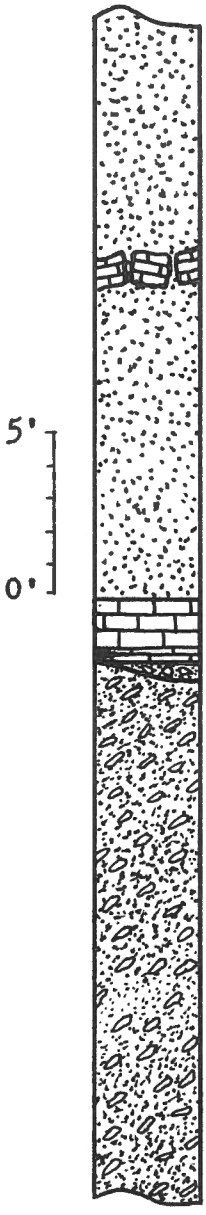
Figure 35. A_1 limestone overlying with angular unconformity red Horton conglomerate and sandstone. Finlay Beach, N.S.

Figure 36.

PARTIAL STRATIGRAPHIC COLUMN,
FINLAY POINT BEACH, NOVA SCOTIA.



Collapse Breccia - calcite cemented sand with minor disrupted limestone beds.

A_1 limestone - light grey, laminated, crystalline.
green pebble to cobble conglomerate; trace copper.

Horton Group - red pebble conglomerate and coarse sandstone.

68 - Mabou Harbour Mouth, N.S.

lat. 46°05'12" long. 61°28'04"

No limestone outcrops were found after an extensive search along the shore at Mabou Harbour Mouth. Some red siltstone and sandstone of the Horton Group does outcrop along the shore.

Norman (1935) reported that the basal Windsor limestone outcrops at the base of a brook to the northeast of the gypsum quarry at Mabou Harbour Mouth. This outcrop was not visited by the author.

69 - Southwest Mabou River, N.S.

lat. 45°59'24" long. 61°24'54"

The correct outcrop of limestone as indicated on GSC map 1212A (Kelley, 1967) was not visited. In error a minor side road was taken that leads off the main road 1.1 miles to the southeast of Glencoe Station.

One and six-tenth miles east of Glencoe Station, in the bed of the Southwest Mabou River, 5 feet of laminated, sandy limestone occurs which contains 1 to 2% chalcopyrite. This unit is overlain by 15 to 20 feet of massive grey limestone and underlain by grey, pyritiferous siltstone. Both upstream and downstream from these outcrops gypsum is exposed, indicating that the rocks are within the Windsor Group, and not at its base.

70 - Judique North, N.S.

lat. 45°53'57" long. 61°28'30"

Outcrops of A_1 Windsor limestone can be reached from the Hillsdale road, 0.8 miles east of Judique North, by walking north from the road to a small stream (Kelley, 1967; Stacey, 1953, p. 41).

Red siltstone of the Horton Group occurs upstream from the limestone outcrops. The exact contact of the clastics and the limestone is not exposed, the covered interval being 2 to 3 feet. Twenty-five to 30 feet of light to dark grey, laminated A_1 limestone outcrops beside the stream. Towards the base of the section the limestone is dark, micritic and contains minor amounts of pyrite, but, higher in the section it is lighter in colour, crystalline, and contains no sulphides.

Old rails and blocks of limestone suggest that this outcrop was once quarried, perhaps for lime or building stone.

4b) LOCALITIES IN CENTRAL CAPE BRETON ISLAND

71 - Port Hastings, N.S.

lat. 45°38'39" long. 61°24'08"

A_1 Windsor limestone and Horton clastic rocks outcrop in a large railway cut behind the Skye Motel in Port Hastings.

At this location the Horton Group comprises massive green sandstone with red and black siltstone interbeds. These rocks are in contact with the folded, calcite, fluorite, and gypsum veined A_1 limestone. Pyrite occurs along laminae in the limestone, however, no other sulphides are observed.

Although rocks in this area have been significantly deformed, this locality contains a good section of upper Horton strata.

72 - North West Arm Brook, near Mackdale, N.S.

lat. 45°40'49" long. 61°22'06"

The Windsor-Horton contact could not be located on N.W. Arm Brook, 0.7 miles northwest of Mackdale (map 995A, Ferguson and Weeks, 1950).

Horton conglomerate and siltstone outcrop along the brook, however, where the Windsor-Horton contact had been mapped, only green and grey siltstone with minor limestone interbeds is exposed. Pyrite, disseminated, and in lenses and pods in a medium grey siltstone, is the only visible sulphide mineral.

73 - Trout River, N.S.

lat. 46°07'08" long. 61°08'17"

The Windsor-Horton contact is not exposed at Trout River, on the east shore of Lake Ainslie (map 282A, Norman, 1935).

At one time small pits were dug on the MacMillan farm but these are now overgrown. Blocks of both A_1 limestone and Horton green conglomerate occur in the area of the old pit. The limestone contains pyrite and minor amounts of galena.

74 - Whycocomagh, N.S.

lat. 45°57'43" long. 61°06'05"

A_1 limestone overlies a good exposure of Horton conglomerate in a roadcut beside highway 105, 1.3 miles northeast of Whycocomagh. The following stratigraphic section was measured proceeding north along the highway from the provincial campground (figure 37).

Windsor Group

1) 15 feet of dark, laminated A_1 limestone, in places fractured and veined by calcite; minor chalcopyrite is visible at the extreme base of the limestone section.

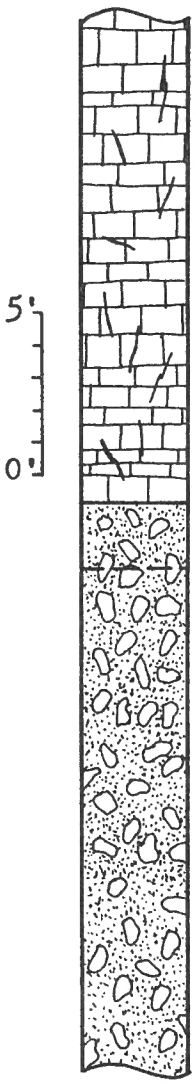
Horton Group

2) 2 feet of grey-green pebble conglomerate; the conglomerate has a coarse grit matrix and subround, 1 to 2 inch pebbles; copper occurs as malachite rimming pebbles and disseminated throughout the matrix.

3) about 2300 feet of red conglomerate and coarse sandstone; in some locations intense jointing and calcite veining suggest minor faulting; channelling is evident at several places within the section.

The only visible sulphide mineral is chalcopyrite which occurs in the basal 0.5 feet of the limestone. Malachite is disseminated in the upper green portion of the Horton Group.

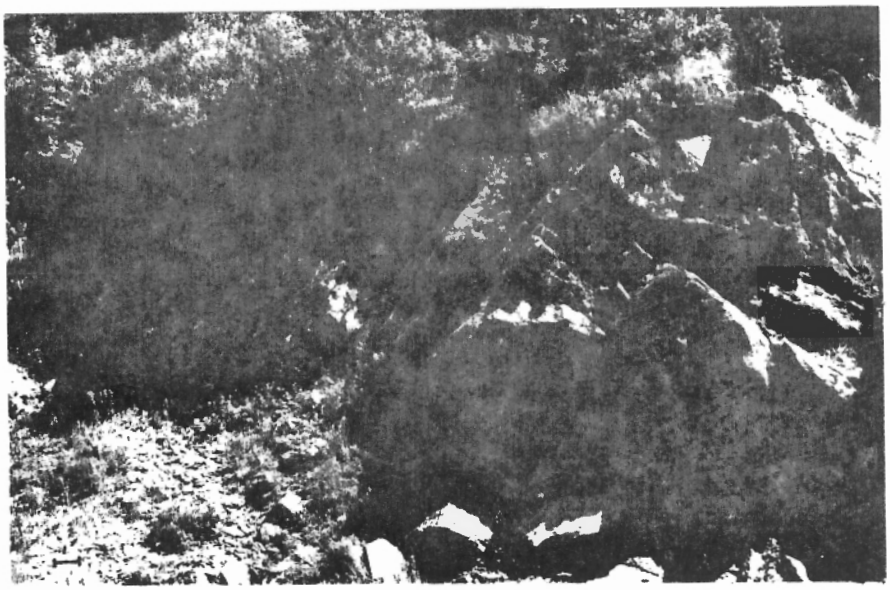
Figure 37.
PARTIAL STRATIGRAPHIC COLUMN,
WHYCOCOMAGH, N.S.



A_1 limestone - dark grey, laminated limestone; in places fractured and veined by calcite; minor chalcopyrite at the extreme base of the section

Horton Group
green pebble conglomerate

red conglomerate and interbedded sandstone



R.V.K. 5-35-73

Figure 38. Typical laminated A_1 limestone overlying massive Horton pebble conglomerate along the Trans-Canada highway at Whycocomagh, N.S.

75 - Washabuck, N.S.

lat. 46°03'15" long. 60°48'08"

The Windsor-Horton contact outcrops in a roadcut and along the shore at Washabuck (map 1211A, Kelley, 1967).

In 1973, the Windsor-Horton contact was exposed in the roadcut, however, by 1974, further road work had resulted in the removal of all the limestone so that just mineralized conglomerate is now exposed. Only the A_1 limestone outcrops on the shore. The most complete stratigraphic section, that in the roadcut (1973), comprised:-

Windsor Group

1) 3 feet of black, laminated, micritic A_1 limestone containing fine-grained disseminated sulphides.

Horton Group

2) 0 to 6 inches of green coarse sandstone with malachite and minor chalcopyrite.

3) 4 to 5 feet of green pebble conglomerate with malachite staining and rare specks of chalcopyrite.

4) unknown thickness of red pebble conglomerate.

The basal limestone at this location contains only 0.05% copper, 0.01% lead and trace amounts of zinc. Slightly higher in the section, the limestone is unmineralized.

76 - Christmas Island, N.S.

76A - borrow pit

lat. 45°58'31" long. 60°44'22"

76B - railway cut and shore

lat. 45°57'48" long. 60°46'05"

76C - shoreline

lat. 45°57'43" long. 60°46'45"

The Windsor-Horton contact is exposed at three locations in the Christmas Island area. A small outcrop of A_1 limestone conformably overlying green and red pebble conglomerate occurs in a borrow pit to the southeast of the highway at Christmas Island. Two other similar outcrops occur along the shore of Bras D'Or Lake between Christmas Island and Grand Narrows (figure 39).

At all three locations the stratigraphy and mineralization are similar. Only the most complete section, that on the shore and in the railway cut, is described.

From the top to the base the section comprises:-

Windsor Group

1) 9 feet of white weathering, medium grey, laminated, carbonaceous, A_1 limestone; minor amounts of sulphide mineralization are visible; specimens from the base of this outcrop contain 0.03 - 0.04% copper and trace amounts of lead and zinc.

Horton Group

2) 3 feet of poorly sorted, grey-green pebble to cobble conglomerate; clasts average 2 to 4 inches in size, but some 1 foot long clasts are present; clasts include limestone, pure quartz, and igneous rock types; about 60% of the conglomerate consists of sand and silt size material, minor malachite occurs around pebbles but no primary sulphides were observed.

3) greater than 20 feet of poorly sorted red matrix conglomerate; unmineralized, but otherwise similar to the overlying green beds.

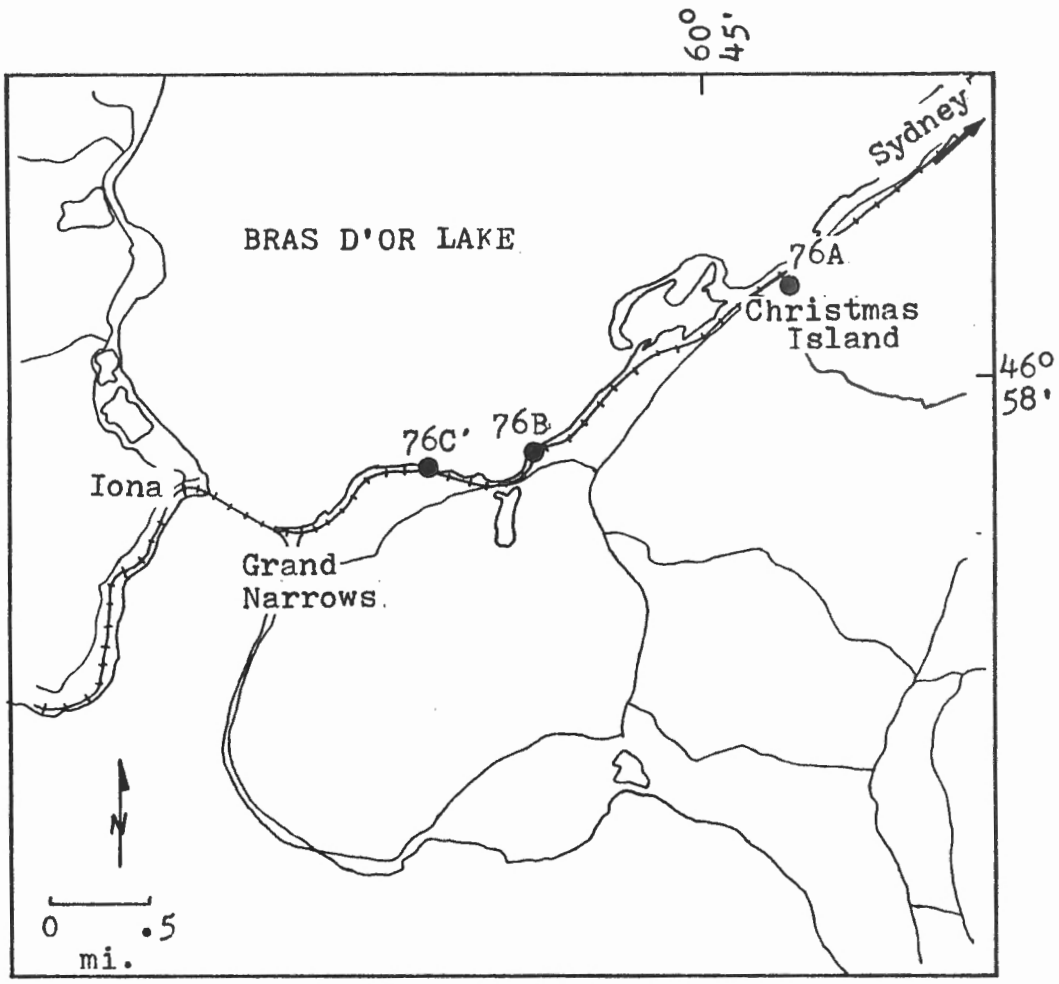
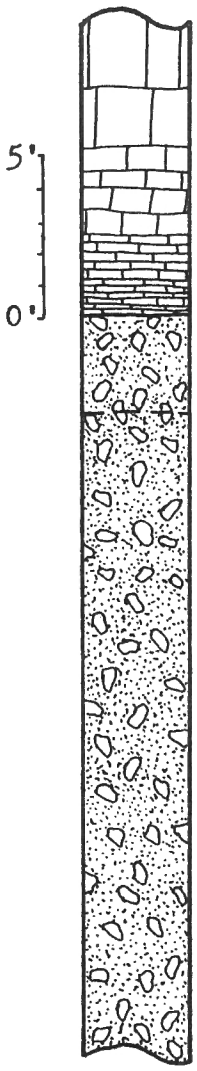


Figure 39.
Copper Occurrences in the Christmas Island area of Nova Scotia.

Figure 40.
STRATIGRAPHIC SECTION,
RAILWAY CUT AND SHORE,
CHRISTMAS ISLAND, N.S.



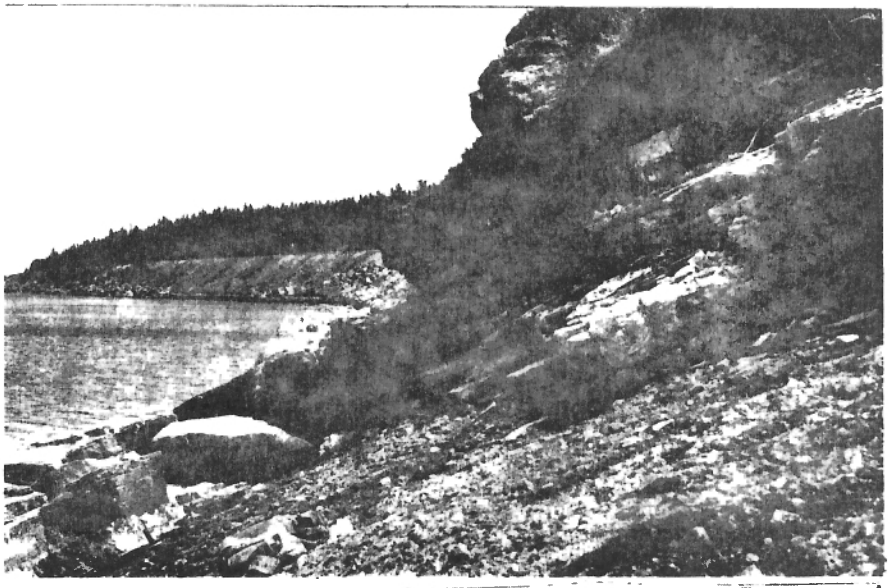
A_1 limestone - laminated, carbonaceous, and contains traces of sulphide mineralization.

Grantmire Formation

green pebble to cobble conglomerate; minor malachite staining.

red pebble to cobble conglomerate.

Along the shore to the south of Grand Narrows, towards Pipers Cove, there are excellent exposures of red sandstone and conglomerate of the Grantmire Formation, however no Windsor limestone is exposed in this area.



R.V.K. 4-11-73

Figure 41. A_1 limestone conformably overlying Horton green pebble conglomerate. View looking northeast along the shore at Christmas Island, N.S.

77 - Yankee Line Road, N.S.

77A - stream valley

lat. 46°07'22" long. 60°55'15"

77B - roadcut

lat. 46°07'59" long. 60°55'00"

The A_1 limestone and the underlying Horton conglomerate are exposed in two outcrops beside Yankee Line Road, near Lower Middle River (figure 42) (Jones and Covert, 1972). One outcrop occurs in a small stream valley, the other in a roadcut.

In the stream valley the stratigraphic section comprises, from the top to the base:

Windsor Group

1) 5 feet of black, laminated A_1 limestone; the basal foot of the limestone section has calcite filled fractures; above this basal foot of the section is typical laminated limestone; galena occurs both disseminated in the rock and along fractures.

Horton Group

2) 5 to 10 feet of grey, sandy, feldspathic conglomerate; no copper mineralization was observed, although pyrite occurs as discrete cubes among the sand grains.

3) undetermined thickness of red conglomerate.

In the roadcut, similar lithological units are exposed, although the Windsor-Horton contact is covered. At this location the grey conglomerate is heavily stained by malachite and sparse galena is disseminated in the limestone.

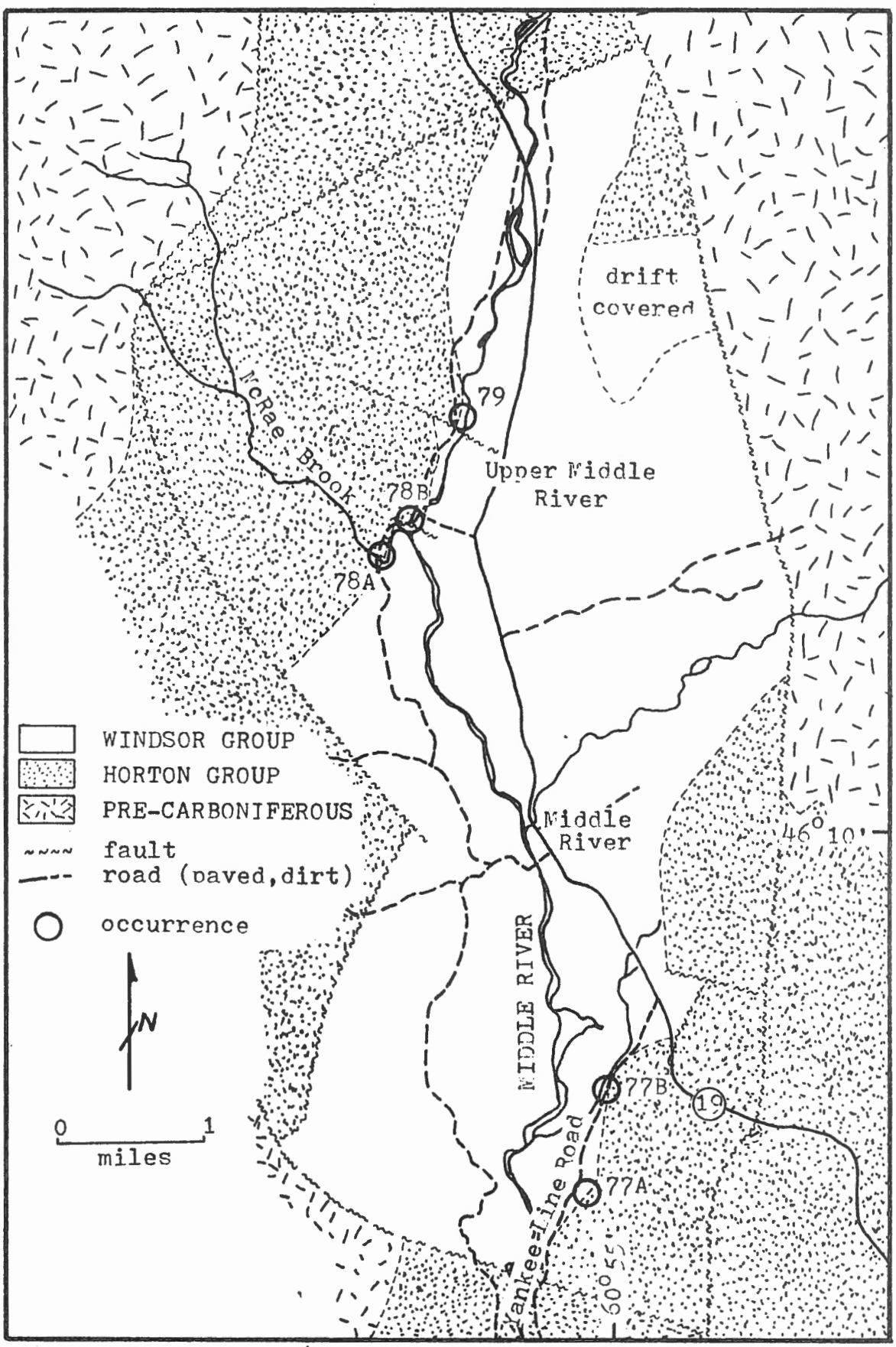


Figure 42. GEOLOGY OF THE UPPER MIDDLE RIVER AREA, N.S. (modified after Kelley, 1967)

78 - McRae Brook, N.S.

lat. 46°11'08" long. 60°56'56"

The Windsor-Horton contact outcrops on McRae Brook, 0.9 miles southwest of Upper Middle River (figure 42).

The stratigraphic section seen at this location includes, from the top (downstream) to the base (upstream):-

Windsor Group

1) 15 feet of dark grey, laminated, micritic A_1 limestone; the basal 10 feet of the limestone is blue-grey weathering while the upper 5 feet weathers brown; very minor pyrite and galena are disseminated in the basal limestone beds.

Horton Group

2) 1 foot of green quartzo-feldspathic sandstone containing minor galena and pyrite.

3) unknown thickness of red sandstone and fine-grained conglomerate.

An analysed sample of the basal limestone contains 0.07% lead, but only trace amounts of copper and zinc.

79 - Upper Middle River, N.S.

lat. 46°11'58" long. 60°56'15"

The Windsor-Horton contact is exposed on a small branch of Middle River, near the town of Upper Middle River (figure 42).

About 5 feet of green, fine-grained, sandy conglomerate is exposed at the base of the stratigraphic section. At the top of the clastic section there is a 2 inch bed of ripple-marked sandstone. These Horton clastic rocks are conformably overlain by 5 to 7 feet of dark grey, laminated, carbonaceous, micritic A_1 limestone.

Abundant pyrite and minor amounts of galena occur in the rocks at the top of the clastic section and the base of the A_1 limestone.

This outcrop is similar to others in the Middle River area, in that lead, and not copper, is the dominant base-metal.

80 - South Side of Baddeck River, N.S.

lat. 46°09'02" long. 60°45'50"

Horton and Windsor rocks outcrop on Peter's Brook, downstream from the Ziom Road bridge at South Side of Baddeck River (map 1211A, Kelley, 1967).

At the base of the stratigraphic section there is red siltstone with minor interbedded pebble conglomerate. Ten to 15 feet of dark grey, laminated A_1 limestone outcrops downstream and on a bluff to the south of the river. The contact of the Windsor and Horton Groups is not exposed.

Pyrite disseminated along laminae in the limestone is the only sulphide visible at this location.

81 - Forks Baddeck, N.S.

81A - northwest showing

lat. 46°11'19" long. 60°47'19"

81B - Baddeck River

lat. 46°10'49" long. 60°46'05"

Two outcrops of A_1 limestone were visited in the Forks Baddeck area (map 1211A, Kelley, 1967).

The northwest showing is to the west of an overgrown farm field, the Windsor limestone outcropping along a ridge. The A_1 limestone at this location is dark grey, laminated, and contains pyrite and possibly some chalcopyrite and galena disseminated along the laminae.

On the bank of the Baddeck River, beneath the road bridge, there is about 20 feet of grey, laminated A_1 limestone. Although pyrite occurs disseminated in the lowermost limestone beds, it is not present towards the top of the limestone.

The Windsor-Horton contact is not exposed at either of the above locations.

82 - St. Ann's, N.S.

82A - McLeod Point

lat. 46°14'07" long. 60°36'41"

82B - Squire Point

lat. 46°13'04" long. 60°35'23"

The mineralized Windsor-Horton contact outcrops at Squire Point and near the town of McLeod Point (map 1211A, Kelley, 1967).

Although both occurrences are similar in lithology, the outcrops on Squire Point present a more complete stratigraphic section as follows:-

Windsor Group

1) 5 feet of dark grey to black, laminated, micritic A_1 limestone; malachite occurs along small fractures; a sample from one foot above the contact contained 0.14% copper, but only trace amounts of lead and zinc.

Horton Group

2) 3 feet of grey-green pebble to cobble conglomerate; malachite occurs as coating on the clasts.

3) 3 feet of coarse feldspathic sandstone; most of the unit is green, however, there are some red lenses; malachite is present in some of the more conglomeratic parts of the unit.

4) unknown thickness of red pebble to boulder conglomerate; minor grey mottling in coarse sandy areas.

At McLeod Point, 3 feet of A_1 limestone overlies a grey-green pebble conglomerate which is stained by malachite.

83 - Englishtown, N.S.

lat. 46°17'55" long. 60°30'39"

Several lead occurrences have been noted in the Windsor limestone outcropping near Oyster Pond, north of Englishtown (Kelley, 1960). The author could only find igneous rocks on the beach where one occurrence was noted, although there may be mineralized outcrops further to the north along the coast (Bob Shewman, 1974, personal communication). In the stream to the east of Oyster Pond, minor amounts of galena were observed in a porous light grey limestone. This is not the A_1 limestone but is probably part of the B subzone of the Windsor Group. The limestone blocks observed by the author did not appear to be in situ.

84 - Cape Dauphin, N.S.

lat. 46°20'40" long. 60°25'20"

Windsor, Horton, and Pre-Carboniferous igneous basement rocks outcrop at Cape Dauphin. The area can be reached by driving to the end of the New Campbellton road which branches off highway 105 at Kelly's Mountain. The outcrops, which should only be visited at low tide, are on the beach to the east of the road at Cape Dauphin.

At the base of the exposed section there are granitic basement rocks cut by mafic dykes. These crystalline rocks are overlain unconformably by 20 feet of red pebble conglomerate similar in lithology to the Grantmire Formation exposed near Sydney. Although minor green mottling occurs in the conglomerate, there are no continuous green zones. Above the conglomerate is a 3 to 5 foot thick, massive, brown to grey, unfossiliferous limestone. The contact of the limestone and the conglomerate is not exposed and may be a fault (Stacey, 1953). Above this massive limestone there is 10 to 20 feet of brown, porous, fossiliferous (brachiopods) limestone. These limestones correlate with the B subzone of the Windsor Group (Stacey, 1953). The rocks exposed on the sea cliffs to the east are part of the Upper Windsor Group and have been described by Stacey. No sulphides were observed at this location.

4c) LOCALITIES IN EASTERN CAPE BRETON ISLAND

85 - Coxheath, N.S.

85A - Musgrave Showing

lat. 46°07'48" long. 60°20'30"

85B - McMullin Showing

lat. 46°06'14" long. 60°23'05"

Several small showings occur along the northwest side of the Coxheath Hills, six miles southwest of Sydney. Two of the most accessible of these showings occur near the Frenchvale road; the Musgrave showing in a small borrow pit beside the road, and the McMullin showing on Frenchvale Brook just southeast of McLeanville (Bell and Goranson, 1938a).

At these showings a thin section of dark, laminated limestone overlies green and red conglomerate of the upper Grantmire Formation. Minor chalcopyrite is disseminated in the basal few inches of the limestone, and malachite occurs throughout the upper two to four feet of the green conglomerate.

This area was drilled by Mariner Mines in 1967 and Cerro Mining Company of Canada in 1970. The work established that about 0.2 to 0.3% copper over 3 to 4 feet is continuous along strike for more than three miles.

86 - Point Edward, N.S.

lat. 46°10'02" long. 60°16'20"

Blue-grey weathering limestone resembling the A_1 outcrops at Limestone Point, on the southeast shore of West Arm - Sydney Harbour. The outcrops occur in a roadcut and along the shore by the Anglican Church.

Sandstone of the Windsor Group (Bell and Goranson, 1938) occurs at the base of the section. It is overlain by 7 to 10 feet of massive limestone which contains a few fossils.

Minor galena, pyrite, and chalcopyrite occur in the basal 4 feet of the limestone, galena being the dominant sulphide.

Although this contact is similar in gross lithology and mineralization to the Windsor-Horton contact, all the rocks are within the Windsor Group.

87 - East Bay, N.S.

lat. 46°00'03" long. 60°25'38"

An excellent exposure of Windsor limestone and Grantmire conglomerate on the northwest shore of East Bay can be reached by a private road which branches from the Eskasoni road, about 1.5 miles southwest of McKenzie East Bay (Bell and Goranson, 1938). The limestone-conglomerate contact is exposed on the shore to the northeast of the private road. An alternate access route is to walk along the beach for 1.3 miles southwest from McKenzie East Bay. The latter route affords a good view of the Grantmire Formation.

From the top (southwest) to the base (northeast), the stratigraphic section includes:-

Windsor Group

1) greater than 8 feet of buff-weathering, non-fossiliferous limestone; 1 to 6 inch beds; strike 60°, dip 20°W.

2) 7 feet of dark, laminated limestone; possibly some nodular anhydrite in the top 5 feet of the unit.

3) 4 to 5 feet of 'lumpy stromatolitic limestone'; unit includes stromatolitic detritus. detritus.

4) 4 feet of laminated limestone with SH (-V?) stromatolites.

5) 0.5 to 1 foot of laminated limestone with long wavelength, low amplitude ripples on the upper surface of the unit; immediately underlying unit 4; minor pyrite.

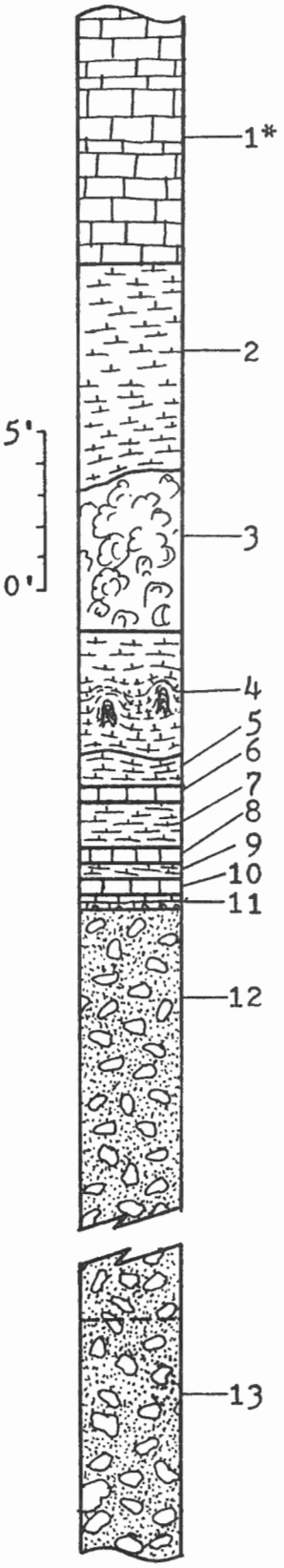
6) 5 inches of massive, dark grey limestone.

7) 1.5 feet of laminated grey limestone.

8) 0.5 feet of massive grey limestone with visible pyrite.

9) 0.5 feet of laminated, dark grey limestone.

Figure 43.
PARTIAL STRATIGRAPHIC COLUMN,
EAST BAY, N.S.



Windsor Group - unknown subzone
thick to thin-bedded dark grey limestone with SH and SS algal stromatolites; minor pyrite, bornite, and chalcopyrite occur in the basal beds.

Grantmire Formation
green pebble to boulder conglomerate; heavy malachite staining in the top six feet of the unit

red pebble to boulder conglomerate

*numbers refer to descriptions of units in text

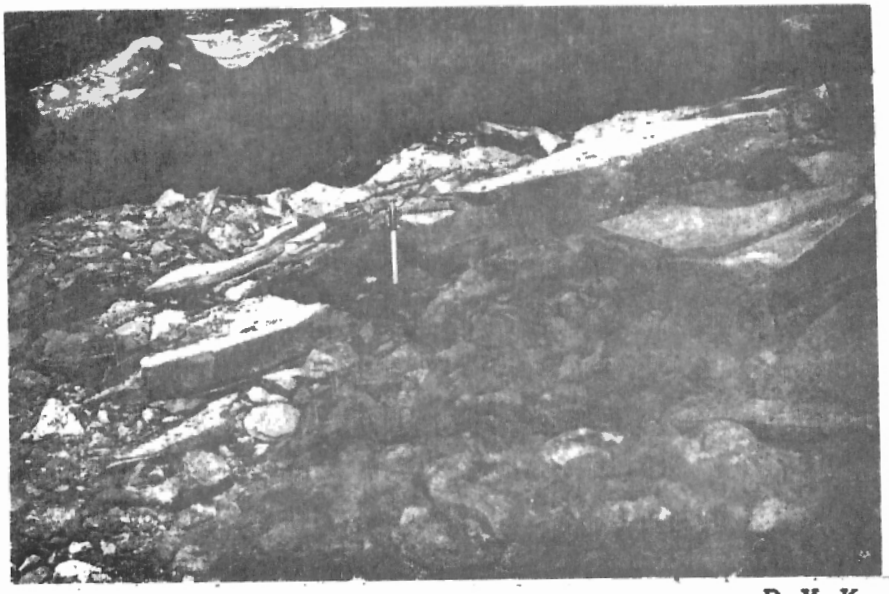


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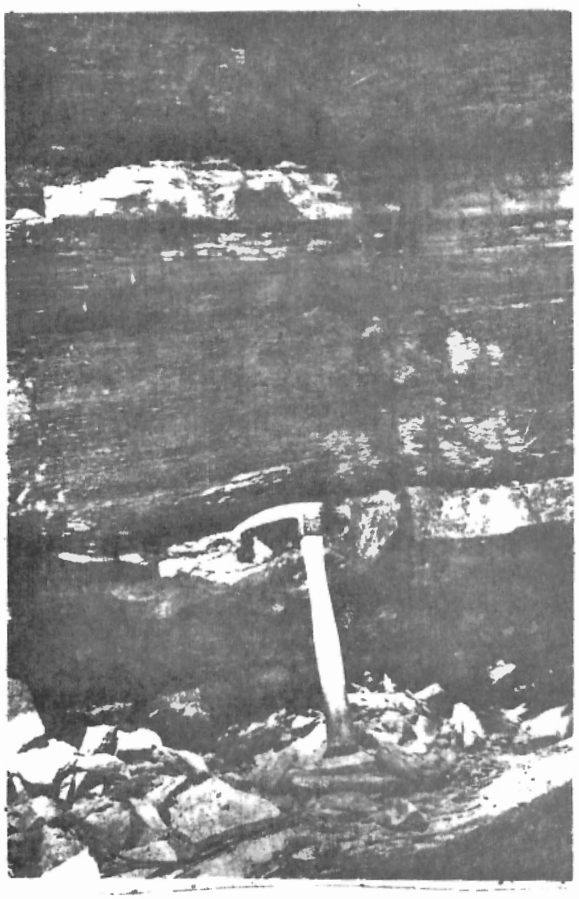
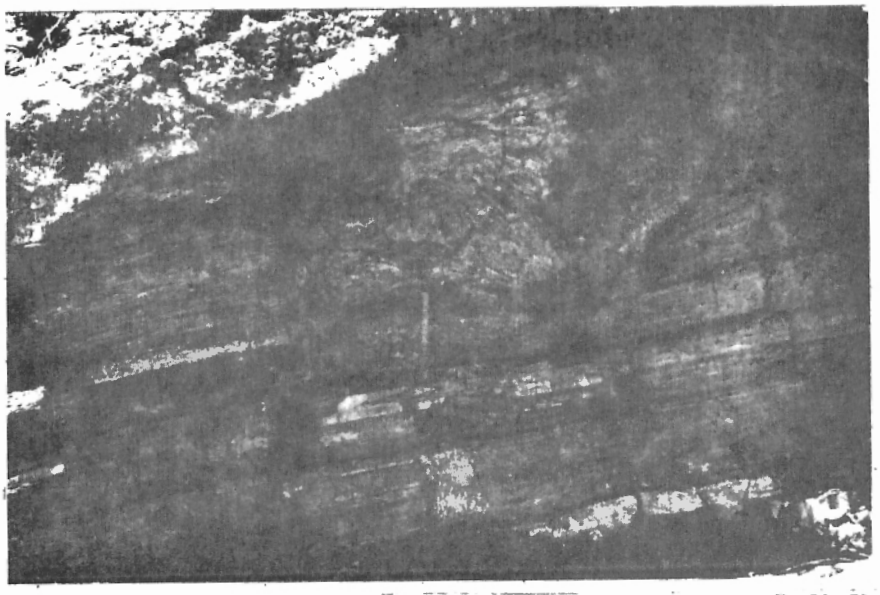
Figure 44. Windsor-Horton contact with micritic, thin-bedded limestone (unit 11) overlying cobble conglomerate (unit 12), East Bay, N.S.



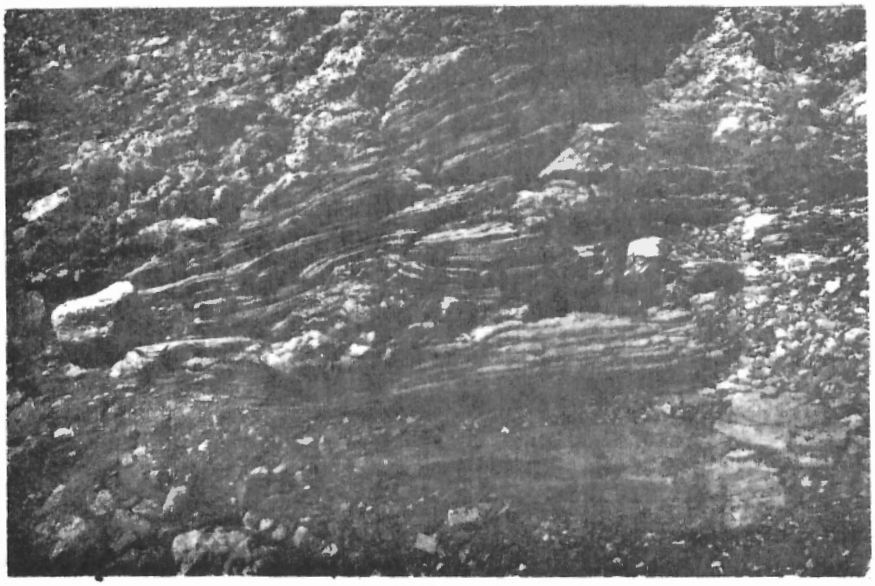
R.V.K. 6-19-73

Figure 45. Argillaceous limestone and interbedded massive limestone (units 5 to 11), East Bay, N.S.



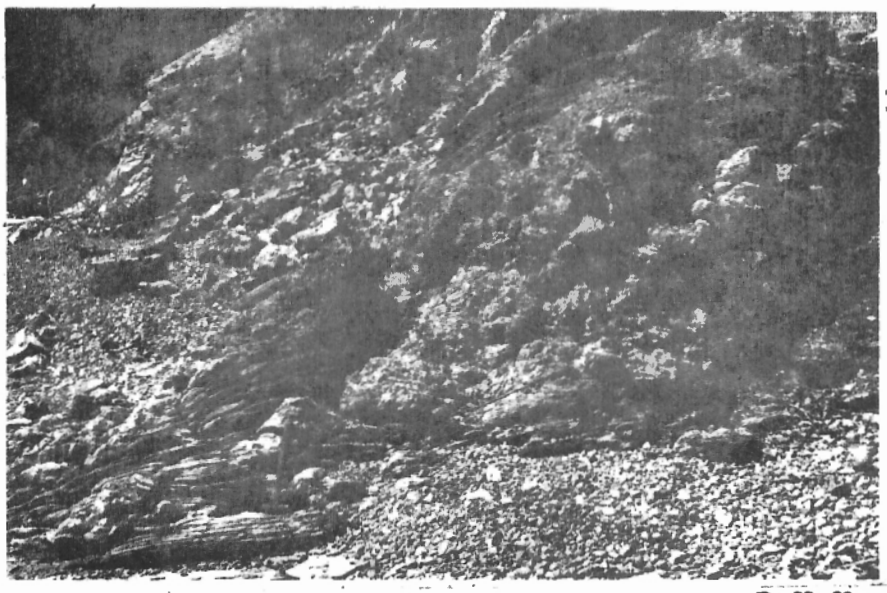
R.V.K. 6-20-73

Figure 46. Columnar stromatolites (unit 4), East Bay, N.S.



R.V.K. 6-21-73

Figure 47. Small stromatolitic bioherms (unit 4), East Bay, N.S.



R.V.K. 6-22-73

Figure 48. 'Lumpy stromatolitic limestone', algal bioherms and algal rubble (units 3 and 4), East Bay, N.S.

R.V.K. 6-23-73

Figure 49. Shaly limestone, possibly originally containing nodular anhydrite (unit 2), East Bay, N.S.

10) 5 inches of massive grey limestone with visible pyrite.

11) 5 inches of dark grey to black limestone, thin-bedded and with visible pyrite, chalcopyrite, and bornite; at the extreme base of the unit there are stromatolitic growths (oncolites) about brachiopod shells and pebbles of the underlying conglomerate.

Grantmire Formation

12) about 60 feet of grey-green, pebble to boulder conglomerate with minor interbedded coarse sandstone; the clasts average 3 to 4 inches long but some up to 1 foot in length do occur; porphyry, granite, quartz and metamorphic rock clasts were noted; malachite coats pebbles and also occurs in the matrix in the top 6 feet of the unit.

13) greater than 200 feet of red pebble to boulder conglomerate; minor green mottling; clasts average 4 to 10 inches in length but do occur up to 2 to 3 feet in length; the clasts are angular to subround.

The principle sulphide minerals in the section are pyrite, chalcopyrite, bornite, and sphalerite. The highest copper concentrations (0.1 to 0.3%) occur in the basal limestone beds (unit 11) and the upper green conglomerate beds (unit 12). Only minor amounts of lead and zinc occur in the rocks (less than 0.1%).

88 - Glen Morrison, N.S.

lat. 45°59' long. 60°19'

The Windsor and Horton rocks in the Glen Morrison area of Cape Breton Island were drilled by Imperial Oil to test a geochemical anomaly in this area of no outcrop. Only one drill hole (GM - 1) could be found in the core storage facility at Louisdale. The following is a summary log of that drill hole.

drill hole GM - 1, Imperial Oil Ltd.

0' - 11' overburden and fragments of limestone

Windsor Group

11' - 20' dark grey to black micritic limestone; areas of finely laminated organics and massive carbonate suggest an algal origin; a 2 to 3 inch thick bed of quartz sandstone occurs at 18'; minor chalcopyrite is visible throughout the limestone.

Horton Group

20' - 22' green sandy pebble conglomerate with subangular to subround, 2 inch size, igneous and volcanic clasts in a coarse sand matrix; minor chalcopyrite occurs throughout the unit.

22' - 30' red pebble conglomerate with abundant feldspar grains; no visible sulphide mineralization.

89 - Catalone Lake, N.S.

lat. 45°59'25" long. 59°59'30"

A limestone quarry was operated by Sydney Steel Corp. at the junction of the Catalone River and highway 22 (Weeks and Cameron, 1960).

In drilling to outline the limestone reserves, minor copper sulphides were encountered in several drill holes. By 1974 the drill core could not be located and the former quarry had been backfilled with earth and landscaped. Blocks of limestone which occur along the river indicate that a fossiliferous B-zone limestone probably contained the copper, however, no copper mineralization could be found at the surface.

90 - **McIntyre Lake, N.S.**

lat. 45°47'22" long. 60°15'15"

A copper showing is located 2 miles southwest of Gabarouse Lake on McIntyre Lake. The lake can be reached by a logging road which branches west off the main road about 1.4 miles south of the town of Gabarouse Lake.

On the south shore of McIntyre Lake a small (less than 100 foot long), thin (less than 10 foot thick) outlier of Lower Carboniferous green pebble to cobble conglomerate rubble overlies Pre-Carboniferous metamorphosed basement rocks. Towards the top of the exposed outcrop green calcareous sandstone contains visible chalcopyrite, an analysis indicating 0.26% copper with negligible lead, zinc, and silver contents. The chalcopyrite in the green clastic unit indicates that the exposed rocks are probably near the limestone-conglomerate contact, but, even after considerable searching, no limestone could be found.

91 - Huntington Mountain, N.S.

lat. 45°57'11" long. 60°19'30"

Outcrops of Lower Carboniferous limestone and conglomerate occur on the north side of the Salmon River Basin, at the base of Huntington Mountain. Access to the area is by the Chapel Road from Rock Elm West to the foot of Huntington Mountain. From this point, if a traverse is run to the northeast, scattered outcrops of conglomerate and limestone can be found.

The lowermost Carboniferous unit exposed in the area is a green sandy pebble conglomerate, similar in lithology to the uppermost part of the Grantmire Formation. Towards the top of the clastic unit there is 1 to 2 feet of green sandstone with minor amounts of coarse clastic detritus. No sulphides were observed in the conglomerate or sandstone. Overlying the clastic unit is a massive, light grey crystalline limestone. Minor amounts of galena occur erratically disseminated throughout the unit, especially in the eastern part of the area.

The limestone at this location is similar in lithology and mineralization to the carbonate rocks exposed at Big Glen (property 92). It does not appear to be A_1 limestone.

92 - Big Glen, N.S.

lat. 45°49'47" long. 60°27'37"

Windsor dolomite is exposed in small test pits to the south of the Salmon River Road at Big Glen, 3.6 miles northeast of Lake Enon (Weeks, 1958).

At this location, light grey to brown, massive dolomite contains minor, erratically disseminated galena. The dolomite is not laminated like the A_1, but is similar to other carbonates outcropping in the Salmon River Basin (e.g. Huntington Mountain).

93 - Lake Enon, N.S.

lat. 45°48'04-46" long. 60°32'00-45"

The Lake Enon celestite mine of Kaiser Celestite Mining Ltd. is located 32 miles south of Sydney, N.S. and may be reached by 9 miles of gravel road (Loch Lomond road) from Big Pond on highway 4.

The strata which contain base-metal mineralization are not exposed by mining but are visible in approximately 75 drill holes. As with other showings in eastern Cape Breton Island, the mineralization occurs at the contact of a sandy, micritic, dark grey to black limestone and an underlying bed of pebble conglomerate. The limestone in the Lake Enon area pinches out to the west and southeast and is terminated by an east trending fault to the south. Little visible sulphide mineralization occurs in the conglomerate beyond the limits of the limestone. Overlying the limestone there is a 'Red Bed Sequence' of sandstone, columnar stromatolites, and red siltstone and evaporites, including the economic celestite.

Binney (1975) concluded that the stratigraphic succession in the Lake Enon area resulted from 1) block faulting in the Devonian or early Carboniferous - the graben structures being filled by coarse clastic detritus eroded from the horsts, creating thick continental red beds, 2) a marine transgression over the red beds and deposition of a sandy, carbonaceous limestone, and, 3) a prograding clastic wedge with intertidal stromatolites and supratidal evaporites.

The sulphide minerals observed at Lake Enon include

pyrite, sphalerite, chalcopyrite, and galena. Chalcopyrite occurs mainly at the contact of the upper green part of the conglomerate and the overlying limestone, while galena and sphalerite are found in greatest abundance higher in the limestone section. Within the sedimentary basin the highest concentration of metal occurs at the limestone-conglomerate contact in the south, where assay values of 0.1 to 0.3% copper over 0.2 to 0.5 feet are common. Zinc values of 0.1% are common in the limestone with a few values as high as 1 to 2% being recorded. Lead concentrations are similar to copper, the highest values being 0.1 to 0.4%.

Binney (1975) suggested that this mineralization is early diagenetic, the metal being leached from the underlying red conglomerate by groundwater and being re-deposited near the contact of the carbonaceous limestone prior to its lithification. The mineral and metal zonation patterns are consistent with the hypothesis of metal-bearing groundwater circulating through the conglomerate and being forced, due to impermeable igneous basement highs into contact with the carbonaceous reducing limestone.

94 - Johnstown, N.S.

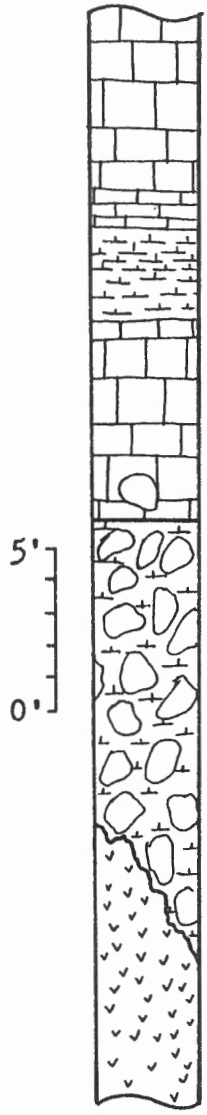
lat. 45°48'34" long. 60°43'17"

On a headland, 0.5 miles north of the church at Johnstown, Windsor limestone overlies conglomerate and Pre-Carboniferous basement rocks.

Volcanic rocks of the Fourchu Group occur at the base of the exposed section (figure 50). The volcanics are overlain by 10 to 15 feet of coarse boulder conglomerate (+2 foot size clasts). The conglomerate has a lime matrix and appears to have resulted from coarse blocks of basement rock falling from a paleo-seacliff into a carbonate mud. The limestones which overlie the conglomerate are generally light brown, porous, and fossiliferous, although some dark, thin-bedded crystalline limestone is present. The limestone is not correlated with the A_1 but is believed to be part of the B subzone of the Windsor Group.

No sulphides were noted in any of the rock units.

Figure 50.
STRATIGRAPHIC SECTION
JOHNSTOWN, N.S.



Windsor limestone - B subzone ?
light to dark brown, thick to thin bedded, fossiliferous.

Conglomerate
coarse boulder conglomerate with a limestone matrix.

Fourchu Group
volcanic rocks

95 - McNabs Cove, N.S.

lat. 45°43'58" long. 60°43'01"

Horton and Windsor rocks outcrop on a small stream at the eastern end of McNabs Cove (map 1083A, Weeks, 1964).

Dark grey, laminated, micritic A_1 limestone containing minor pyrite occurs at a sharp bend in the small stream. The exact contact of the limestone and the underlying red siltstone of the Horton Group is not exposed at this locality.

96 - Soldier Cove North, N.S.

lat. 45°43'00" long. 60°44'49"

The Windsor-Horton contact outcrops on a small point, about half-way between Soldier Cove and McNab Cove (map 1083A, Weeks, 1964). This location can be reached either by walking along the beach from the north or directly down from highway 4.

Red Horton siltstone is exposed at the base of the stratigraphic section. Two to three feet of green pebble conglomerate, similar in lithology to the uppermost Grantmire Formation in the Sydney area, is poorly exposed above the red beds. The conglomerate is overlain, apparently conformably, by greater than 20 feet of deformed dark grey, laminated, micritic A_1 limestone. The basal 2 feet of the limestone contains minor chalcopyrite with pyrite occurring higher in the section. Minor fluorite and calcite veins occur throughout the limestone.

97 - Barra Head, N.S.

lat. 45°40'44" long. 60°48'06"

Dark grey, micritic, A_1 limestone outcrops beside the Barra Head - Corbett's Cove road (map 1083A, Weeks, 1964). The limestone is not mineralized and the basal contact is not exposed.

98 - Corbett's Cove, N.S.

lat. 45°39'47" long. 60°50'21"

Windsor and Horton rocks occur beside the road to Corbett's Cove, 2 miles east of St. Peters (map 1083A, Weeks, 1964). The rocks outcrop in a small borrow pit and several roadcuts.

Indurated sandstone of the Horton Group occurs at the base of the outcrop. This white sandstone, and the overlying dark grey, laminated, micritic A_1 limestone contain minor amounts of pyrite.

99 - St. Peters, N.S.

lat. 45°39'02" long. 60°51'53"

A_1 limestone is exposed in the eastern portion of the Provincial Picnic Park at St. Peters (map 1083A, Weeks, 1964). The dark grey, laminated, micritic limestone contains minor amounts of pyrite, but no other sulphides were observed. Neither the upper or lower contact of the limestone is exposed.

100 - <u>Arichat, N.S.</u>

100A - head of Arichat Harbour

lat. 45°30'47" long. 60°59'16"

100B - pit to west of town

lat. 45°30'47" long. 61°02'35"

Two limestone occurrences were visited in the Arichat area. One is at the western end of a small lake 1.3 miles west of Arichat and is reached by a road and trail leading north from the main highway. The other outcrop is at the head of Arichat Harbour behind the house of Bernie Decoste (Weeks, 1964).

At the first location, massive, unlaminated, calcite-veined, dark grey, micritic limestone is exposed in an old pit. To the northeast of the limestone there is a green pebble conglomerate in vertical contact with the limestone. No sulphides or malachite staining occur in either of the rock units.

Large outcrops of Horton conglomerate occur at the head of Arichat Harbour. A series of pits have been dug in the Windsor limestone that outcrops north of the clastic rocks. It is reported (Weeks, 1964) that lead and zinc occurred in the rocks exposed by these pits, however, by 1974 the pits were overgrown and only scattered blocks of limestone could be found. No sulphides were visible in the massive, black limestone found by the author.

The outcrops at Arichat are similar to those at Black River, 13 miles to the northwest.

101 - Black River, N.S.

lat. 45°41'25" long. 61°07'46"

Mineralized Windsor limestone outcrops on Black River, 7 miles north of Louisdale. The outcrops are reached by walking downstream from where the Rear Black River road crosses Black River.

At the base of the stratigraphic section there is Pre-Carboniferous igneous basement rock. Two to three feet of grey, pyritic, fine-pebble conglomerate unconformably overlies the basement. Overlying the conglomerate there is about 10 feet of massive, dark grey to black limestone. The limestone is, in places, heavily veined by calcite, the veins also containing minor chalcopyrite.

The area about these showings has been drilled by Imperial Oil and Kaiser Celestite. One of the drill holes is summarized to give a more complete stratigraphic section than that exposed on surface.

drill hole BR - 2, Kaiser Celestite Mining Ltd.

0 - 15.6'	overburden.
15.6' - 211.0'	gypsum, anhydrite, and interbedded red siltstone and conglomerate.
211.0' - 291.0'	dark grey to black, laminated limestone; heavily brecciated with calcite filling the pore space; chalcopyrite, galena and pyrite occur in the brecciated areas, and in very minor amounts disseminated throughout the rock.
291.0' - 293.5'	lost core.
293.5' - 294.2'	black massive limestone containing pyrite and chalcopyrite; the pyrite is concentrated in styolites.

drill hole BR - 2, (continued)

294.2' - 298.8' green pyritic conglomerate and sandstone.

298.8' - 308' andesite and granodiorite basement; heavily fractured and altered but not mineralized.

Although there is copper in basal Windsor limestone, this mineralization is not similar to the typical mineralization that occurs along the Windsor-Horton contact.

CONCLUSIONS

Although the main purpose of this open file is to document the outcrops visited by the author in the Atlantic Provinces, especially their location and access, some regional mineralization trends were noted.

Copper mineralization, where found, is disseminated in the Windsor and/or Horton rocks within 2 to 12 inches of the Windsor-Horton contact. Chalcocite is the dominant copper sulphide mineral in many outcrops about Antigonish. In some outcrops (e.g. Brierly Brook) a chalcopyrite zone is seen to overlie the zone of chalcocite mineralization. Bornite was only observed at East Bay, where it occurs in the limestone, 2 to 3 inches above the Windsor-Horton contact. Chalcopyrite is the most common copper-sulphide mineral, occurring at the Windsor-Horton contact in the northern part of the Windsor-Truro area, the Antigonish - Strait of Canso area, and central and eastern Cape Breton Island. Other base-metal sulphides are also visible at the Windsor-Horton contact in the Upper Middle River area (galena) and at Lake Enon (sphalerite, galena). In western Cape Breton Island, pyrite is the dominant sulphide mineral, with few outcrops containing base-metal sulphides in this area.

Pyrolusite (MnO_2) occurs in the red A_1 limestone at Johnson Cove and White Head, near Windsor, N.S. and at Markhamville, N.B. In New Brunswick, other than at Upham and near Hillsborough, the limestone is red to white,

crystalline, and contains no sulphide mineralization.

In summary, minor amounts of base-metal sulphides occur along the Windsor-Horton contact south of Truro, in the Antigonish-Strait of Canso area, and in central and eastern Cape Breton Island.

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