
**Geology of the Ecum Secum Area,
Halifax and Guysborough Counties,
Nova Scotia**

by Derek E. McBride



**Nova Scotia
Department of Mines**

**a joint project with the
Canada Department of
Regional Economic Expansion**

Paper 78-1

PROVINCE OF NOVA SCOTIA

DEPARTMENT OF MINES

PAPER 78-1

GEOLOGY OF THE ECUM SECUM AREA,
HALIFAX AND GUYSBOROUGH COUNTIES, NOVA SCOTIA

by

DEREK E. MCBRIDE

HALIFAX, NOVA SCOTIA

1978

HON. WILLIAM GILLIS, MINISTER

John C. Smith
Deputy Minister

D. A. Murray, Director
Mineral Resources

TABLE OF CONTENTS

	Page
Abstract	1
Introduction	1
Geological Setting	4
Stratigraphy	4
Meguma Group	4
Goldenville Formation	4
Halifax Formation	5
Summary	6
Structural Geology	8
First Set of Structures	8
Late Minor Structures	8
Economic Geology	9
Correlation and Conclusions	9
Acknowledgements	11
References	12

LIST OF FIGURES

Figure 1: Geological map of the Ecum Secum area	2
Figure 2: Geological cross-sections of the Ecum Secum area	3
Figure 3: Lower hemisphere equal area projections of structural data from the Ecum Secum area	7

LIST OF TABLES

Table 1: Data on Mines and Prospects	10
--	----

GEOLOGY OF THE ECUM SECUM AREA, HALIFAX AND GUYSBOROUGH COUNTIES,
NOVA SCOTIA

Derek E. McBride

ABSTRACT

Regional mapping of a 180 square km area in the Meguma Group of eastern mainland Nova Scotia was performed to obtain a better understanding of the relationship between gold deposits, structure and stratigraphy. The Meguma Group consists of the quartz wackes of the Goldenville Formation overlain by slates of the Halifax Formation. The quartz wackes represent the coarser facies of flysch megacycles and may contain minor iron carbonate and pyrite. The Halifax Formation consists of a basal grey slate unit and upper dark grey carbonaceous sulphide-bearing slate unit.

The gold deposits occur as native gold and minor sulphides in deformed quartz-carbonate veins confined to slate bands within the Goldenville Formation. Only minor gold production is recorded and most of it was produced before 1900.

Correlation between the location of auriferous veins, structure and stratigraphy shows that the veins are confined to a 200 metre thick stratigraphic horizon in the Goldenville Formation whose base is approximately 1,300 metres below the Halifax-Goldenville contact. This horizon is outlined by the presence of iron carbonate and pyrite as minor minerals in the quartz wacke.

The structure controls the present distribution of deposits in two ways. First, the veins form in narrow dilation zones in the hinges of anticlines, and second, the outcrop pattern of the favourable stratigraphic horizon is controlled by the fold geometry. Later folding has not had any marked effect on the distribution of the rocks nor the mineralization they contain.

INTRODUCTION

This report and accompanying maps summarize the results of a field study of the Meguma Group in the summer of 1975. Copies of Maps J35, J36, I35, I36 at a scale of 1 inch = 1/4 mile, are available on request from the Nova Scotia Department of Mines, Halifax. The area encompasses approximately 180 square km on the Atlantic coast, about 120 km east of Halifax (Fig. 1). It is bounded on the south by the mainland coast excluding the offshore islands, on the north by latitude 45°03'30", on the east by longitude 62°00', and on the west by longitude 62°15'. It includes the eastern two-thirds of the Moser's River Sheet (Faribault, 1886, Map 38).

The topography is a peneplain with low rolling hills and broad river valleys. Along the coast, the deep bays and bay mouth bars are evidence for a submerged shoreline. Many offshore islands are low flat areas of bedrock. The rounded hills and islands are composed of glacial

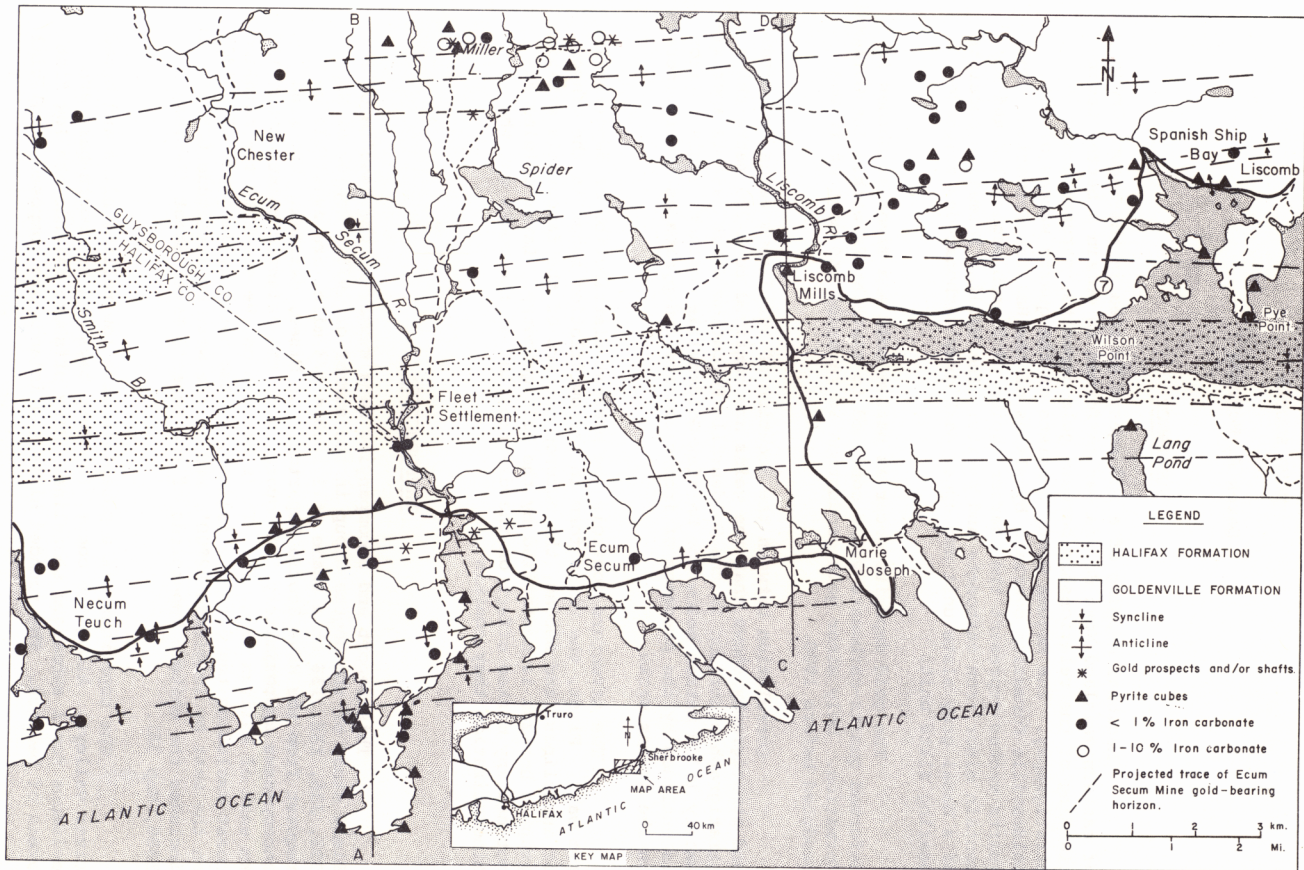
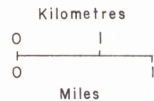
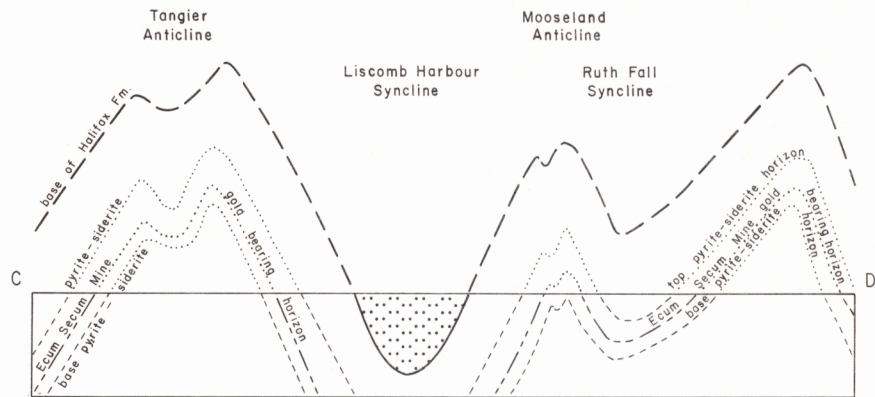
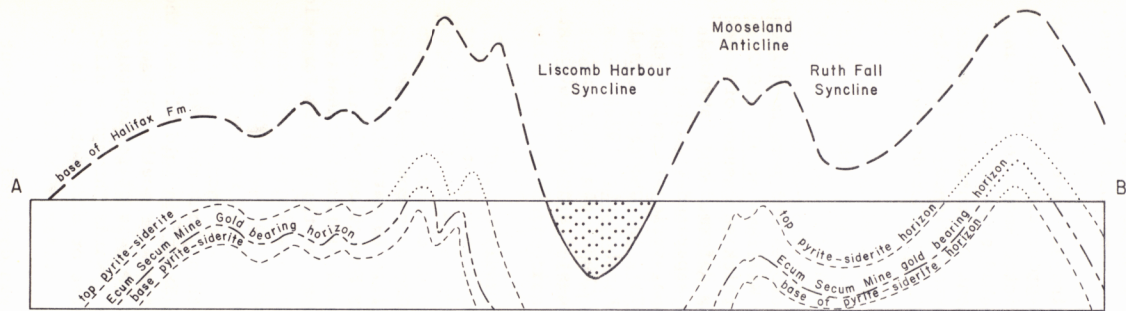


Figure 1. Geological map of the Ecum Secum area.



No verticle exaggeration

Figure 2. Geological cross-sections of the Ecum Secum area.

boulders and fine sand of glacio-fluviatile origin. Large barren areas composed of boulders or bedrock are common along the higher ridges.

Forest cover is variable. Hardwood trees grow on the sandy hills while in the lower country and along the rocky ridges, stands of spruce and fir predominate. Dwarf trees (cat spruce) occur within a mile or two of wind-swept coasts. Outcrop density varies from high in the rocky barrens to low under forest cover and along many coastal sections.

In the past, gold mining and prospecting have been carried out throughout the area. However, significant gold production has been recorded from one area only. Gold is the only metal known to occur in amounts of economic interest. Faribault (1886) had suggested that stratigraphic and structural factors are important in controlling gold distribution in the area. The present project was designed to investigate his observations in more detail and attempt to better define the controlling parameters.

GEOLOGICAL SETTING

The area lies within the Appalachian orogen and more specifically, within that part of the orogen termed Zone I by Williams *et al.* (1972). They described the zone as being composed of a thick succession of Lower Ordovician and earlier clastic sedimentary rocks deformed and intruded during the Acadian orogeny. This succession is separated from the adjacent zones to the north by a major fault zone, variously called the Cobequid-Chedabucto Fault by Rast and Grant (1973), the Chedabucto Fault by Benson (1974), and Glooscap Fault System by King *et al.* (1975). Benson (1974) suggested that movement along the Chedabucto Fault is essentially sinistral whereas Schenk (1971) suggested a dextral movement.

STRATIGRAPHY

Meguma Group

Schenk (1971) states that the Meguma Group is composed of at least seven kilometres of sandy flysch (Goldenville Formation) overlain by up to six kilometres of shaly flysch (Halifax Formation) with a southerly provenance. Faribault (1886) measured a minimum thickness of 3,300 m for the Goldenville Formation and 1,200 m for the Halifax Formation.

Goldenville Formation

The Goldenville Formation is exposed throughout the area and accounts for over 90 per cent of the outcrops. Except in fold hinges, the beds strike just north of east and dip steeply north or south. These beds are predominantly quartz wacke with lesser amounts of feldspathic and lithic wacke. Each quartz wacke bed grades upwards through a siltstone into a mudstone and ranges from one to three or more metres in thickness.

Generally, no lithological variation was detected throughout most of the Goldenville Formation. Light grey quartz wacke is the

dominant lithology; it is repetitively bedded, crudely cleaved, and regionally metamorphosed. The wacke is composed mainly of rounded clasts of quartz in a fine-grained siliceous matrix. Clastic grains of minerals other than quartz are uncommon or present in amounts of less than one per cent; micaceous minerals make up less than five per cent of the rock. A few beds of feldspathic wacke were observed but could not be correlated with one another.

Faribault (1886) stated that some thicker slate bands occur near the gold deposits and may be two or more metres thick. These are seen only along some coastal sections (e.g. Pyes Head) and as waste material on mine dumps. Here it is more aptly described as a cleaved siltstone. It is in these cleaved siltstones and slates that the gold-bearing quartz veins are found. They are confined to these finer grained clastic sedimentary rocks and are stratabound by the coarser quartz wacke.

Near the upper margin of the Goldenville Formation, the repetitively bedded quartz wacke beds decrease in thickness to less than 0.5 m with an average thickness of about 5 to 15 cm. Thin beds of iron carbonate and concretions are concentrated in the upper one hundred metres of the Formation.

Interesting variations in the occurrence of siderite, pyrite, and other iron carbonates were found. Regionally, the occurrence of pyrite appears to be stratigraphically restricted. Figure 1 shows the distribution of pyrite crystals observed in the quartz wackes of the Goldenville Formation. Three areas contain significant amounts of pyrite: Ecum Secum Bridge; near Miller Lake northeast of New Chester; and a belt from Liscomb Mills to Spanish Ship Bay. On the scale of an individual bed, pyrite occurs either near the upper margin of the slate bed or within a few centimetres of the overlying quartz wacke.

The distribution of siderite and other iron carbonates appears to be much more widespread than for pyrite (Fig. 1). The pattern may be explained by three specific types of concentration. Firstly, iron carbonate occurs as 20 to 30 x 10 cm limy boudins in thinly bedded quartz wackes of the Goldenville Formation within 100 m of the contact of the Goldenville and Halifax Formations. Secondly, siderite is found in a broad horizon within the quartz wacke as concentrations up to two percent. This distribution is very similar to that for the pyrite. All mine workings in the area occur within this horizon. The third concentration is a narrower zone in the Miller Lake area where the iron carbonate forms up to 10 per cent of the quartz wacke. The gold veins of the Lone Cloud and Evangeline Mines (the Miller Lake Gold District) occur within this zone.

The distribution of iron-bearing minerals shows that there are mineralogical variations within the Goldenville Formation which may prove useful for stratigraphic correlation.

Halifax Formation

The Halifax Formation consists of thinly laminated light grey and dark grey-black slates. The formation is poorly exposed in the area.

Its contact with the Goldenville Formation is exposed southeast of New Chester on the Ecum Secum River. It may also be seen at the high tide mark on the Ecum Secum River, on Liscomb Head just east of the map area, and on Highway 7 south of Bear Brook. In all locations where the contact is exposed, the transition zone from the thinly bedded quartz wacke of the Goldenville Formation to the slate of the Halifax Formation is less than 2 m thick. The Halifax Formation at all locations is a medium to light grey slate.

These light coloured slates appear to form a continuous lower slate member. Its thickness varies from a few metres at Liscomb Head to approximately 200 m at Wilson's Point on the north side of the Liscomb Harbour Syncline. The section at Wilson's Point provides continuous exposure through the lower light coloured slate member into the upper dark grey slate member. Within the lower member there are bands, up to 10 m thick, of a darker grey ferruginous variety. The transition between the two members is gradational over several metres. In the transition zone, the slate is dark grey, manganese staining is present, and sulphides are disseminated throughout the darker grey variety. The upper part of the upper member is not exposed. The few exposures in the Ruth Fall Syncline suggest a stratigraphic sequence comparable to the southern band.

Summary

The stratigraphic succession in the Ecum Secum area consists of quartz wackes of the Goldenville Formation, overlain by the Halifax Formation consisting of a lower micaceous slate and an upper carbonaceous, sulphide-bearing slate. This stratigraphic succession suggests a change from coarse clastic material through fine clastic material to carbonaceous material in a sulphide precipitating sapropel environment. Harris and Schenk (1975) interpret this transition as roughly coeval facies changes in a deep sea fan. The rapid change in thickness of the micaceous slate supports this interpretation.

FIGURE 3

Lower hemisphere equal area projections of structural data from the Ecum Secum area.

- A. Poles to bedding (300 points; contours: 1, 3, 5, 8 and 15%).
- B. Fold Axes (31 points; contours: 7, 14 and 20%), S_0/S_1 lineations and mineral lineations associated with major deformation.
- C. Poles to cleavage (500 points; contours: 1, 10, 20, 30 and 35%).
- D. Poles to sinistral kink band axial planes (41 points; contours: 2.5, 5, 10 and 15%), dextral kink band axial planes and faults.
- E. Poles to joints (226 points; contours: 1, 5, 10, 20 and 25%).
- F. Poles to quartz veins (67 points; contours: 3, 6, 9 and 12%).

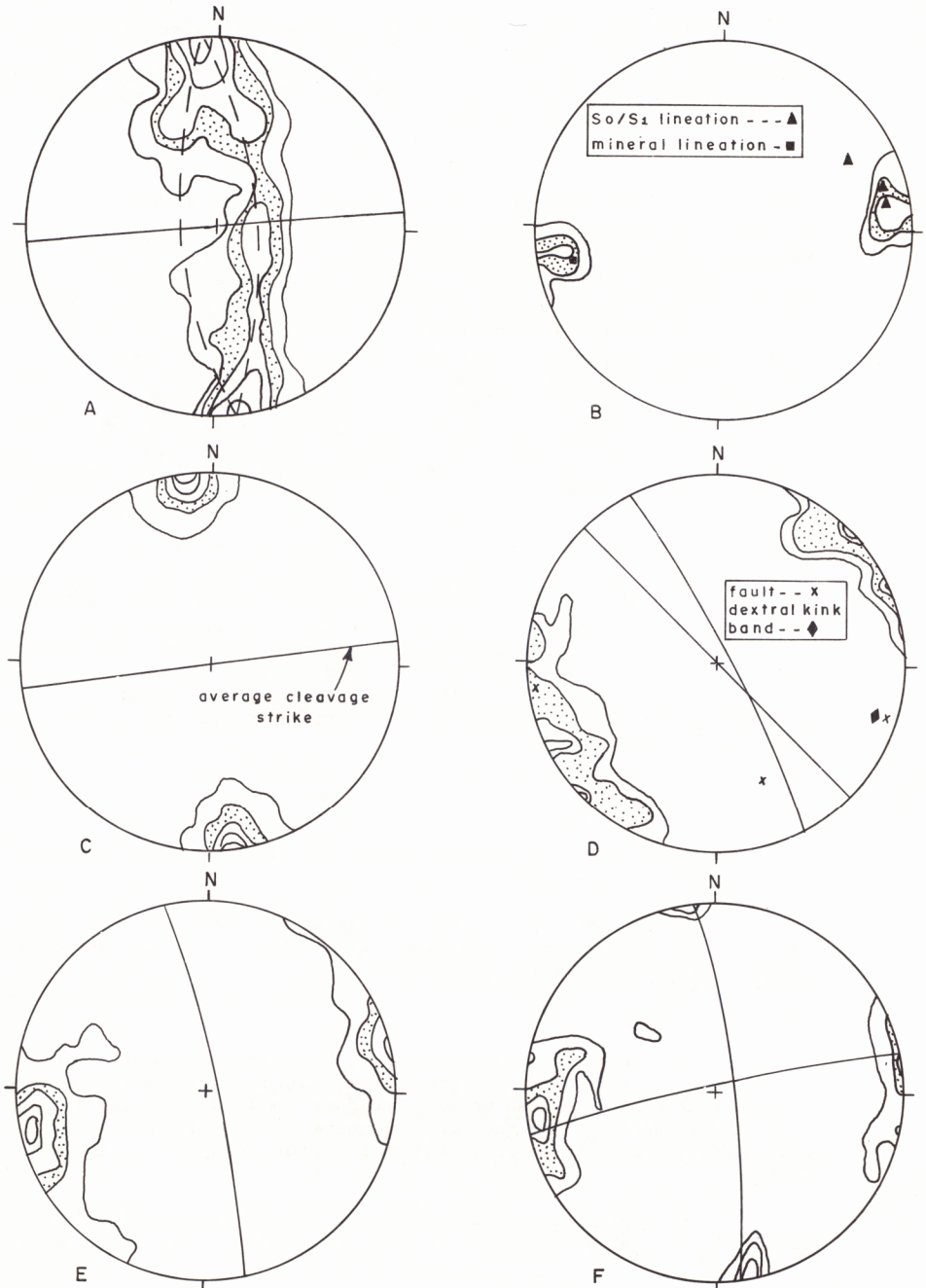


Figure 3. Explanation is on facing page.

STRUCTURAL GEOLOGY

The rocks of the Meguma Group have been deformed by one set of major folds followed by three sets of minor folds. The first set of folds controls the distribution of the rock types and to a lesser degree the topography in the area. Structural control is a major factor in the localization of gold-bearing quartz veins.

First Set of Structures

Major folds and associated minor folds are common as easterly trending, gently plunging synclines and anticlines (Figs. 1 and 2). The stereographic projection of all the bedding attitudes (Fig. 3A) and the cleavage (Fig. 3C) shows that the planar cleavage is parallel to the axial planes of the folded bedding. The girdle in Figure 3A is broad because many folds are included with plunges which vary from 16° E to 16° W, but the most common plunge of the folds in the area is about 16° W (Figs. 3A & B). The orientations of the intersection lineations of bedding on cleavage are similar to the fold axes (Fig. 3B). The strike of the cleavage varies from 078° to 088° and the dip from 80° N to 80° S (Fig. 3C). The change in dip is mainly accounted for by fanning across the folds and cleavage refraction. If it is assumed that the average cleavage attitude is found in the hinge of a fold, the reading is 083° , vertical.

There are two major synclines and three major anticlines in the area (Figs. 1 and 2). The cross-sections (Fig. 2) show tight anticlines and open to tight synclines. The size of the folds changes markedly along strike and they may die out or become very localized. For example, the Ruth Fall Syncline changes from a broad westerly plunging syncline in the west to a minor syncline at Spanish Ship Bay (Figs. 1 and 2). Deformed quartz veins, showing the same variability in fold geometry, are common in the gold areas.

Late Minor Structures

Three sets of structures deform the slaty cleavage. Their relative ages are unknown.

Two of these structures occur as gentle warps and weak crenulations with either sub-horizontal or northwesterly, sub-vertical axial planes. Neither structure was observed at more than a few locations. The later folds may be responsible for the curvature in the trend of the structures across the area.

Kink bands are found throughout the area, and appear to be concentrated in zones with sinistral kink bands being the most common. Dextral kink bands are also present and form box folds with the sinistral kink band suggesting that they are conjugate. Box folds were observed only along the Ecum Secum River and on a logging road west of the Liscomb River.

The sinistral kink bands range in strike from about 110° to 210° with two statistical peaks at 130° , vertical dip, and 154° , 84° E dip

respectively (Fig. 3D). The reason for the double peak is unknown but may be related to either the zonal kink band development or the regional swing in trend. The orientation of the one measured dextral kink band is 018° , 85° W dip. Where sinistral kinks and minor faults are observed together, they have the same attitude and sense of displacement.

ECONOMIC GEOLOGY

Gold is the only element found in the area that to date has had any economic importance (Malcolm, 1929). It is concentrated in east-west striking, stratabound quartz veins which occur in slate horizons between quartz wacke beds deformed by minor F_1 folds (Fig. 3F). These veins carry, in addition to gold, minor amounts of galena, sphalerite, chalcopyrite, pyrite, pyrrhotite and varying amounts of arsenopyrite.

Nine areas in four belts have been prospected in detail for gold with only limited success. The Ecum Secum was the only mine to produce a significant amount of gold (Table 1). The Nova Scotia Department of Mines' records show that most of the operations were small, inefficient and the deposits narrow. The history of these mines and prospects is summarized in the Nova Scotia Department of Mines Mineral Inventory.

Another set of north-northwest striking veins (Fig. 3F) are not deformed and rarely contain any economic minerals. These veins are parallel to the predominant joints in the area (Fig. 3E).

CORRELATION AND CONCLUSIONS

In the previous discussion, the stratigraphy, structure and economic geology have been described and it is apparent that relationships exist between mineralization, structure and auriferous veins. The veins are always east-west, deformed, and confined to slate bands in the quartz wacke. On the cross-sections (Fig. 2), the base of the disseminated siderite zone in the quartz wacke is about 1,300 metres below the Halifax-Goldenville contact. If siderite bands along the Halifax-Goldenville contact are omitted, the main siderite zone appears to be less than 500 metres thick and forms a facies within the Goldenville Formation between 1,300 and 800 metres below the upper limit of the Formation. Within this zone are much more restricted bands which have very high (>10%) concentrations of siderite. The Miller Lake Gold District lies within this restricted belt. Elsewhere, lesser amounts of siderite are associated with all the known gold-bearing structures. Siderite is also the most common accessory mineral in the veins.

The distribution of pyrite is similar to that of siderite, but seems to have a more limited distribution. If the section west of Ecum Secum Bridge is considered a type area, the distribution of pyrite is seen to be concentrated within 1,300 metres of the upper margin of the Formation as a band less than 500 metres thick. This pattern is somewhat complicated by minor folding; however, both siderite and pyrite are concentrated in the same stratigraphic section. This distribution represents a concentration of iron in a limited stratigraphic section. The formation of siderite is probably controlled by regional geochemical variations and the pyrite by local variations in some slate bands.

TABLE 1

DATA ON MINES AND PROSPECTS

Property Name	Time of Operation	Ore Crushed (tons)	Gold Production (oz.)	Present Investigation	
				Host Rock	Minerals
Moosehead Mine	1873-1935	2,840	471	Slate	?
Ecum Secum Mine	1869-1907	2,983	1,275	Slate	Arsenopyrite, pyrite, galena, pyrrhotite, chalcopyrite, sphalerite
Treasure Island Prospect	1902-?	94	16	?	10-20 cm. quartz vein
Fleet Mine	1939-1950	?	?	?	Traces of sulphides
Jolotta Prospect	1906-1930?	-	-	Slate	Deformed quartz veins with galena
Miller Lake Gold District	1903-1948	360	270	Slate	Pyrite, chalcopyrite, pyrrhotite, galena, sphalerite, arsenopyrite in folded quartz-carbonate veins

The control of these geochemical conditions on the localization of gold is apparent when the parameters in Figure 1 are compared. All the known gold prospects occur near or at the base of this 500 metre section of the Goldenville Formation. Faribault (1886) and Malcolm (1929) suggest that in the map area several gold-bearing horizons are present. However, this study shows that gold is localized in a single stratigraphic horizon of limited thickness (<200 m) whose base is approximately 1,300 metres stratigraphically (present thickness) below the Halifax-Goldenville contact. The correlation of these zones suggests that the metals were deposited together at the same time as the host rocks probably by a change in the geochemical composition of the environment. The deposition of iron in the form of siderite and pyrite leads to the conclusion that the geochemical change was an increase in the pH from the introduction of carbonate into the depositing environment. It is interpreted that the deposition of the gold and other metal was syngenetic. Recent work has shown that a similar mechanism was responsible for the deposition of gold in the Porcupine Camp (Karvinen, 1978) and Abitibi Belt (Ridler, 1976). The auriferous horizon has been deformed, so it becomes important to trace its outcrop pattern. The structural geology shows that the major structures can be readily drawn on cross-section (Fig. 2). When the base of the iron zone is projected across the section, the deposits at Ecum Secum are in the same stratigraphic and structural position as those in the Miller Lake District.

The large syncline centered north of Fleet Settlement and Liscomb Mills has had a major influence on the position of the favourable stratigraphic horizon. On the north side of the Miller Lake anticline, the favourable horizon runs parallel to the fold axis to the edge of the map area, but on the south side the horizon becomes folded around the syncline in the vicinity of Liscomb Mills. It appears briefly as the Jollota prospect and the lack of recorded gold prospects west of it and northeast in the Spanish Ship Bay area.

ACKNOWLEDGEMENTS

The author would like to thank D. Bourque for his able assistance and companionship in the field, and the Rumleys of Rumley's Cabins for their hospitality.

I also would like to thank J. D. Keppie, H. V. Donohoe and P. S. Giles for critically reading the manuscript. I am grateful to J. Fahie for typing the manuscript, to D. Bernasconi and J. Campbell for drafting the figures and to R. Morrison for the photographic work.

Funds for this project were provided jointly by the Canada Department of Regional Economic Expansion and the Province of Nova Scotia.

REFERENCES

- Benson, D. G.
1974: Geology of the Antigonish highlands, Nova Scotia; Geol. Surv. Can., Mem. 376, 92 p.
- Faribault, E. R.
1886: Report on the Lower Cambrian rocks of Guysborough and Halifax Counties, Nova Scotia; Geol. Surv. Can., Summ. Rept., Vol. 2, Part P, p. 131-163.
- Harris, I. M., and Schenk, P. E.
1975: The Meguma Group; Maritime Sediments, Vol. II, no. 1, p. 25-46.
- Karvinen, W. O.
1978: The Porcupine Camp - A model for gold exploration in the Archean; Paper presented to the Prospectors and Developers Association, Toronto, March 1978, 16 p.
- King, L. H., Hyndman, R. D., and Keen, C. E.
1975: Geological development of the Continental Margin of Atlantic Canada; Geoscience Can., Vol. 2, no. 1, p. 26-35.
- Malcolm, W.
1929: Gold fields of Nova Scotia; Geol. Surv. Can., Mem. 156, 253 p.
- Rast, N., and Grant, R.
1973: Transatlantic correlation of the Variscan-Appalachian Orogeny; Am. Jour. Sci., vol. 273, p. 572-579.
- Ridler, R. H.
1976: Stratigraphic keys to the gold metallogeny of the Abitibi Belt; Paper presented to the Prospectors and Developers Association, Toronto, March 1976, Can. Min. Jour., June 1976, p. 81-90.
- Schenk, P. E.
1971: Southeastern Atlantic Canada, Northwestern Africa and Continental Drift; Can. Jour. Earth Sci., Vol. 8, No. 10, p. 1218-1251.
- Williams, H., Kennedy, M. J., and Neale, E. R. W.
1972: The Appalachian structural province; Geol. Assoc. Can., Special Paper 11, p. 181-261.

Paper 78-1 Geology of the Ecum Secum Area, Halifax and Guysborough Counties, Nova Scotia by Derek E. McBride