THE CAMBRIAN-ORDOVICIAN PLATFORMAL ROCKS OF THE NORTHERN PENINSULA

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INTRODUCTION

The clastic-carbonate deposits of the Western Platform were studied during the summer of 1976 in the coastal area north of Table Point on the Great Northern Peninsula. The primary purpose of the study was to:

(1) Establish stratigraphic subdivisions of the sequence from the lower Cambrian Hawkes Bay formation up to the Middle Ordovician Table Head Formation,

(2) Identify the main stratigraphic and sedimentological features of the stratigraphic column,

(3) Locate the Cambro-Ordovician boundary,

(4) Study the nature of the lower and middle Ordovician boundary, previously called a "disconformity", and

(5) Assess the diagenesis of the carbonates and its relationship to mineralization in the area.

The study concentrated on the areas of Table Point, Hawkes Bay, Port au Choix, and the St. Barbe Coast from Savage Cove north to Cape Norman.

STRATIGRAPHIC SUBDIVISION OF CAMBRO-ORDOVICIAN CARBONATES

Cambrian

Only the rock sequence that overlies the Forteau Formation was studied. This included rocks previously placed in the Hawkes Bay Formation (Schuchert and Dunbar, 1934). Three lithostratigraphic units of formational status, however, exist in this formation. These units are:

(a) Hawkes Bay Quartzite Formation. The formation consists of white, pink and minor multicolored quartzites and thin interbedded units of red and green-gray sandstone and shale. The rocks contain abundant shallow water, tidal sedimentary structures and trace fossils. Fossils, for example, trilobites, suggest an upper lower Cambrian age (Boyce, pers. comm.).

The quartzites are known extensively in the vicinity of Hawkes Bay and the St. John's Highlands but an important but small exposure of the top beds of the formation was discovered near Green Island Brook (Fig. 1).

The formation conformably overlies calcareous sandstones and limestones of the Forteau Formation.

(b) Micrite Formation. The formation consists of dark grey, burrowed, lenticular and thin bedded micrites with some calcarenite and calcirudite. A thin basal grey shale unit is present in Hawkes Bay. It conformably overlies the quartzites and contains a trilobite and inarticulate brachiopod fauna that suggests an upper middle Cambrian age. It is well exposed in Hawkes Bay and along the St. Barbe Coast.

UNIT

8 Fractured and sheared, rubbly, blue-black limestone - previously mapped as Table Head Fm. (M. ORD).

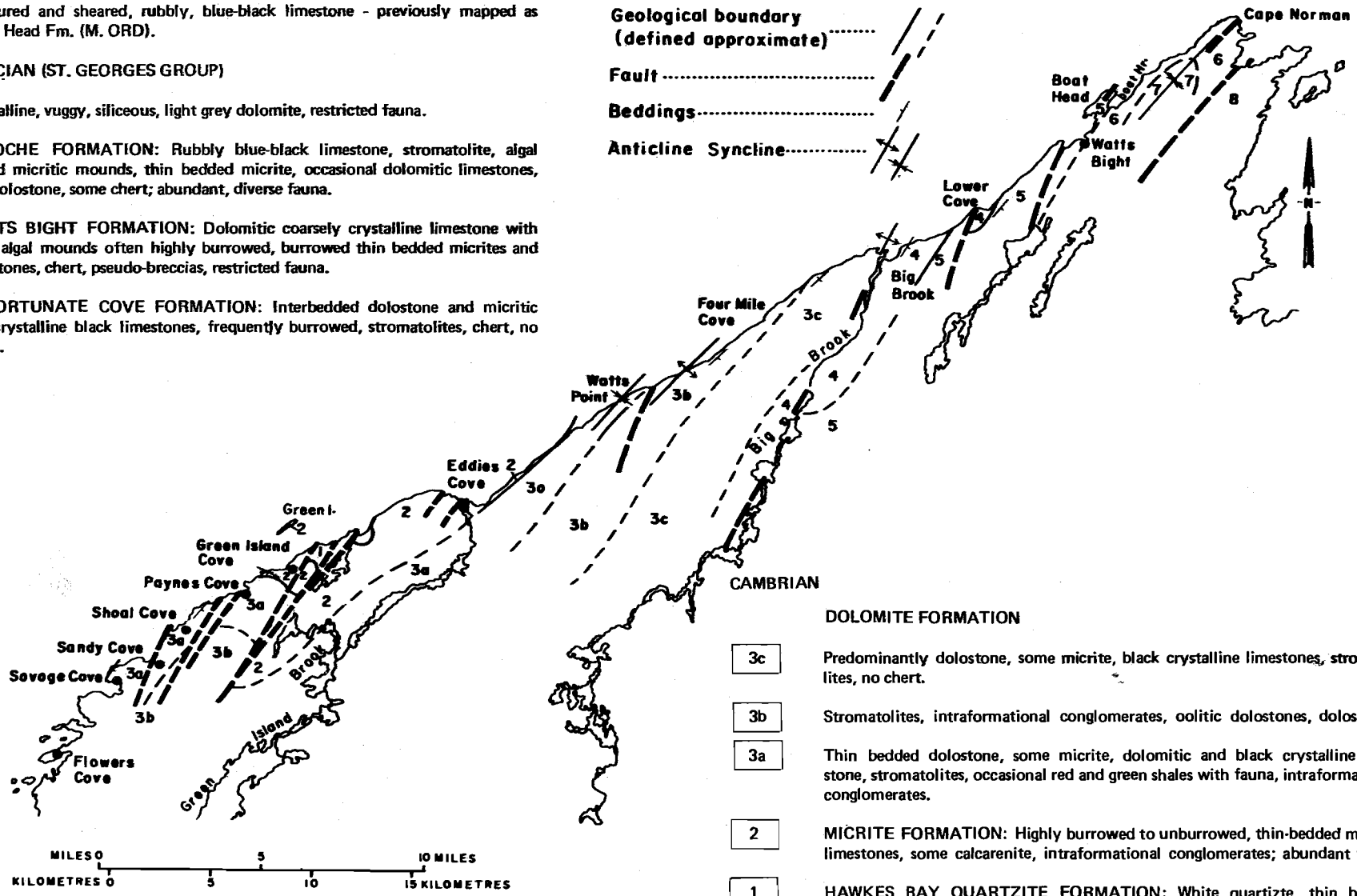
LOWER ORDOVICIAN (ST. GEORGES GROUP)

7 Crystalline, vuggy, siliceous, light grey dolomite, restricted fauna.

6 CATOCHE FORMATION: Rubbly blue-black limestone, stromatolite, algal bound micritic mounds, thin bedded micrite, occasional dolomitic limestones, and dolostone, some chert; abundant, diverse fauna.

5 WATTS BIGHT FORMATION: Dolomitic coarsely crystalline limestone with large algal mounds often highly burrowed, burrowed thin bedded micrites and dolostones, chert, pseudo-breccias, restricted fauna.

4 UNFORTUNATE COVE FORMATION: Interbedded dolostone and micritic and crystalline black limestones, frequently burrowed, stromatolites, chert, no fauna.



DOLOMITE FORMATION

3c Predominantly dolostone, some micrite, black crystalline limestones, stromatolites, no chert.

3b Stromatolites, intraformational conglomerates, oolitic dolostones, dolostones.

3a Thin bedded dolostone, some micrite, dolomitic and black crystalline limestone, stromatolites, occasional red and green shales with fauna, intraformational conglomerates.

2 MICRITE FORMATION: Highly burrowed to unburrowed, thin-bedded micritic limestones, some calcarenite, intraformational conglomerates; abundant fauna.

1 HAWKES BAY QUARTZITE FORMATION: White quartizte, thin bedded micrite, glauconitic sandstone, rusty burrowed, dirty sandstone (equivalent to Hawkes Bay Quartzite Formation).

LOGAN (1863) (Richardson's Divisions) N to K		SCHUCHERT & DUNBAR (1934)	WHITTINGTON & KINDLE (1968)	KLUYVER (1975)		KNIGHT (This Report)
	MIDDLE	TABLE HEAD FORMATION DISCONFORMITY	ORDOVICIAN TABLE HEAD FORMATION DISCONFORMITY	TABLE HEAD FORMATION DISCONFORMITY	MIDDLE	TABLE HEAD FORMATION CONFORMABLE
I	LOWER	ST. GEORGE'S FORMATION	ST. GEORGE'S FORMATION	PORT AU CHOIX FORMATION	LOWER ST. GEORGES GROUP	DIAGENETIC CARBONATES / SILICEOUS DOLOMITE FM.
H				CATOCHE FORMATION		LAIGNET POINT MEMBER / CATOCHE FM.
G				BARBACE POINT		WATTS BIGHT FORMATION
F						UNFORTUNATE COVE FORMATION
E					U	CAMBRIAN DOLOMITE FORMATION
D						
	UM	HIATUS LABRADOR SERIES	CAMBRIAN		M	MICRITE FORMATION
C	L	HAWKES BAY FORMATION			L	HAWKES BAY QUARTZITE FORMATION
B		FORTEAU FORMATION				FORTEAU FORMATION
A		BRADORE FORMATION				

Table I Comparative Stratigraphic Chart, Cambro-Ordovician Autochthon, Great Northern Peninsular

(c) Dolomite Formation. This formation, which is well exposed along the St. Barbe Coast, consists predominantly of dolostones, abundant stromatolites, intraformational breccias, some oolitic dolarenites, some limestones, and a few horizons of green and red shales and siltstones. Three members are present, a lower dolomite-limestone member, a middle stromatolitic member, and an upper dolostone member. Fossils collected in the lower member suggest a lower upper Cambrian age; the rest of the formation has yielded no fauna so far. All these Cambrian rocks represent a shallow, shelf sequence beginning with an extensive tidal sand flat (the Quartzite Formation) that preceded deepening of the shelf sea at which time fine grained shelf limestones (Micrite Formation) were deposited. The carbonates vertically accreted until fluctuating very shallow subtidal to supratidal conditions existed in which extensive dolomites were laid down under predominantly hypersaline conditions (Dolomite Formation).

Ordovician

The Ordovician of the Northern Peninsula is predominantly composed of dolomites and limestones. Two units have long been recognized - these are the lower Ordovician St. George's Formation (Schuchert et al. 1934; Collins et al., 1972, 1973, 1975) or Group (Kluyver, 1975) and the middle Ordovician Table Head Formation. The basal contact between these rocks and the underlying Cambrian rocks is located at Big Brook, where it is placed at the first appearance of chert in the carbonates. Chert is widespread in the Ordovician St. George's Group but appears to be absent from the upper Cambrian Dolomite Formation. There are, however, other differences between the formations below and above the Cambro-Ordovician contact which suggest that for the present it is suitably located. This places the contact of the Cambrian and Ordovician at least 300 meters higher stratigraphically than shown on other maps of the St. Barbe Coast (Bostock et al., 1976).

In the past, subdivision of the Ordovician carbonates has been done mainly by biostratigraphic means and, except for Kluyver (1975), no detailed lithostratigraphic data are available. Kluyver, however, only subdivided the St. George's Group in the Port au Choix area and the lithostratigraphic formations have not been extended outside that area. In the summer of 1976, in a regional study, the St. George's Group was subdivided into four formations and one diagenetic carbonate unit (Table I). These units are:

(a) Unfortunate Cove Formation. The formation consists of a generally poorly exposed sequence of dolostones, stromatolites, minor micritic limestones, black shales and chert. Most of the rock types suggest predominantly shallow subtidal and intertidal deposition but some deeper water carbonates are also present.

(b) Watts Bight Formation. This formation, which conformably overlies an extensive thin unit of burrowed micrite in the top of the Unfortunate Cove Formation, is composed of dolomitic limestones with abundant very large stromatolitic mounds and bioturbated limestone. Chert is abundant, particularly low in the formation, and some dolostone is also present. Three facies have been identified, a stromatolitic mound facies which consist of a lower and an upper facies units, a middle burrowed limestone facies between the two mound facies units, and an upper dolostone - limestone facies. The latter is probably equivalent to the Barbace Point Formation described by Kluyver (1975) at Port au Choix.

The formation contains a sparse, lower Ordovician fauna; it appears to have been deposited mainly in a deepish water, carbonate shelf, although the sea became shallow and the shelf emergent as the rocks of the top of the formation were being deposited.

(c) Catoche Formation (Kluyver, 1975). This formation conformably overlies the Watts Bight Formation. It consists of a rubbly weathering, blue-grey micritic limestone rich in a lower Ordovician fauna, and resembles the middle Ordovician Table Head Formation very closely in basic lithology. It also contains calcarenite and calcirudite beds, several horizons of stromatolitic mounds (at Boat Harbour), several horizons of biomicrite mounds with sponges (at Port au Choix), and some argillaceous dolomitic limestones and dolostones. At Port au Choix, the top of the formation consists of a distinctive platy laminated micrite called the Laignet Point Member.

The formation is dated as late Arenig (Cummings, 1967) and was deposited in widespread subtidal shelf conditions which accompanied a major transgressive event.

(d) Diagenetic Carbonates. The Catoche Formation is overlain by diagenetic carbonates which have been called the Port au Choix Formation by Kluyver (1975). However, since the carbonates have been radically altered by secondary processes and diagenesis that was possibly transgressive to the stratigraphy, they are not assigned formational status in this report. The diagenetic carbonates are well exposed at Port au Choix and south to Table Point. They consist of couplets of 1-2 m in thickness of tight, massive dolostone overlain by very vuggy dolostones rich in sparry dolomite. The latter lithology was called "pseudobreccia" by Cummings (1968) and the use of this term is continued for consistency although it is not a satisfactory descriptive name for the rock type. The upper part of the unit is mostly covered at Port au Choix but consists of grey, vuggy, silty dolomite (Kluyver, 1975).

The diagenesis of the carbonates has been related previously to karstification of the St. George's Group during formation of the St. George's - Table Head disconformity (Cummings, 1968; Collins et al., 1972, 1973, 1975). The present work casts doubt upon this idea and upon the presence of a disconformity. The diagenesis is related to cyclic penecontemporaneous to early post-depositional processes acting upon a sequence of shallow water shelf carbonates. These were deposited on an unstable shelf which was emerging from the subtidal conditions of the underlying Catoche Formation to the inter-supratidal conditions of the overlying Siliceous Dolomite Formation.

(e) Siliceous Dolomite Formation. This formation was named by geologists of the Daniel's Harbour Zinc Mine (Hartlein et al., 1975). It is well exposed near Table Point where it consists predominantly of dolostones with some limestones near the base, common green shales in the upper half, and local stromatolite and quartzite. Abundant features of subaerial deposition are also present. Collins et al. (1972, 1973, 1975) have described cycles consisting of limestone breccies, dololaminite, shale, and bioturbated dolomite. The limestones of the base of the unit contain a late Arenig graptolite fauna (Collins et al., 1972). The formation was predominantly deposited in an intertidal-supratidal environment and thins rapidly northwards to Port au Choix.

At the top of the formation is the surface that has been described as a disconformity which, according to Collins et al. (1972, 1973), represents a time interval of possibly 10 million years. This surface was studied in detail. The presence of similar sediments above and below this surface, the absence of any basal conglomerate other than a nodular limestone bed formed by diagenesis of a bedded limestone that overlies the surface, the presence of possible algal borings, and the lack of definitive karst features all indicate that the surface has no more than local significance and represents only a short time interval (Knight, in press).

It is suggested that the contact between the Siliceous Dolomite Formation of the St. George's Group and the overlying middle Ordovician Table Head Formation at Table Point be placed at the first rubbly limestone bed, which occurs eleven meters above the old disconformity surface. Elsewhere, for example, Port au Choix, the disconformity is probably a dolomitization front since Table Head limestones grade down into dolomitized Table Head limestone and then into vuggy and brecciated dolomite of the upper part of the diagenetic carbonates of the St. George's Group.

The Table Head Formation has been well described in the past (Whittington et al., 1963) and is not described in detail here. The formation does, however, closely resemble the Catoche Formation as already stated. Since the disconformity is no longer considered to be significant or to occur at all, it is suggested that the importance of this two fold lower-middle Ordovician subdivision be re-evaluated. The lower Table Head Formation limestone on the Great Northern Peninsula certainly does not represent any diversion from the general trend of carbonate deposition in the area; it is only where the interbedded limestones and shales, shales and greywacke sandstones of the middle and upper parts of the Table Head Formation occur that there is a marked change of rock types and depositional environment. For this reason, it may be appropriate to include the rubbly limestones of the lower Table Head Formation in the St. George's Group and redefine the middle and upper Table Head Formation as a new group with two or three separate formations.

MINERALIZATION

The carbonates of the great Northern Peninsula are ideal host rocks for lead-zinc deposits of Mississippi Valley type. At present, there is an operating mine, almost exclusively of sphalerite, at Daniel's Harbour. Widespread small showings of lead and zinc also occur elsewhere on the peninsula. Many have been correlated stratigraphically with the deposits of the mine, which occur in the diagenetic carbonates of the St. George's Group.

Many Pb-Zn showings have also been found on the St. Barbe Coast, where they are now known to occur in the lower member of the upper Cambrian Dolomite Formation. Reconnaissance work in the Canada Bay area during 1976 resulted in the discovery of some quite favorable galena showings in brecciated dolostones associated with stromatolites of the Dolomite Formation; since other lead showings are known near Hawkes Bay in the same formation, it is possible that lead mineralization may be hosted almost exclusively by the upper Cambrian dolomites.

The zinc mineralization at Daniel's Harbour is still however an enigma. Its location, restrictive stratigraphic position and localized nature, and the purity of the sphalerite appear to present problems if the mineralization is related to a process of karstification produced during the formation of the "disconformity". For instance, suitable pseudobreccias occur elsewhere in the area but are not mineralized.

The solution may be that the zinc was introduced from a possible deep seated hydrothermal source early in the postdepositional history of the diagenetic carbonate unit. This process is amplified in a forthcoming report (Knight, in press).

CONCLUSIONS

(1) The Cambrian stratigraphy of the area is revised and the Cambro-Ordovician boundary placed 300 meters higher in the stratigraphic column.

(2) The St. George's Group consists of four lithostratigraphic formations and one diagenetic carbonate unit. It is suggested that the limestones of the lower Table Head Formation be added to the St. George's Group.

(3) Diagenetic carbonates are related to contemporaneous sedimentary processes, not to karstification.

(4) The St. George - Table Head disconformity does not occur (Knight, in press).

(5) Pb-Zn mineralization is widespread in the upper Cambrian Dolomite Formation.

(6) Sphalerite mineralization is localized at Daniel's Harbour in the diagenetic carbonates. It may have been related to a deep seated hydrothermal source which supplied zinc into pore fluids in the diagenetic carbonates early in the postdepositional history of the carbonates (Knight, in press).

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